Noise-Related Hearing Loss Frequency And Related Factors In A University Hospital Occupational Diseases Clinic. Ege University Faculty Of Medicine Hospital Occupational Diseases Clinic -2018

Bir Üniversite Hastanesi Meslek Hastalıkları Kliniğinde Gürültüyle İlgili İşitme Kaybı Sıklığı Ve İlgili Faktörler. Ege Üniversitesi Tıp Fakültesi Hastanesi Meslek Hastalıkları Kliniği -2018

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Abstract

Objective	Noise is an important hazard that negatively affects hearing and perception in humans, causes physiological and psychological disorders, and reduces work performance. We wanted to determine the socio-demographic and occupational factors associated with the frequency of noise-induced hearing loss in patients who applied to the occupational diseases clinic and draw attention to what should be done to prevent its occurrence.
Materials and Methdos	The population of the cross-sectional study consisted of 463 workers who applied to a university hospital Occupational Diseases Policlinic between November 2015 and November 2018. General physical examination was performed and hearing problems were evaluated and than audiometric examination was performed with Madsen Itera II audiometry device. Chi-square test and descriptive statistics were used as statistical analysis.
Results	23.5% of the workers were diagnosed with hearing loss. 397 (85.7%) of the participants described that they were exposed to noise in the workplace. Noise exposure has been associated with hearing loss. 15 packs / year and above smoking, expressing noise exposure in the workplace and not using headphones, chemical substances in the work environment; Exposure to any of the lead, manganese and mercury made a significant difference in terms of hearing loss.
Conclusion	The correct use of personal protective equipment such as earphones depends on individual factors. Incorrect and inadequate headphone use is an important factor in noise-induced hearing loss. For this reason, engineering measures are extremely important among the primary preventive methods. Smoking, chemical exposure are effective factors in noise-related hearing loss.
Keywords	Hearing loss, noise, occupational disease

Özet

Amaç	Gürültü, insanlarda işitme ve algıyı olumsuz etkileyen, fizyolojik ve psikolojik bozukluklara neden olan ve iş performansını düşüren önemli bir tehlikedir. Meslek hastalıkları kliniğine başvuran hastalarda gürültüye bağlı işitme kaybının sıklığı ile ilişkili sosyo-demografik ve mesleki faktörleri belirlemek ve oluşumunu önlemek için neler yapılması gerektiğine dikkat çekmek istedik.
Yöntemler	Kesitsel çalışmanın evrenini Kasım 2015 ile Kasım 2018 arasında bir üniversite hastanesi Meslek Hastalıkları Polikliniğine başvuran 463 çalışan oluşturdu. Genel fizik muayene yapılarak işitme sorunları değerlendirildi ve ardından Madsen Itera II odyometri cihazı ile odyometrik inceleme yapıldı. İstatistiksel analiz olarak ki-kare testi ve tanımlayıcı istatistikler kullanıldı.
Bulgular	Çalışanların %23,5'inde işitme kaybı tanısı konuldu. Katılımcıların 397'si (%85,7) iş yerinde gürültüye maruz kaldığını belirtti. Gürültüye maruz kalmanın işitme kaybı ile ilişkili olduğu görülmüştür. 15 paket/yıl ve üzeri sigara içmek, işyerinde gürültüye maruz kalmayı ifade etmek ve çalışma ortamında kulaklık, kimyasal maddeler kullanmamak; kurşun, manganez ve civa gibi herhangi birine maruz kalmak işitme kaybı açısından önemli bir fark yaratmıştır.
Sonuçlar	Kulaklık gibi kişisel koruyucu ekipmanların doğru kullanımı bireysel faktörlere bağlıdır. Yanlış ve yetersiz kulaklık kullanımı gürültü kaynaklı işitme kaybında önemli bir faktördür. Bu nedenle mühendislik önlemleri birincil önleyici yöntemler arasında son derece önemlidir. Sigara içmek, kimyasal maruziyet gürültü kaynaklı işitme kaybında etkili faktörlerdir.
Anahtar kelimeler	İşitme kaybı, gürültü, meslek hastalığı

INTRODUCTION

According to the International Labor Organization (ILO), "noise" includes any sound that causes hearing loss or is harmful to health or poses other hazards (1). Noise is an important hazard in terms of both occupational and environmental pollution, affecting hearing and perception in humans negatively, causing physiological and psychological disorders, reducing work performance and quality (2).

People are exposed to noise from noisy vehicles, equipment, loud music, large vehicles, etc. throughout their lives. However, this form of noise that people are exposed to does not mostly affect hearing (1). Chronic hearing loss due to noise is the result of cumulative cochlear noise exposure, that is, the result of cumulative microtrauma, and is the most common cause of hearing loss (3). This loss is a sensorineural hearing loss due to damage to the hairy cells in the cochlea. Loss begins as the exposure repeats. Early changes are in the form of affecting cells in the cochlea floor and start around 4000 Hz on the audiometric graph. As the exposure continues, the 4000 Hz based notch deepens and expands. Noise-related hearing loss (NRHL) is always seen in neurosensory type and often bilateral (4). Noise causes temporary and permanent threshold shift in hearing, causes acoustic trauma and reduces labor productivity by 30-60% (5-6). It can also cause physiological damage (cramps, stress, hypertension, tachycardia, etc.) and psychological damage (anxiety, fatigue, insomnia, etc.) (7).

NRHL is one of the most common preventable occupational diseases. Occupational diseases are cases of temporary or permanent illness, disability or mental failure that the insured suffers due to a recurring reason or due to the execution conditions of the job, depending on the nature of the job (8). The ILO estimates that some 2.3 million women and men around the world succumb to work-related accidents or diseases every year. Worldwide, 160 million victims of work-related illnesses annually (9). According to the statistics of 2021, 1207 occupational diseases were diagnosed by the Social Security Institution (SSI) in Turkey. In 2021, 55 people were reported as NRHL (effects of noise in the inner ear) by the SSI. This low number is due to reasons such as the prevalence of unregistered work in our country and the problems experienced in the detection of occupational diseases (10). Although the Social Insurance and General Health Insurance Law seems to cover all employees, public employees are not included in the notification of work accidents and occupational diseases (11).

Mining, iron and metal industry, stone, earthworks, timber and carpentry, textile and leather industry, construction works, paper industry, printing industry, transportation noise are high business lines (12-13).

In this study, it was aimed to determine the frequency of noise-related hearing loss and related socio-demographic and occupational factors in applicants to a University Hospital Occupational Diseases Clinic.

METHOD

The population of the cross-sectional study consisted of 433 employees who applied to the University Hospital Occupational Diseases Clinic between November 2015 and November 2018, who underwent audiometry examination. Employees who did not undergo audiometry examination were not included. One of the patients who applied to our outpatient clinic was excluded from the study because of congenital bilateral total hearing loss. The study was started after the approval of the Ege University Ethics Committee on 11.12.2018 with Decision No: 18-12/7. The data of the workers were obtained from the occupational diseases' anamnesis form developed by the relevant university's Occupational and Occupational Diseases Department and filled in on the basis of the statement, and the exposure assessment form developed in the same way.

Occupational diseases clinic where the research was carried out Turkey's occupational diseases clinic is established to train specialists and is one of the first education and research clinics that started to offer specialty training. Polyclinic evaluates occupational disease applications with SSI referral as of November 2015 and and prepares occupational disease reports to be sent to SSI.

In our study, the variables of the study to evaluate noise-induced hearing loss; gender, age, smoking and alcohol consumption status, being overweight and having a work accident in the last 1 year, using headphones, hypertension, allergy and chronic disease, chemical odor in the environment. These findings were obtained from the files of retrospective employees.

Hearing-related problems were evaluated by the Otorhinolaryngology specialists of the university and audiometric examination was performed with Madsen İtera II audiometry device.

In audiometric examinations, in assessing the test results, the hearing threshold values at 4000 Hz along with the arithmetic mean of the hearing values at 500-1000-2000 Hz were taken into consideration while evaluating the test results. ISO 1999 and American National Standard ANSI S3-1 were taken into consideration in the acceptance of pure sound mean and 4000 Hz hearing threshold (14,15).

Patients with normal pure tone average and frequency of 4000 Hz and more than 25dB symmetric sensorineural hearing loss are accepted as NRHL. Those who have unilateral hearing loss at different levels on the right or left side compared to the pure sound average and those with notches at 4000 Hz were also evaluated as unilateral NRHL (16,17) .

SPSS 21.0 program was used in the analysis of the data. In the analysis, descriptive statistics and chi-square were applied and p <0.05 level was accepted statistically significant.

RESULTS

The way the study was conducted is shown in the Figure1.

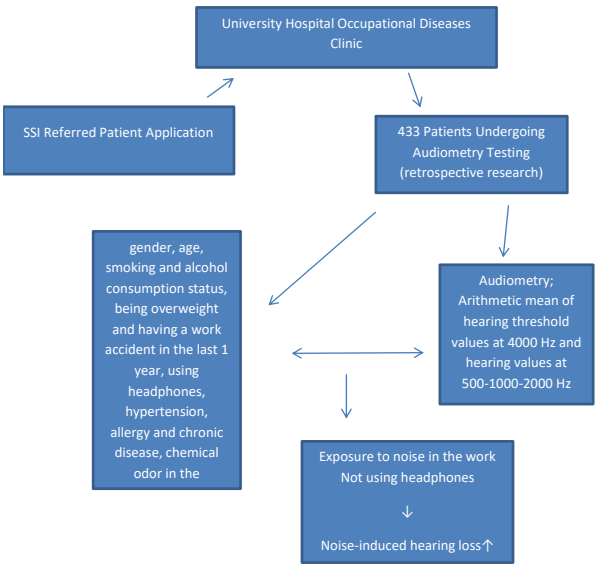

Figure 1. The way of working

A total of 430 patients, 36 (%8.2) women and 394 (%91.8) men, who applied to the outpatient clinic within a three-year period, were included in the study. By performing audiometry examination by otorhinolaryngology specialists, employees with bilateral neurosensory hearing loss were evaluated as those with noise-induced hearing loss. The average age of our patients is 39.00 ± 8.61, minimum age is 17, maximum age is 74. According to their educational status, 55.6% (239) of the applicants stated that they received education at the level of primary and secondary education, 33.5% (144) at high school, 11% (47) at the undergraduate, university and postgraduate. 2.3% of our participants are below the minimum wage, 19.3% of them (83) have a minimum wage level and 337 (78.4%) have a higher income level than the minimum wage. While of our 24.4% (105 patients) whose smoking was questioned stated that they never smoked, 24.7% (106) quit and 50.9% (219) still answered.

While 48.4% (208 people) of the patients who participated in our study were overweight (BMI≥25), 21.9% (94 people) were obese (BMI≥30). When we grouped the participants as underweight, normal, overweight and obese according to body mass index in our study, there was no significant difference between the groups with and without hearing loss (table-1).

It was observed that 48.8% (210 people) of the applicants to the outpatient clinic had a previously diagnosed comorbid disease. 20% (86 people) of the participants stated that they had any history of allergy, 7.4% (32 people)were diagnosed with hypertension.

Considering the distribution of the sectors in which the patients are working, it was seen that 54.9% (236 workers) of the most applications were from the cement, glass, soil, ceramic industry.

When the applicants' exposure to occupational risk factors in their workplace was questioned, 84.9% (365 people) were exposed to noise, 36.7% (158 people) smelling chemical in the work environment.

60.7% (261 people) of the workers who were asked to use earplugs as personal protectors stated that they used one of type of headphones.

There was no significant difference between participants with or without hearing loss in terms of gender, smoking and alcohol use (Table-1).

Table 1: Distribution of Gender, Age, Level of Smoking and Hearing Loss in Application According to the Diagnosis of Hearing Loss

Variables	Number		Hearing loss		No hearing loss		p value
	n	%	n	%	n	%	
Gender							0.98
Female	36	8.2	9	23.7	29	76.3	
Male	394	91.8	100	23.5	325	76.5	
Age							0.10
<40	215	50.0	40	18.6	175	81.4	
≥40	215	50.0	54	25.1	161	74.9	
Smoking							0.34
Never	105	24.4	19	18.1	86	81.9	
Left	106	24.7	21	19.8	85	80.2	
Still Using	219	50.9	54	25.3	165	74.7	
Alcohol							0.12
Yes	79	18.4	12	15.2	67	84.8	
No	346	80.5	82	23.7	264	76.3	
Unspecified	5	1.2	0	0	5	100	
BMI Category							0.19
< 18,5 weak	12	2.8	3	25	9	75	
18,5-24.9 normal	116	27	19	16.4	97	83.6	
25-29.9 overweight	208	48.4	45	21.6	163	78.4	
≥30 obese	94	21.9	27	28.7	67	71.3	
Hearing Complaint							0.28
Yes	213	49.5	56	26.3	157	73.7	
No	217	50.5	38	21.6	179	78.4	

BMI: Body mass index

57.7% of our participants (248 people) stated that they had a work accident in the last year. The group without hearing loss stated that they had a higher rate of work accidents than the group diagnosed with hearing loss. The difference was statistically significant (p = 0.00) (Table-2).

60.7% (261 people) of 397 people working in noisy environment stated that they use headphones. Hearing loss was found to be significantly high in the group who stated that they did not use headphones despite the noise exposure (p≤ 0.05) (Table-2).

Table 2: Distribution of Participants' Working Year, Occupational Accident and Earphone Usage Status According to the Diagnosis of Hearing Loss in the Last 1 Year

Variables	Number		Hearing loss		No hearing loss		p value
	n	%	n	%	n	%	
Having a Work Accident in the Last 1 Year							≤ 0.05
Yes	248	57.7	35	14.1	213	85.9	
No	182	42.3	59	32.4	123	67.6	
Using Earplugs as Personal Protection							0.33
Yes	261	60.7	53	20.3	208	79.7	
No	169	39.3	41	24.3	128	75,7	
Describing Noise Exposure and Using Earplugs							≤ 0.05
Yes	261	60.7	53	20.3	208	79.7	
No	169	39.3	41	24.3	128	75.7	

There was no significant relationship between patients with and without a diagnosis of hearing loss in terms of having a chronic disease (Table- 3).

Table 3: Distribution of Comorbid Diseases of the Participants According to the Diagnosis of Hearing Loss

Variables	Number (% in total)		Hearing loss		No hearing loss		p value
	n	%	n	%	n	%	
Presence of Comorbid Disease							0.15
Yes	210	48,8	52	24.8	158	75.2	
No	220	51.2	42	19.1	178	80.9	
Allergy							0.33
Yes	86	20	16	18.6	70	81.4	
No	339	78.8	78	23	261	77	
Unspecified	5	1.2	0	0	5	100	
Hypertension							0.65
Yes	32	7.4	8	25	24	75	
No	398	92.6	86	23.1	312	76.9	

Hearing loss was found to be significantly more common in patients who stated that they were exposed to noise ($p \leq 0.05$) (Table-4). There was no significant difference in hearing loss with exposure to any of lead, manganese, or mercury (Table-4).

Table 4: Distribution of Participants' History of Exposure to Some of the Occupational Risk Factors According to Hearing Loss Status

Variables	Number (% in total)		Hearing loss		No hearing loss		p value
	n	%	n	%	n	%	
Exposuring to Noise							
Yes	365	84.9	89	24.4	276	75.6	≤ 0.05
No	65	15.1	5	7.7	60	92.3	
To be Finding Smelling Chemical in the Working Environment							0.67
Yes	158	36.7	42	26.6	116	73.4	
No	272	63.6	52	19.1	220	80.9	

DISCUSSION

NRHL is quite common among preventable occupational diseases. Occupational hearing loss was diagnosed in 21.9% (94 people) of 430 patients who applied to our outpatient clinic. It is observed that 23.5% (91 people) of 392 male workers in 7 workshops in İzmir who participated in Ozturk's thesis study were diagnosed with noise-induced hearing loss as in our study (18). In a similar study, 99 workers working in an administrative office in India were evaluated and hearing loss was found in 21.7% (22 persons) (19).

Nelson et al. reported that the risk of noise-induced hearing loss in men is three times higher than in women (20). 8.2% (38 people) of the participants in our study were women and 91.8% (425 people) were men. There was no significant gender difference in our study in terms of the diagnosis of occupational hearing loss. The reason for this is thought to be due to the fact that the number of female patients is approximately 10 times less than the number of male patients.

In the study of Louw et al., it was stated that advancing age is a risk factor for noise-induced hearing impairment (21). In our study, hearing loss in the 40 years and older group was similar to younger age groups.

It has been observed that smoking significantly affects hearing loss at all frequencies in workers exposed to noise. Studies have shown that there is a dose-response relationship between the amount of smoking and low-frequency hearing thresholds (22). In a study conducted in China; Smoking was significantly associated with both speech frequency and high-frequency hearing loss in men, but not women (23). In our study, no significant relationship was found between hearing loss and smoking status. The reason for this may be that the amount of smoking and the duration of quitting and the duration of quitting are not known clearly.

In the study of Park et al., a positive correlation was found between alcohol dependence and hearing loss (24) . In a meta-analysis study of 18 studies published in the last 25 years by Qian et al., it was shown that there is a significant relationship between alcohol consumption and hearing loss (25).In our study, no significant relationship was found between hearing loss and alcohol consumption status. This may be because the amount of alcohol consumption is not known, or it may be because the people included in the study did not have alcohol dependence.

In the study of Lalwani et al., 1488 adolescents were evaluated and obesity was found to be a risk factor for the increase in sensorineural hearing loss (SNHL) (26). In a study conducted in children, the relationship between obesity and bilateral SNHL was investigated, although it was not associated with obesity, bilateral SNHL was more common in low-weight children compared to normal-weight children (27). In our study, when we grouped the participants as underweight, normal, overweight and obese according to body mass index, we could not find a significant difference between the groups with and without hearing loss. In our study, there was no difference in obesity between the groups with and without hearing loss. The reason for this is thought to be due to the small number of participants.

Farouk et al., reported that there is a positive correlation between the ambient noise level and the frequency of NRHL diagnosis in a textile factory (28).In a study conducted in Denizli, the frequency of noise-induced hearing loss increases up to 33% in people who work in noisy environments with 85 dB and above and do not use personal protective equipment (12). In our study, more hearing loss was observed in those exposed to noise.

It has been observed in many studies that environmental and occupational chemical exposure may cause hearing loss. Cases of hearing loss due to asbestos and pesticide exposure have been reported (29). Studies have shown that lead and cadmium can damage nerve conduction in the cochlea or vestibular system, causing significant hearing loss. Rabinowitz et al. observed hearing loss more frequently in

those with solvent exposure (30). In a Chinese study, combined exposure to noise and low-level TEXS(toluene, ethylbenzene, xylene, and styrene) was shown to cause SFHL(speech-frequency hearing loss) each in hearing function more often than exposure alone (31). In a published review, although no clear relationship was observed between lead and hearing loss, it was observed that as lead exposure increased, it had a positive effect on hearing loss (32). Similarly, in our study, there was no significant difference between the use of odoriferous chemicals in the working environment and hearing loss. The reason for this may be that we do not know what kind of chemicals and how much and how.

In various studies, a negative correlation was found between the frequency of earplug use and hearing loss (33). In our study, the rate of hearing loss was found to be higher in those who described the noise they were exposed to in the workplace and did not use earplugs.

Occupational noise exposure and hearing impairment have a negative impact on work safety and increase the likelihood of work-related injuries. Although this has been shown in researches (34,35). In our study, the frequency of having a work accident was found to be lower in patients with hearing loss, in contrast with these studies. This may be because our participants only had a history of occupational accident in the last year.

Cayir et al. In a study they conducted, blood pressure was found to be higher in people who were exposed to a total of 75 dB noise for 4 hours a day (36). It has been shown that the prevalence of arterial hypertension due to noise increases around the airport (37). Zhang et al. High frequency hearing loss on audiometry, ECG abnormalities and hypertension were observed more in noise-exposed workers (38). In our study, there was no significant difference in hypertension between those who were exposed to noise and those who were not. The presence of hypertension in the history of the participants in our study may be due to the verbal statements of the patients.

Limitations of the Research

As this was a hospital-based study, the data were taken from the files of the workers involved.

• Some of the data, such as noise exposure, is based on the workers' statement and may be affected by factors such as personal sensitivity level, sociocultural level.

• The inaccessibility of workplace noise measurements and the inability to access patients' employment and periodic examination information limits our information.

• In the outpatient clinic records, it has been questioned whether patients used hearing protectors, and there is no clear information about the duration they use, the type of protector and whether it is used effectively.

CONCLUSIONS AND RECOMMENDATIONS

Noise is of great importance in occupational hearing loss in our research and other studies. Measures to be taken to prevent occupational hearing loss are of great importance. Causes such as smoking, chemicals and age increase the effectiveness of hearing loss due to noise. For this reason, while taking the work history and medical history, it should be questioned in detail and sufficient time should be allocated. New research is needed for the development and advancement of this field.

It has been shown again that the correct and effective use of personal protective equipment such as earplugs depends on individual factors and cannot be among the priority protective measures. Therefore, engineering measures are extremely important among primary protective methods (12,33).

In order to prevent occupational hearing loss, workplace supervision should be performed. Workplace risk assessment should be done. Workplace noise mapping should be made by measuring workplace noise and employees' personal noise exposure. Necessary technical and engineering measures should be taken to reduce noise. Employees should be trained to use their personal protectors effectively. At the recruitment examination, individuals at risk for their noisy exposure should be identified and regular periodic examinations should be planned according to the result of the risk assessment (13).

Since this study was retrospectively analyzed, there are some inadequacies. Future studies are needed. This study can guide us on what we should pay attention to when doing future studies.

Ethical Declarations

The privacy and confidentiality of the participants was protected. The study was conducted in accordance with scientific principles and literature. The study was started after the approval of the Ege University Ethics Committee on 11.12.2018 with Decision No: 18-12/7.

Source of Finance

No financial support was used by authors during this study.

Conflict of Interest

On behalf of all authors, I, as the corresponding author, accept and declare that; we have NO affiliations with or involvement in any organization or entity with any financial interest or non-financial interest in the subject matter or materials discussed in this manuscript.

Thesis

Occupational diseases are extremely important in that they are almost entirely preventable diseases. Hearing loss due to noise in the workplace is a kind of occupational disease that can be prevented by various protective measures and negatively affects the quality of life of the person.

The aim of our study is to select those diagnosed with noise-induced hearing loss from all patients who applied to our outpatient clinic, and to determine the cause of hearing loss, if any, by revealing their demographic characteristics, to identify additional diseases and to draw attention to the importance of occupational protective measures.

Authorship Contributions

Concept: YYA, NK, MT, Design: YYA, NK, MT, Supervising: MT, Financing and equipment: YYA, NK, MT, Data collection and entry: YYA, NK, Analysis and interpretation: NK, YYA, Literature search: YYA, NK, Writing: YYA, Critical review: MT.

REFERENCES

1. *Ozdemir M. Investigation Of Noise-Related Hearing Loss In Employees In Small-Scale Bodywork Businesses, The Ministry Of Labor and Social Security, Occupational Health and Safety Specialist Thesis- Ankara, 2016.*

2. *Report of Noise of a WHO-PDH Informal Consultasion, Prevention of Noise- Induced Hearing Loss, 28-30 October 1997 Geneva.*

3. *Senkal OA, Aydın E. Hearing and Noise-Induced Hearing Loss in Aviation, ENT and BBC Journal 21 (2): 47-54, 2013*

4. *Occupational Diseases and Work Related Diseases Diagnosis Guide, T.C. Ministry of Labor and Social Security, Page-133-137*

5. *Toprak R, Akturk N. (2004) The Negatıve Effects Of Noise On Human Health Vol 61, No 1,2,3 2004 S: 49 - 58 Türk Hij Den Biyol Journal.*

6. *Bonzaft AL, McCarthy DP, The Effects of Elevated Train Noise on Reading Ability, Environmental Behavior, 1975; 7 (6): 517–27.*

7. *Devren M. Audiological findings and comparison of psycho-social aspects of hearing impaired patients with noise (PhD thesis). Edirne: Trakya University Institute of Health Sciences. 1999*

8. *Social Security Institution, "SSI Statistical Year books", SSI Publication, Ankara, 1984-2009*

9. *ILO (International Labour Organization), World Statistic. (Accessed Date: 20.07.2023) https://www.ilo.org/moscow/areas-of-work/occupational safety-and-health/ WCMS_249278/lang--en/index.htm#:~:text=The%20ILO%20estimates%20that%20some,of%20work%2Drelated%20illnesses%20annually.*

10. *Sosyal Güvenlik Kurumu, 2021 İstatistik verileri, (Accessed Date: 20.07.2023) https://www.sgk.gov.tr/Istatistik/Yillik/fcd5e59b-6af9-4d90-a451-ee7500eb1cb4/*

11. *Yilmaz F. (2010) Occupational Health and Safety Conditions of Women Workers in Turkey, International Journal of Social Research, 3, 13, 268-284.*

12. *Erdogan A. (2016) Effect of Noise Level on Employees in Three Textile Factories in Denizli. Specialization Thesis-Denizli*

13. *Cetin O. Investigation of Noise-Related Hearing Loss in OAL, Inspection of Noise Dependent Hearing Losses in OAL Mine, Mining / September - December 2000*

14. *Lee HJ, Lee JM, Na G, et al. Which Patients With a Unilateral Hearing Aid for Symmetric Sensorineural Hearing Loss Have Auditory Deprivation? Clin Exp Otorhinolaryngol. 2020 Feb;13(1):23-28. doi: 10.21053/ceo.2019.00402. Epub 2019 Jul 16.*

15. *Luders D, Goncalves CGO, Lacerda ABM, et al. Music students: conventional hearing thresholds and at high frequencies. Observational Study Braz J Otorhinolaryngol. 2014 Jul-Aug;80(4):296-304. doi: 10.1016/j.bjorl.2014.05.010. Epub 2014 Jun 6.*

16. *Mathur N. Noise-Induced Hearing Loss Clinical Presentation. (Accessed Date: 09.09.2024) https://emedicine.medscape.com/article/857813-clinical?form=fpf*

17. *Golub JS, Brickman AM, Ciarleglio AJ, et al. 2 4, José A Luchsinger Association of Subclinical Hearing Loss With Cognitive Performance. JAMA Otolaryngol Head Neck Surg. 2020 Jan 1;146(1):57-67. doi: 10.1001/jamaoto.2019.3375.*

18. *Ozturk A. Evaluation of noise and affecting factors in casting business (Master's Thesis). İzmir: Dokuz Eylül University, 2004*

19. *Majumder j, Patel RC, Kotadiya S, et al. Hearing Threshold Status and Risk Estimate of Hearing Impairment among Administrative Workforce, Indian J Occup Environ Med. 2018 Jan-Apr; 22 (1): 11–16. doi: 10.4103 / ijoem. IJOEM_22_18, J.*

20. *Nelson DI, Nelson RY, Concha-Barrientos M, Fingerhut M. The Global Burden of Occupational Noise-Induced Hearing Loss. Am J IndMed 2005; 48: 446-458.*

21. *Louw C, Swanepoel W, Eikelboom RH, et al. Prevalence of hearingloss at primaryhealthcareclinics in South Africa. AfrHealthSci. 2018 Jun; 18 (2): 313-320. doi: 10.4314 / ahs.v18i2.16.*

22. *Sung JH, Sim CS, Lee CR, et al. Relationship of cigarette smoking and hearing loss in workers exposed to occupational noise. Ann Occup Environ Med. 2013 Jul 3; 25 (1): 8. doi: 10.1186 / 2052-4374-25-8.*

23. Wang D, Zhu Y, Li C, et al. Relationship between cigarette smoking and hearing loss in China: A cross-sectional study in Zhejiang province. Tob Induc Dis. 2021 May 26;19:40. doi: 10.18332/tid/135440.

24. Park JA, Suh MJ. Hazardous Alcohol Consumption and the Risk of Hearing Impairment in Adults Based on the Korean National Health and Nutrition Survey: A Retrospective Study. J Audiol Otol. 2019 Apr;23(2):63-68. doi: 10.7874/jao.2018.00241. Epub 2019 Feb 8.

25. Qian P, Zhao Z, Liu S, et al. Alcohol as a risk factor for hearing loss: A systematic review and meta-analysis. PLoS One. 2023 Jan 20;18(1):e0280641. doi: 10.1371/journal.pone.0280641.

26. Lalwani A K, Katz, Liu Y-H, et al. Obesity is Associated With Sensorineural Hearing Loss in Adolescents Laryngoscope. 2013 Dec;123(12):3178-84. doi: 10.1002/lary.24244. Epub 2013 Jun 17.

27. Bluher A, Kawai K, Wang A, et al. Obesity as a Possible Risk Factor for Pediatric Sensorineural Hearing Loss. Laryngoscope. 2021 Jun;131(6):1416-1419. doi:10.1002/lary.29289. Epub 2020 Dec 2.

28. Farouk MS, Khader JA, Moh'd MT. Hearing Loss in a Textile Factory. Saudi Medical Journal 2000; 21 (1): 58-60.

29. Li X, Ohgami N, Yajima I, et al. Arsenic Level in Toenails Is Associated With Hearing Loss In Humans. PLoSOne. 2018 Jul 5; 13 (7): e0198743. doi: 10.1371 / journal . pone.0198743. eCollection 2018.

30. Rabinowitz PM, Galusha D, Slade MD, et al. Organic solvent exposure and hearing loss in a cohort of aluminum workers. Occup Environ Med. 2008 Apr; 65 (4): 230-5. Epub 2007 Jun 13.

31. Zhang Y, Liu Y, Li Z, et al. Effects of coexposure to noise and mixture of toluene, ethylbenzene, xylene, and styrene (TEXS) on hearing loss in petrochemical workers of southern China. Environ Sci Pollut Res Int. 2023 Mar;30(11):31620-31630. doi: 10.1007/s11356-022-24414-6.

32. Carlson K, Neitzel RL. Hearing loss, lead (Pb) exposure, and noise: a sound approach to ototoxicity exploration. J Toxicol Environ Health B Crit Rev. 2018;21(5):335-355.

33. Bhumika N, Prabhu GV, Ferreira AM, Kulkarni MK. Noise Induced Hearing Loss Still a Problem in Shipbuilders: A Cross Sectional Study in Goa, Annals of Medicaland Health Sciences Research, v.3(1); Jan-Mar 2013

34. Amjad-Sardrudi H, Dormohammadi A, Golmohammadi R, et al. Effect of noiseexposure on occupational injuries: a cross-sectionalstudy. J ResHealthSci. 2012 Dec 13; 12 (2): 101-4.

35. Choi SW, Peek-Asa C, Sprince NL, et al. Hearing loss as a risk factor for agricultural injuries. Am J Ind Med. 2005 Oct; 48 (4): 293-301.

36. Cayir A, Barrow TM, Wang H, et al. Occupational noise exposure is associated with hypertension in China: Results from project ELEFANT. PLoS One. 2018 Dec 31;13(12):e0209041. doi: 10.1371/journal.pone.0209041. eCollection 2018.

37. Rosenlund M, Berglind N, Pershagen G et al. Increased prevalence of hypertension in a population exposed to aircraft noise. Occup Environ Med. 2001; 58: 769-73. doi: 10.1136 / oem.58.12.769.

38. Zhang L, Chen S, Chen Z, et al. Relationship between occupational noise exposure and hypertension: Cross-sectional evidence from real-world. Front Public Health. 2022 Dec 12;10:1037246. doi: 10.3389/fpubh.2022.1037246.