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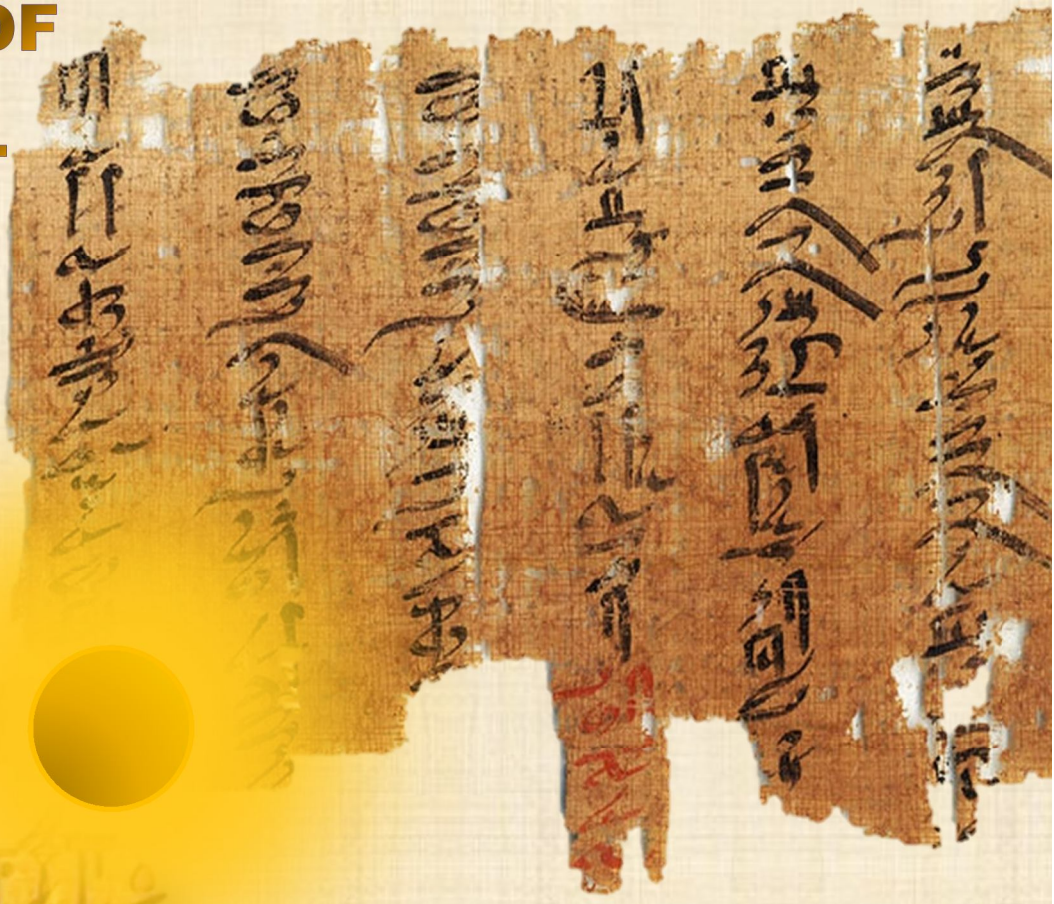

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Original article

Prevalence and Manifestation of Ototoxic Medications among the Attendees of the Audio-Vestibular Unit at Al-Zahraa University Hospital, Cairo, Egypt

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ABSTRACT

Background: Hearing loss is considered to be one of the most common factors of moderate to severe disability specially in the developing countries. Ototoxicity is inner ear damage due to usage of chemical substances, which can lead to either reversable or permanent hearing loss and/or vestibular loss. Ototoxic hearing impairment can impact the quality of life by many ways; therefore, we should be very careful when it comes to choose drug therapy to minimize the risk.

Aim of the work: To identify the commonly implicated ototoxic medications among the adult Egyptian population and to study its presenting features.

Patients and Methods: This is a retrospective study, that involved review for the medical notes of all adult patients, who attended the Audio-Vestibular Unit with otological problems between January 2014 and December 2018. A total of 1110 medical folders were reviewed, and data were manually extracted.

Results: The prevalence of ototoxic medication among the adult attendees was 26.6%. The most common manifestation was hearing impairment, as it was reported in 83.2% of the cases. Tinnitus came second by 70% followed by vertigo in 31%. Aspirin was the most common drug used [44.7%] of the patients, followed by aminoglycoside in 15% of our study sample, then the non-steroidal anti-inflammatory drugs [NSAIDS] in 14.3%.

Conclusion: Audiometric screening is critical to capture the true prevalence of hearing loss. Baseline audiometric and vestibular function test should be performed before prescribing any ototoxic medication especially in patients with other associated risk factors.

Keywords: Ototoxicity; Hearing Impairment; Tinnitus; Vertigo; Hearing Screening.

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* Main subject and any subcategories have been classified according to research topic.

INTRODUCTION

Hearing dysfunction is considered to be one of the most common chronic diseases after high blood pressure and arthritis[1]. According to the World Health Organization [WHO], more than 5% of the world populations have disabling hearing loss. It is estimated that higher percentage of these individuals live in developing nations [2].

Ototoxicity mean damage of the cochlea and/or vestibular apparatus due to exposure to chemical substances, leading to hearing loss and/or imbalance. Ototoxicity can be reversible or permanent. Some of the commonly used ototoxic drugs are aminoglycoside, platinum-based chemo-therapeutic, loop diuretics, macrolide anti-biotics, and antimalarials[3]. Some of the nonsteroidal anti-inflammatory drugs [NSAIDS] have been considered to be ototoxic[4].

Ototoxic hearing dysfunction can have significant impact on the personal communication and life quality, with significant vocational, educational and social consequences and therefore should be considered when choosing drug therapy to minimize risk [5].

Inner ear dysfunction as a result of drug therapy can be presented in variety of ways including tinnitus, vertigo, imbalance, hyperacusis, aural fullness, dizziness, and deafness[6]. There are many factors that influence the severity of the resultant ototoxicity such as: age, gender, coexisting medical conditions like heart failure, renal failure, high blood pressure, genetic factors, type of medicine, route of administration, duration of therapy, bio-availability and pre-existing hearing loss[3].

According to researchers best of knowledge, there were no researches done before to investigate the prevalence and the manifestations of the ototoxic medication on the Egyptian population. In addition, there was no studies answer the question: what the most frequent ototoxic medication used and the effect of associated comorbidities on hearing? Therefor we designed this study.

AIM OF THE WORK

To assess the prevalence and manifestation of the ototoxic medications among adult patients who attended the audio-vestibular unit at Al-zahraa University hospital, Cairo, Egypt. In addition to identify the common implicated ototoxic medications among them.

PATIENTS AND METHODS

Study design, setting, and population

This is a five-year retrospective cross-sectional study that was carried out at Al-Zahraa University Hospital, Cairo, by reviewing the medical records of all adults patients attended the Audio-Vestibular Unit, Otorhinolaryngology department between January 2014 and December 2018. We confirm that the present study was obliged to the standards of Declaration of Helsinki [Ethical Approval No. 20200/102]

Inclusion and exclusion criteria:

Data were manually extracted from patients' records and all adult patients aged ≥18 years of both sexes were included in the study, while records of incomplete data were excluded from the study.

A total of 1110 medical records were found to be eligible for the study and their data were retrieved.

The obtained data included

1- Demographic characteristics as age, sex, and occupation.

2- Noise exposure, ear trauma and head injury, fever & admission to fever hospital, medical history of diabetes, hypertension, and renal disease.

3- History of ototoxic drug intake was reviewed and accordingly, the studied patients were divided into two groups; the first one [group I] are those who had history of ototoxic drug intake and the second group [group II] included those who did not have such history. The type of these drugs [amino-glycosides, loop diuretics, non-steroidal anti-inflammatory drugs, or antineoplastic drugs, macrolide antibiotics, and anti-malarial drugs] was also included. The associated otological symptoms as hearing impairment, tinnitus, and vertigo were also obtained from the notes.

4- Hearing threshold at the air conduction and bone conduction in each ear across different frequencies [0.25, 0.5, 1, 2, 4 & 8 KHz] was retrieved. According to the obtained data the type of hearing impairment was classified

into, sensorineural hearing loss [SNHL], conductive HL, or mixed HL. Also, the degree of hearing loss was recorded [mild, moderate, moderate-severe, sever, and profound].

Statistical analysis

The collected data were reviewed. Coding and statistical analysis of collected data were done using SPSS program [statistical package of social science; SPSS Inc., Chicago, IL, USA] version 16 for Microsoft Windows. Mean and standard deviation [SD] were calculated to measure central tendency and dispersion of quantitative data while frequency of occurrence was calculated to describe qualitative data. Student t test was used for comparison of quantitative data between two groups and Chi-square- test [X^2] for comparison of qualitative data. Level of significance was taken at P value of < 0.05 and the results were represented in tables and graphs.

RESULTS

The total number of adult patients presented between January 2014 and December 2018 to the Audio-Vestibular unite, Ear, Nose and Throat [ENT] department, with otological problem and eligible for the study were 1110 patients. Mean age of the patients was 50.47±14.94 with nearly equal percentages of males and females. Housewife and manual worker were the most prevalent occupation among them [39.7% and 39.1% respectively] [**Table 1**].

Table [1]: Socio-Demographic characteristics of the studied sample

	Total No. [1110]	**%**
Age [mean ±sd] Min-max	50.47±14.94 [14-90]	
Sex [n,%]: Males Females	 544 566	 49.0% 51.0%
Occupation: Housewife Manual worker Professional Not working[unemployed] student	 441 433 110 99 27	 39.7% 39.1% 9.9% 8.9% 2.4%

Out of the 1110 patients, there was 293 patients [26.6%] had history of ototoxic drug i.e. the prevalence of ototoxic medication among the adult attendees was 26.6% [Figure 1].

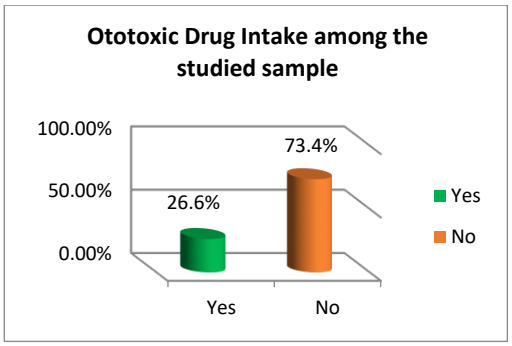

Figure [1]: prevalence of ototoxic intake among the studied sample

In our study, there was overlapping between the presenting complaints in the study group, the most common symptom was hearing impairment, reported in 83.2%. Tinnitus came second by 70% followed by vertigo in 31% [Figure 2].

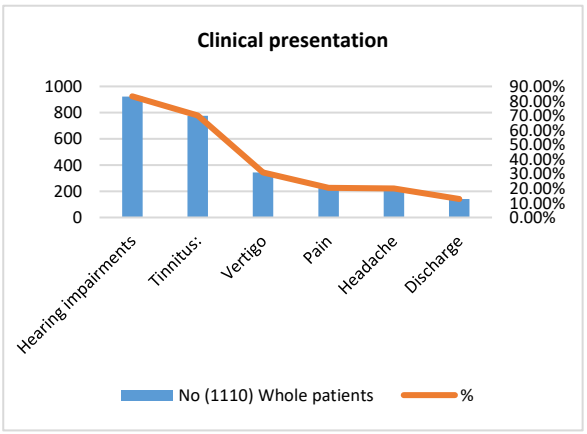

Figure [2]: Clinical presentation among the studied sample

Aspirin was the most common drug used, where it was used in 44.7 % of the patients, followed by aminoglycoside in 15% of our study sample, then came the non-steroidal anti-inflammatory drugs [NSAIDS] in 14.3%. figure [3**]**.

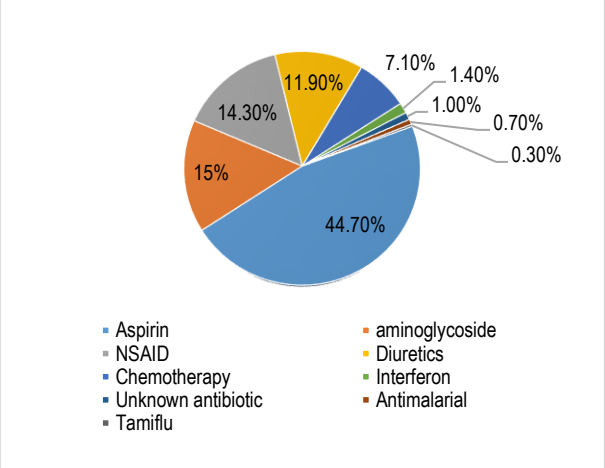

Figure [3]: Type and frequency of ototoxic drugs used by patients

We divided the patients according to the ototoxic drug intake into two groups: **Group 1** with positive history of ototoxic drug intake and **group II** without such history, there was no statistically significant difference between the two study groups regarding the age, while there was statistically significant difference between both groups, regarding the gender and the occupation as shown in [Table 2].

Noise exposure and family history of hearing impairment [as associated risk factors for hearing impairment], were lower among group I [20.8% and 6.5% respectively] than group II [33.8%, and 7.7% respectively] While the reverse was true regarding hypertension and diabetes mellitus [49.1% and 32.1% respectively in group I] and [44.1% and 29.5 % respectively in group II] [Table 3]

In our study, the most common form of hearing loss among both groups was SNHL, where it was found in 56% in group I and 61% in group II, followed by mixed hearing loss then conductive hearing loss [Table 4].

The bilateral hearing affection was more prevalent in group I [78.1%] than group II [55.6%] and this was statistically significant. In addition, the degree of hearing impairment was varying from mild to profound hearing loss in both groups with no statistically significant difference [table 5].

Table [2]: Association of ototoxic drug intake and socio-demographic characteristics

	Group I [293]	Group II [n=817]	P value
Age [mean ±sd] Min-max	51.76±14.70 [16-85]	49.96±15.01 [14-90]	0.070
Sex: Males Females	 121[41.3%] 172[58.7%]	 423[51.8%] 394[48.2%]	 0.002*
Occupation: Housewife Manual worker Professional Not working[unemployed] Student	 131[44.7%] 90 [30.7%] 29 [9.9%] 29 [9.9%] 14 [4.8%]	 310 [37.9%] 343 [42.0%] 81 [9.9%] 70 [8.6%] 13 [1.6%]	 <0.001*

*significant difference [p value <0.05].

Table [3]: Frequency of the other associated risk factors for hearing impairment among the studied groups

Associated risk factors for hearing impairment	Group I [293]	Group II [n=817]	P value
Noise exposure	61[20.8%]	276[33.8%]	<0.001*
Ear trauma and head injury	36[12.3%]	66[8.0%]	0.032*
Fever & admission to fever hospital	33[11.3%]	61[7.5%]	0.045*
Family history [of hearing impairment]	19[6.5%]	63[7.7%]	0.491
hypertension	144[49.1%]	360[44.1%]	0.133
Diabetes Mellitus	94[32.1%]	241[29.5%]	0.408
Renal diseases	10[3.4%]	23[2.8%]	0.605

Table [4]: Distribution of hearing impairment types among the studied groups

Types of hearing impairment	Group I [293]	Group II [n=817]	P value
Normal	37[12.6%]	150[18.4%]	
SNHL	164[56%]	498[61.0%]	<0.001*
conductive	11[3.7%]	84[10.3%]	
mixed	81[27.6%]	85 [10.4%]	

Table [5]: Hearing impairment characteristics among the studied groups

Hearing impairment characteristics	Group II [n=817]	Group I [293]	P -value
Laterality:			
– Unilateral HI	56[21.9%]	296[44.6%]	<0.001*
– Bilateral HI	200[78.1%]	371[55.6%]	
Degree of hearing impairment in the RT Ear:			
– Mild	71[22.4%]	185[23.3%]	
– Moderate	54[17.0%]	96[12.1%]	
– Moderate-severe	26[8.2%]	97[12.2%]	0.078
– Severe	22[6.9%]	62[7.8%]	
– Profound	6[1.9%]	22[2.8%]	
Degree of hearing in the LT Ear:			
– Mild	82[25.9%]	181[22.8%]	
– Moderate	63[19.9%]	132[16.6%]	0.052
– Moderate-severe	22[6.9%]	72[9.1%]	
– Severe	17[5.4%]	55[6.9%]	
– Profound	5[1.6%]	35[4.4%]	

*significant difference [p value <0.05].

DISCUSSION

The rate of hearing dysfunction has been rising up over the past decade and is likely to significantly increase in the coming years. Evidence suggests that early detection of drug induced ototoxicity permit the consideration of treatment modifications to lower or prevent permanent hearing impairment and imbalance[7].

In the present work, older patients were at higher risk to develop ototoxicity when they use ototoxic medication than younger population**.** This result was against the result of **Javadi et al.**[8]. Our finding could be explained by the fact that vulnerable areas in the cochlea that are affected by aging include the hair cells and the stria vascularis. Hair cells cannot be replaced and are susceptible to accumulated damage.

This study showed that hearing impairment with history of ototoxic drug intake is more prominent in females than males. This finding is in disagreement with the study of **Javadi et al.**[8] who stated the higher incidence of ototoxicity had been reported in men in comparison to women. On the other hand, the experimental study by **Kirkim et al.[9]** concluded that, the rate of hearing impairment was higher in female rats than males upon usage of cisplatin. This finding may be due to the more damage seen in neuronal tissues such as the cells of spiral ganglion and brainstem neurons.

In the present study both of the study groups hearing impairment was more prevalent among housewives, manual worker and unemployed than professionals. This may be attributed to the fact that the lower socioeconomic status and low educational levels among these population, made them at a higher risk of chronic comorbidities and ototoxic medications. This is in agreement with **Cunningham and Tucci[10]** who reported that hearing loss is significantly associated with lower levels of education and economic hardship, including both low income and unemployment. Similarly, other research shows that manual workers are at higher risk of exposure to dangerous noise in their working environment and are more likely to develop hearing impairment [HI][11]**.**

The commonest implicated ototoxic drugs were aspirin followed by aminoglycoside then nonsteroidal anti-inflammatory drugs. Other implicated drugs were diuretics, chemotherapy, interferon, thyroxin, unknown antibiotic, antimalarial and Tamiflu.

Salicylates are the active ingredients of aspirin. Tinnitus and hearing loss are commonly reversible and are associated with acute intoxication or long-term usage of salicylates. NSAIDs share similar therapeutic actions and ototoxicity side effects with salicylates. The ototoxic effects of the salicylates can be due to biochemical reactions and subsequent electrophysiological changes in the cochlea and the cochleovestibular nerve. Salicylates and non-steroidal anti-inflammatory drugs inhibit cyclo-oxygenase and decrease prostaglandin activity, potentially lowering cochlear blood supply[12].

It has been reported that both aminoglycoside and cisplatin generate reactive oxygen species in the cochlea and so induce mitochondrial dysfunction and

induction of apoptotic pathways[13]. The rate of hearing impairment as a result of aminoglycosides usage, has been significantly decreased due to the newly developed generation which, have lower ototoxic effect[14]**.**

Interferon induced hearing impairment was described in a study by Sharifian et al. They reported that hearing loss and significant changes in the bone conduction occurred in patients after treatment with INF-α.[15].

The most common presenting otological symptoms were the hearing loss [83.2%] followed by tinnitus [70%] and vertigo [31%]. The association between vertigo, tinnitus and hearing loss is well described in the literature due to ototoxic drugs, due to damage or degeneration of the inner ear and the vestibulocochlear nerve[16].

In agreement with the current work, noise-induced hearing loss [NIHL] comes as second cause of sensorineural hearing loss. NIHL is multi-factorial disease that results from the interaction of exposure to noise, other risk factors as solvents, drugs, period of exposure and vibration[17]. NIHL pathophysiology is a combination of mechanical and metabolic effect. Chronic exposure results in metabolic changes in cochlear hair cells and capillary vasoconstriction. In recent decades, the high incidence of NIHL in developing nations is due to absence of pre-employment audiometric assessments and regular hearing check-up[18].

In our study, head trauma came as a risk factor associated with significant percentage of hearing loss. The head trauma sometimes causes inner ear damages which, commonly presented with hearing loss, tinnitus and dizziness. Direct injuries to the inner ear, fracturing along the cochlea and vestibule, as a matter of course, bring inner ear symptoms[19].

Regarding the significant association between past history of fever and/or admission to fever hospital and ototoxicity induced hearing impairment, this is in consistent with previous study in Egypt by Abdel Rahman et al. that shown that previous admission to fever hospital was significantly associated with sensorineural hearing loss**[20].** Similarly, a retrospective study carried out by Samdi et al. has shown that the most common risk factor of hearing loss was febrile illness and its treatments with possibly ototoxic drugs[21].

In the present study HI in patients with history of hypertension, diabetes mellitus and renal diseases were comparable between groups. These findings are in agreement with **Joo et al.** who stated that high blood sugar, high blood pressure and cerebral vascular disease are often found to be as comorbid diseases with hearing dysfunction [22]**.** The effect of lipids and glycosides and metabolic complications on the audio-vestibular systems are considered to be important factors in the hearing impairment [23]. The micro-vessel atherosclerosis caused by hyper-tension may be associated with a reduction in the level of oxygen and the nutrition supply for the inner ear**[24].**

Regarding types of hearing impairment in this study, SNHL was the most common followed by mixed and conductive hearing loss in both groups**.** This can be explained as it described above that most of the ototoxic medication cause cochlear dysfunction by different mechanisms that lead to SNHL. This was reported in several studies, which had shown that ototoxic drugs cause functional impairment and/or cellular degeneration of tissues of the inner ear and result in sensorineural hearing loss[9,25-26].

The bilateral hearing affection was more prevalent in group I [78.1%] than group II [55.6%] and this was statistically significant. The dominant bilateral hearing loss in group one can be explained by the systemic effect of the ototoxicity and should affect both ears more or less equally.

This study was one of the first studies that looked at the prevalence of ototoxic medications among the Egyptian population. We really in need to conduct more similar studies to have our own Egyptian and middle east statistical data.

Limitations

Possible biases may have existed in the recorded information. Some patients' information was missing or not reported by the attending doctor and this has markedly limited the number of cases included in this study. Retrieving manually the un-computerized data added additional burden for the study as long time and more effort were needed.

Conclusions and recommendations

1- Audiometric screening is critical to capture the true prevalence of hearing loss, particularly at an early stage among young adults.

2- Baseline audiometric and vestibular function test should be performed before prescribing any ototoxic medication especially in patients with other associated risk factors.

3- The objectives of the audiometric screening are a] Early detection of the auditory and or vestibular toxicity so modification of the treatment protocol can be applied if possible b] Early intervention by providing an appropriate rehabilitation tools.

Financial and Non-Financial Relationships and Activities of Interest

Authors declare that, there was no competing interest

REFERENCES

1- **Bansal D, Varshney S, Malhotra M, Joshi P, Kumar N.** Unilateral sensorineural hearing loss. A retrospective study. Indian J Otol **2016**; 22 [4]: 262-7. DOI**:** 10.4103/ 0971-7749.192174

2- **WHO.** Deafness and hearing loss; Fact Sheet No 300, Updated March **2015**. Available from: www. who. int/entity/ mediacentre/ factsheets/ fs300/en/.

3- **Ganesan P, Schmiedge J, Manchaiah V, Swapna S, Dhandayutham S, Kothandaraman PP:** Ototoxicity: A Challenge in diagnosis and treatment. J Audiol Otol. **2018** Apr; 22[2]: 59-68. doi: 10.7874/jao.2017.00360. Epub 2018 Feb 26.

4- **Johnson AC, Morata TC.** Occupational exposure to chemicals and hearing impairment. The Nordic Expert Group for Criteria Documentation of Health Risks from Chemicals. PDF, Arbete och Hälsa. **2010**; **44** [4]177. Retrieved May 4, 2016. Available at: https://www. norskoljeoggass.no/globalassets/dokumenter/drift/arbeidsmiljo/kjemisk-arbeidsmiljo/fagtema/ horsels ska delige-kjemikalier/occupational-exposure-to-chemicals-and-hearing-impairment.pdf

5- **Joo Y, Cruickshanks KJ, Klein BEK, Klein R, Hong O, Wallhagen M.** Prevalence of ototoxic medication use among older adults in Beaver Dam, Wisconsin. J Am Assoc Nurse Pract. **2018**;30[1]:27–34. doi:10.1097/JXX. 0000000000000011

6- **Cianfrone G, Pentangelo D, Cianfrone F, Mazzei F, Turchetta R, Orlando MP, et al.** Pharmacological drugs inducing ototoxicity, vestibular symptoms and tinnitus: a reasoned and updated guide. Eur Rev Med Pharmacol Sci. **2011**; 15:601-36. [PMID: 21796866].

7- **Castañeda R, Natarajan S, Jeong SY, Hong BN, Kang TH.** Traditional oriental medicine for sensorineural hearing loss: Can ethnopharmacology contribute to potential drug discovery? J Ethnopharmacol. **2019** Mar 1; 231: 409-428. doi: 10.1016/j.jep.2018.11.016.

8- **Javadi MR, Abtahi B, Gholami K, Safari Moghadam B, Tabarsi P, Salamzadeh J:** The Incidence of Amikacin Ototoxicity in Multidrug-Resistant Tuberculosis Patients. Iran J Pharm Res. **2011** Fall; 10[4]:905-11. PMID: 24250429.

9- **Kanjikar S, Doddamani A, Malige R, Reddy N.** Audiometric analysis of type and degree of hearing impairment and its demographic correlation: A retro-spective study. J Adv Clin Res Insights **2015**; 2, 189–192. doi: 10.15713/ins.jcri.76

10- **Cunningham LL, Tucci DL.** Hearing Loss in Adults. N Engl J Med **2017**;377:2465-73. DOI: 10.1056/NEJMra 1616601

11- **Feder K, Michaud D, McNamee J, Fitzpatrick E, Davies H, Leroux T.** Prevalence of hazardous occupational noise exposure, hearing loss, and hearing protection usage among a representative sample of working Canadians. J Occup Environ Med. **2017** Jan; 59 [1]: 92-113. doi: 10.1097/JOM. 0000000000000920.

12- **Curhan SG, Eavey R, Shargorodsky J, Curhan GC.** Analgesic use and the risk of hearing loss in men. Am J Med. **2010**;123[3]:231–237. doi:10.1016/j.amjmed.2009. 08.006

13- **Laurell G.** Pharmacological intervention in the field of ototoxicity. HNO. **2019** Jun;67[6]:434-439. doi: 10.1007/ s00106- 019-0663-1.

14- **Obasikene G, Adobamen P, Okundia P, Ogusi FO.** Prevalence of ototoxicity in University of Benin Teaching Hospital, Benin city: a 5-year review. Niger J Clin Pract. **2012**;15[4]:453-7. doi: 10.4103/1119-3077. 104527.

15- **Sharifian MR, Kamandi S, Sima HR, Zaringhalam MA, Bakhshaee M.** INF- α and ototoxicity. BioMed Res Int **2013**; 295327. Doi: 10.1155/2013/295327

16- **Mores JT, Bozza A, Magni C, Casali RL, Amaral MIRD.** Clinical profile and implications of tinnitus in individuals with and without hearing loss. Codas. **2019** Oct 17; 31[6]: e20180029. doi: 10.1590/2317-1782/20192018029. eCollection 2019.

17- **Zhang X, Ni Y, Liu Y, Zhang L, Zhang M, Fang X, Yang Z, Wang Q, Li H, Xia Y, Zhu Y.** Screening of noise-induced hearing loss [NIHL]-associated SNPs and the assessment of its genetic susceptibility. Environ Health. **2019** Apr 4;18[1]:30. doi: 10.1186/s12940-019-0471-9.

18- **Khoshakhlagh AH, Ghasemi M.** Occupational Noise Exposure and Hearing Impairment among Spinning Workers in Iran, Iran Red Crescent Med J. **2017**; 19[5]: e42712. doi: 10.5812/ircmj.42712.

19- **Choi MS, Shin SO, Yeon JY, Choi YS, Kim J, Park SK.** Clinical characteristics of labyrinthine concussion. Korean J Audiol. **2013** Apr; 17[1]:13-7. doi: 10.7874/ kja.2013.17.1.13.

20- **Abdel Rahman AG, Meky FAS, Allam MF, El Tabakh M, El Gaafary MM.** Prevalence and risk factors for hearing disorders in secondary school students in Ismailia, Egypt. EMHJ **2007**; 13**[3]:** 586-594. Available at: https://apps.who.int/iris/handle/10665/117288

21- **Samdi MT, Kirfi AM, Grema US, Bemu AN.** Risk factors and identifiable causes of hearing impairment among pediatric age group in Kaduna, Nigeria. Indian J Otol. **2017;** 23 [4]; 241-243. **DOI:** 10.4103/indianjotol. INDIANJOTOL_68_17

22- **Joo Y, Cruickshanks KJ, Klein BEK, Klein R, Hong O, Wallhagen M.** Prevalence of ototoxic medication use among older adults in Beaver Dam, Wisconsin. J Am Assoc Nurse Pract. **2018**;30[1]:27–34. doi:10.1097/JXX. 0000000000000011

23- **Nemati S, Hassanzadeh R, Mehrdad M, Sajedi Kia S.** Hearing Status in Patients with Type 2 Diabetes Mellitus According to Blood-Sugar Control: A Comparative Study. Iran J Otorhinolaryngol. **2018;** 30[99]: 209–218. PMID: 30083527

24- **Umesawa M, Sairenchi T, Haruyama Y, Nagao M, Kobashi G.** Association between hypertension and hearing impairment in health check-ups among Japanese workers: a cross-sectional study. BMJ Open. **2019** Apr 24; 9[4]:e028392. doi: 10.1136/bmjopen-2018-028392.

25- **Tanaka M, Hasegawa S, Nakao S, Shimada K, Mukai R, Matsumoto K, et al.** Analysis of drug-induced hearing loss by using a spontaneous reporting system database. PLoS ONE. **2019**; 14[10]: e0217951. doi: 10.1371/ journal. pone.0217951

26- **Shuaibu IY, Chitumu D, Mohammed IB, Shofoluwe NA, Usman MA, Bakari A, Lawal LK.** Pattern of hearing loss in a tertiary hospital in the North Western Nigeria. Sahel Med J [serial online] **2018** [cited 2019 Nov 13]; 21: 208-12. Available from: http:// www. smjonline. org/ text. asp? 2018/21/4/208/249081.

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