Journal of Health, Medicine and Nursing
ISSN 2422-8419 An International Peer-reviewed Journal
Vol.15, 2015

Assessment of noise-induced hearing loss (NIHL) in Wasit, Iraq

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Abstract

Background. The civilization and the major industries are responsible for excessive noise which represents an environmental pollution that can be highly hazardous to people who are occupationally exposed. Hence, new legislative actions are being implemented in many countries to mitigate noise pollution that is now being considered as a major public health problem. This study was done to inspect impact and nature of the noise pollution in in a selected group of patients in Iraq.

Methods. This research constitutes a retrospective study in which we evaluated 8907 patients who were transferred to a secondary care medical center in Wasit/ Iraq between 1/1/2006 to 30/12/2010, because of hearing problems. Data were collected on several characteristics including age, sex, residency, duration of noise exposure, job description, associated chronic diseases or psychological disturbance symptoms, previous exposure to acoustic trauma or living nearby source of noice, level of education and the uses of personal protective devices. Analysis of their Audiogram and typanogram tests was also done.

Results. 805 patients were diagnosed as having varying degrees of noise- induced hearing loss . There was a progressive elevation in number of hearing loss patients over the five years of study: 56, 92, 166, 210, 281 patients were diagnosed in 2006, 2007, 2008, 2009, and 2010, respectively. Male to female ratio was 15:1, 95% of patients were living inside the city, 61% were outdoor workers, 12% were street police men, 23% were indoor employees working within a noisy field, and 4% of diverse occupations. 67% of patients were being close to the home/ street electric generator **.** There was significant correlation with duration to noise exposure, but there was a poor correlation with associated chronic illness like hypertension&/or diabetes and psychological disturbance symptoms like (lack of concentration, headache, sleep disturbances).

Conclusion. Noise-induced hearing loss seems to be an insidious growing problem among Iraqi people after 2006, it could be a preventable disease and it is a bad outcome of civilizations and urbanization. It has a clear impact physically and less psychologically on people, hence big effort should be done to raise population awareness about this specific form of environmental pollution.
Key words. Acoustic trauma, ear protectors, noise induced hearing loss, areas full of noise.

Introduction

Hearing loss caused by exposure to entertainment and vocational noise results in ruined incapability that is substantially 100% Noise-induced hearing loss (NIHL) can be described as the second most common type of hearing loss due to sensory and neural origin , after presbycusis (1). Hearing loss is usually a condition associated with difficulties in communication that decrease emotional and cognitive state and all modality of life (2-7). Noise-induced hearing loss begins as sensory neural hearing deficit at the higher frequencies (3,000 to 6,000 Hz) and develops progressively due to long standing exposure to unrestrained sound levels (8). The loss is usually symmetric, but noise from firearms or sirens may result in non-homologous loss. While acoustic trauma, a related condition, can happen from sudden exposure to brief impulsive noise (9). NIHL is basically used to indicate the permanent, accumulative loss of hearing that occurs gradually after exposure to high levels of noise for period of months or years of. NIHL has been known for long time as an issue in career associated with prognathous noise ,with studies demonstrate that people who are faced noise levels more than 85 dB will suffer from NIHL (10). An ideal NIHL is of a sensory neural type comprise of insult to the inner ear. It is bilateral and symmetrical, usually start by affecting the higher frequencies (3k, 4k or 6k Hz) and then continue to involve the lower frequencies (0.5k, 1k or 2k Hz) (11). Defective of hearing at high frequencies will at first result in a loss of distinctness in heard speech and then affect the daily activities with the progression of hearing loss. Hearing loss-related symptoms, such as problems in usual and phone conversation, result in tendency to rise up the radio/television loudness. Tinnitus usually happens in the premature stages of NIHL. Other big health impacts due to the noise pollution are lack of concentration, lassitude, headache, disturbances of sleep pattern, etc. The hazard of hearing loss and injury to the inner ears increases with the sound strength, the period of time an employee is exposed to noise and the individual receptivity to NIHL (12).

Multiple exposures and concomitant patho-physiologic actions create hearing loss. Noise trauma has been found to insult outer cells in the Organ of Corti especially at the base of cochlear (the site for high frequency sounds to be encoded), generating a high frequency model of hearing loss (13). Studies also involve cardiovascular risks, including smoking (14), diabetes and a history of cardiovascular disease (15, 16). Pretended mechanisms for these impacts comprise of micro angiopathic (or endothelial) injury leading to hypoxia and ischemia of inner ear parts (17). However, the data about the role for cardiovascular risk factors are indecisive (18, 19). The mechanisms and type of cochlear insult have yet to be conclusively discriminated. The dB is a unit used to measure the noise exposure, which is a scale weighted toward sounds at higher frequencies, to which the human inner ear is more affected. The noise can result in constant loss of hearing at long standing exposures similar to a medium SPL of 85 dB or higher for an eight-hour period (20).Depending on the logarithmic scale, a 3-dB increase in SPL represents a doubling of the sound strength. Therefore, 88 dB of noise level for four hours exposure of noise will provide the same noise "dose" as eight hours at 85 dB, hence sound power of 40 hours at 90-dB noise will be the same as a single gunshot, which is approximately 140 to 170 dB. (21, 22)

Safe Sound Levels

The National Institute for Occupational Safety and Health (NIOSH) guidelines are stated in terms of the maximum time that you can safely be exposed to different time-weighted averages (TWAs) of sound pressure on a daily basis over a 40-year period (1).

T.W.A. Decibel Levels Maximum Exposure
85 dB 8 hours
88 dB 4 hours
91 dB 2 hours
94 dB 1 hour
97 dB 30 minutes
100 dB 15 minutes
103 dB 7½ minutes
106 dB 3¾ minutes

Exposure to 115+ dB or greater may pose a serious health risk.
Motorcycle/Hair dryer/Lawn 85-90 dB
Woodshop/Chainsaw/Firecrackers (small) 100-110 dB
Ambulance Siren/Jet Engine at Take-Off/Pneumatic Drill 110-120 dB
Rock concerts 119-140 dB. (1).

Aims and objectives of study

1. To estimate the incidence of NIHL in Wasit

2. To determine the relation between the chronic illness and NIHL

3. To find the psychological drawback of NIHL.

Patients and methods

The method used is a retrospective chart review of 8,907 patients who were transferred because of hearing problem to Audiology unit in Alkarama teaching hospital, as a secondary care medical center, in Wasit/ Iraq between 01/01/2006 and 30/12/2010. The test of audiometric measurements were done by using Diagnostic Audiometer AD226 Valid from serial no. 162502 – software version 3.12 (Inter acoustics A/S, IT-5610 Rome, Italy), where its annual calibration was done according to the international standards. In this study , it has been used a chamber with a property of sound attenuation, with a sound pressure level in the background not overreach the upper limit octave-band levels of standard rooms for audiometric test. In the evaluation process, the team measures the average value at 3, 4 and 6 kHz for the ear with the worst hearing capability, for every tested person.

Of the 8,907 patients examined, 805 were diagnosed with Noise Induced Hearing Loss (NIHL). For those 805 patients, several important data [age, sex, residency, main complaints, duration of noise exposure, job description, associated chronic diseases (ischemic heart disease, diabetes mellitus) or complaints like (lack of concentration, headache, sleep disturbances), previous exposure to acoustic trauma or living near source of

noise, educational level and the utilizing of ear plugs or ear muffs in cases of working in very noisy area or factories], were collected.

Data collected are arranged in tables to show the number and percentage of variables.

Statistics

Chi-square test was used to decide the relative significance of the different variables. P-value ≤ 0.05 was rated as statistically significant, a value ≤ 0. 005 was rated as highly significant while (P < 0.5) considered as non-significant

Results:

In Table No. (1) Which shows prevalence of patients with NIHL for the five years with M/ F ratio, it appears there is a gradual increase in number of patients with NIHL along the five years (56, 92, 166, 210,281 patient)respectively, with a predominance of male over female (13:1, 14:1, 11:1, 16:1, 13:1) among the five years .

The distribution of NIHL patients according to the chief complain (Tinnitus sensation, Hearing difficulty, Ear discomfort after noise exposure, Ear Hypersensitivity for sounds) and the Mean of duration of exposure to noise are demonstrated in Table No. (2) Which shows predominance of Hearing difficulty as a presenting symptoms (30, 57,104, 110 patient among 2006, 2007, 2008 and 2009) while Tinnitus sensation (160 patient) was the most predominant symptom during 2010. Mean of duration of exposure to noise are found to range from 8 to 10 hours along the five studied years.

In this study it can be seen that the distribution of NIHL patients according to their residency showed a high percent of urban patients in comparison to rural patients (95%, 94%, 99%, 91%, and 92%) respectively among the five years as demonstrated in Table No. (3).

According to different specific variables, the distribution of NIHL patients were studies and demonstrated in Table No. (4). Associated chronic illness seems to increase gradually (15, 26, 33, 60, 67 patient) respectively. People who showed psychological disturbance symptoms also increase gradually among the five years (1, 3, 12, 10, 14 patient) respectively. The condition of being close to the home/ street electric generator were also studied in this paper and It has showed also a gradual increase in the number of patients who were close to the home/ street electric generator (22, 27, 35,70, 110 patient) respectively.

The Distribution of NIHL patients according to the type of job (outdoor workers, Street police men, Indoor worker or Miscellaneous) was showed obvious predominant for an outdoor work (34, 56, 101, 128, 171 patient) respectively as main cause of NIHL in this study as has been demonstrated in (Table 5).

The NIHL patients who are using an ear protecting devices(PTD) in the noisy areas, in this study, show very small increase in the number of people in relation to increase number to NIHL patient over the five years (2, 2, 8, 14, 21) respectively which is demonstrated in Table No. (6).

Discussion

In our study it was found that the number of patients with hearing loss increases significantly ($p<0.05$) in 2008, 2009 and 2010 (166, 210, 281 patient) respectively. This can be explained by the huge increase in the number of the imported cars, automobiles and private home/street electric generators (23, 24). Similar results were reported by John Smith (25).

To estimate the effect of this huge increase in the number of the imported cars, automobiles and private home/street electric generators on Wasit environment; we considered a local study conducted by *Hameed et al* (26), where this study focused on noise level measurements in Wasit enviroment which carried out to find tantamount sound pressure level which was estimated with the aid of sound level meter of a digital Class-1 type ((Model NA-20, Rion.. Digital, China). Noise measurements in *Hameed et al* study were carried out in 5 points in each studied site: At the passageways of markets, streets and between cars in garage for internal transport was 90 - 96 dB spl, while near the generators and at workplaces in textile industries/ the weaving sections, the noise levels at these measurement points were 102- 104 dB spl (26).

The findings above are higher than the permissible noise level for 8 hours working per day depending on the Occupational Safety and Health Administration (OSHA)(1). Hence Wasit environment in those selected sites could be considered as polluted environment with noise which can participate in the gradual increase in number of NIHL patient which has been shown in our performed study.

In this performed study it has been found that, there is increase in the tinnitus as presenting symptoms over the 1st four years of study, but it was the main and obvious presenting symptom (160 patient) during 2010 more than hearing difficulty as presenting complaints, significantly increased ($P < 0.05$) , and this can be explained on the basic knowledge that NIHL usually involve the high frequencies at first ,which is usually away from the speech frequencies (13) , hence the patient can develop the NIHL and they did not complain from hearing loss and may only has ear discomfort or tinnitus which could be the presenting symptoms.

In this study it has been shown that the distribution of NIHL patients according to their residency showed a high percent of urban patients in comparison to rural patients, which considered as statistically (p- value ≤ 0.001)as highly significant. This can be easily explained according to basic knowledge about the overcrowding and noise pollution in the cities in contrary to the peaceful rural areas.

In our study it has been shown that there was no important correlation between the chronic illness and NIHL. (D.M or IHD) or with the psychological symptoms like sleep disturbance and anxiety and mood changes. Although it has been shown in 2006, 2007 and 2008 there are some patients showed that, but it was non-significant ($P < 0.1$). That was in contrary to other studies which showed that that diabetes elevate the opportunity of hearing loss twofold giving more evidence of an effect of diabetes on hearing loss (27, 28). His study also highlight an important correlation between noise and diabetes (29). On the other hand Driscoll (30), pointed out that the health impacts comes with noise may involve disturbance of sleep, increased blood pressure, and psychological complaints like anxiety and mood upset, in addition to general symptoms like headache and nausea (30).

In this study the patients who were wearing the ear protection devices (PTD) in the noisy areas, showed increase in number along the five years but it was not significant ($P < 0.1$) over all the studied years. However it was not the case in PTD usage study done by Chavalitsakulchai et al, (31) who evaluated attitudes toward PTD usage in 469 weaving workers, and reported that 215 (45.8%) of them agreed that they often use PTDs, 73 (15.6%), sometimes use them, and 181 (38.6%) never use them. According to Meliksah et al it has been demonstrated that the NIHL ratio was clearly more predominant on the exposed subjects and it is unattainable to create any distinct difference between “safe” and “harmful” noise exposure.. The high prevalence of the NIHL in Meliksah et al study might be explained by insufficient use of personal protective devices, and absence of measures that reduce noise effect might clarify the high spread of the NIHL as in Meliksah et al study (32).

Our study shows no significant number of people who wear ear protection devices , which means that public is greatly intangible of the hazards of elevated noise levels if they exposed to it, and may be do not consider this exposure to elevated level of noise may result in real hearing problem .Hence statutes is desired to reduce hazardous noise levels and to defend people at harmful effect of noise (33) because the major social sequel of the hearing deterioration is the failure to comprehend speech in normal circumstances, which is deemed as a serious handicap. Hence occupational health has to be a priority for owners of factory and policy makers. The attention of government have been done especially to traffic, but it looks not enough (33).

Conclusions

NIHL seems to be an insidious growing problem among people in Wasit/Iraq after 2006. It could be a preventable disease and it is a bad outcome of civilizations and urbanization .It has a clear impact physically and less psychologically on people, hence big effort should be done to raise population awareness about this specific form of environmental pollution.

A major solution- will be to educate people about the risk connected with higher level of the noise, to recommend wearing ear protecting devices in noisy areas, and to decrease traffic congestion in urban areas.

Further studies is required in the field to find the best way to solve this preventable problem.

I wish to express my sincere thanks to the Al karama Audiology staffs, whom their names are below, for providing me with all the necessary facilities for the research:

1.Dr. Alaa Husain Eleue, M.D, Audiologist, . M.B.Ch.B, . AL- Karama Teaching Hospital –Kut,Wasit

2.Mr. Mustafa Muhsin Keseer, Diploma of physics, Audiology Unit/ ENT Department AL- Karama Teaching Hospital –Kut,Wasit.

3. Mr. Salah Mahdi Dahel Diploma of Nursing, Audiology Unit/ ENT Department AL- Karama Teaching Hospital –Kut,Wasit.

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Appendix

Table 1.

Prevalence of patients with NIHL in period 2006-2010

Year	Number of male patients	Number of female patients	Total number of patients	M/ F ratio
2006	52	4	56	13: 1
2007	86	6	92	14: 1
2008	152	14	166	11: 1
2009	198	12	210	16: 1
2010	261	20	281	13: 1

Table 2.
Distribution of NIHL patients according to the chief complain and the mean of duration of exposure to noise.

year	Hearing difficulty	Tinnitus sensation	Ear discomfort/ Hypersensitivity after noise exposure	Vertigo/ unsteadiness.	duration of exposure to noise/hours	Total number of patients
2006	20	30	4	2	10	56
2007	28	57	4	3	10	92
2008	39	104	10	12	9	166
2009	75	110	9	16	10	210
2010	160	96	11	14	8	281

Table 3.
Distribution of NIHL patients according to their residency.

Year	Urban areas	Rural areas	Percentage of Urban/ rural
2006	53	3	95%
2007	87	5	94%
2008	164	2	99%
2009	191	19	91%
2010	258	23	92%

Table 4.
Distribution NIHL patients according to different specific variables.

Year	associated chronic illness	%	Showing psychological disturbance symptoms	%	being close to the home/ street electric generator	%	Total number of patients
2006	15 patients	26%	1 patients	2%	22 patients	40%	56
2007	26 patients	28%	3 patients	3%	27 patients	30%	92
2008	33 patients	19%	12 patients	7%	35 patients	20%	166
2009	60 patients	28%	10 patients	5%	70 patients	33%	210
2010	67 patients	23%	14 patients	5%	110 patients	39%	281

Table 5.
Distribution of NIHL patients according to the type of job.

Years	outdoor workers	Traffic police men	Indoor worker	Miscellaneous
2006	34	8	12	2
2007	56	11	21	4
2008	101	20	38	7
2009	128	25	48	9
2010	171	34	65	11

Table 6.
Distribution NIHL patients according to their wearing the ear protectors in the noisy areas.

Year	Patients who wear Ear protectors in the noisy areas	Total number of patients
2006	2	56
2007	2	92
2008	8	166
2009	14	210
2010	21	280