Noise induced hearing loss in textil factory and dental labrotory

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الخلاصة

من أجل توفير مرجع وطني موحد من الضوضاءالتي يسببها فـ يفق دان السـ معللسـ كان كردسـ تان فـ ميدينـ ة اربيـ لى نـ مصـ نالخـ زل والنسـ يج ومختبـ طـ ب الأسـ نان ، أجـ ري الاستطلاع على 125 فقدان السمع عينة منمختلف الأعمـ اروالجـ نسمعـ ا.وقـ تـ م قيـ اس توصيل عتبة السمع من توصيل الهواء والعظام على نطاق الترددات من 250هرتـ زإلـ ى 8كيلـ وهرتزتحـ ت ظـ روفقياسـ يةأجـ ريباختبـ اقيـ اس السـ مع لعينـ ةمختـ ارةفـ ي غرفـ ة إثبات الصوت ، ونوع (IAC). نغمة نقيةتشـ غيلها يـ دويفييبنـ ا تـ ون،ذ وعنغمـ ة (تعليمـ ات التشـ غيل MA 53)ومجهـ زبـ ماعـ ة TDH-39تـ ي تقـ ام فـ ي Maicoتشخيصـ ية محدودة. واجهنافـ يمرضـ انـ االممارسـ ة ENT.STنـ كا مـ نالصـ مم والعصـ بي sensori، ولا سيما في نطاق الترددات العالية يعملونفـ ي أمـ اكنمختلفـ ةصـ اخبةفـ ي هـ ذه الدراسـ ة سوف نقوم باختيار عينـ ةلـ دينافـ يمصـ نع للنسـ يجفـ ي مصـ نعهاصـ اخبةجـ دا والكثيـ ر مـ ن البالغين العاملين فيه.

تهـ دف إلـ ى الكشـ ف عـ نالإصـ ابةودرجـ ةالصـ مم وأيواقيـ ةاللازمـ ةالممكنـ ةنتـ ائج البيانـ اتالإحصـ ائيةتيـ ر انـ ه لا يوجـ د فـ روقكبيـ ر بـ ينعتبـ اتالسـ معفـ ي الأذنـ ينالميمنـ ى واليسرى في جميع الترددات، يتعرض الذين تتراوح أعمارهم بين 20> و <40 سنة. أما بالنسـ بةلمجموعـ ةتـ ن كبـ ار السـ ن (40 -49)سـ نة كـ انأسـ وأفـ ي 4كيلـ وهرتزتـ ردد. أظهرت النتائج أنه لا يوجد تفاعلبـ ينتعـ رض الضوضـ اء – والعمـ ر وتـ ؤثرفـ ي أي مـ ن الترددات six ، تأثيرالضوضـ اء علـ ىالسـ معذات دلالـ ة إحصـ ائية.هـ ذايعنـ ي أنفـ ي كـ ل التردد المختبرة، وexposed subjects قد يتعرض عتبة السمع الى أسوأالقـ يمتقـ اس من non exposed subjects غير المكشوفة.

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Abstract

In order to provide a standard reference of noise induced hearing loss for Kurdistan population in Erbil city from textile factory & dental laboratory, a hearing loss survey was conducted on 125 sample of different ages and both sex .The hearing threshold of air conduction and bone conduction was measured over a frequency range from 250 Hz to 8 KHz under standard condition.

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Audiometric test was performed for the selected sample in a sound proof room, type (IAC). A pure tone manually operated Vienna tone type (Operating instruction MA 53), equipped with TDH 39 earphone mounted in Maico diagnostic GmbH. We faced in our ENT. practice patients complained of sensori -neural deafness especially in high frequency range they are working in different noisy places. In this study we selected our sample in the textile factory as its so noisy factory and so many adults persons working in it.

Aiming to detect the incidence and the degree of deafness and any possible protective measures necessary available to prevent deafness and to determine the prevalence of hearing problems among dental personal. The results of data indicate that statistically there is no significant difference between the hearing thresholds of the right and left ears at all frequency . It is found the mean threshold of the exposed subjects was still significantly worse than that of the non -exposed subjects at all frequencies tested for the exposed subjects aged >20 and <40 year .while for the older group (40 -49) year, it was worse at the frequency 4 KHz . The results showed that there was no interaction between the noise - exposure and the age affect at any of the six frequencies tested .The effect of noise on hearing was statistically significant. This mean that at every frequency tested, the exposed subjects had worse measured hearing threshold values than the non exposed subjects.

Introdaction

Noise is a common occupational hazard that leads to one of the most common complaints in the adult population seen by the otolaryngology noise induced hearing loss (NIHL). The cause and effect relation ship between noise exposure and hearing loss has been appreciated for many years [(1)].

Occupational exposure to excessive noise is commonly encountered in a great Varity of industrial process . The resulting injury of occupational hearing loss is well recognized & global problem [(2)]. Noise is perhaps the most common occupational and environmental hazard. As many as 30 million Americans are

exposed to potentially harmful sound levels in their work places [3] Noise exposure has been recognized as a causal factor in hearing loss for many hundreds of years , noise induced hearing loss is believed to cost over 100 million dollars annually in Sweden, while various agencies in the united states administer several hundred million dollars in compensation each year to individuals suffering from NIHL[4]. Long exposure to noise can damage the soft tissue of the inner ear. Cells and nerves in the inner ear destroyed by continuous or repeated exposure to loud sounds. If enough cells and nerves are destroyed, hearing is permanently damaged [5].

Dental personal are exposed to noise of different sound levels while working in dental clinics or laboratories. Dental laboratory, dental hand piece, amalgamators &other items produced sound noise at different sound levels, which appreciable. Virtually all noise level at dental clinics were below 85 dB [6, 7].

Patients &Methods

1-instrumentation

1.1 Operating instructions MA 53(Audiometer):

The MA 53 is a real two - channel audiometer for advanced pure tone audiometer and speech audiometer tests , has been used in the study . Test can be performed using the TDH 39 headphones **(AC)** Maico diagnostic GmbH, the optional high frequency headphones HAD 200 . B 71 bone conduction receiver **(BC)** or optional insert phones and loud speakers (FF)**[8].**

1.2 Test environment (sound proof room):

The hearing threshold survey was conducted in the audio logical center of the ENT department in the Rezgary hospital . Sound proof room is mounted in a well treated room , equipped will all requirements (ventilation , air conditioning , lighting). The test room must be at normal temperature , provides a reduction in out side noise of about 40 dB will be adequate **[9] .**

1.3 Sound level meter :

An instrument for measuring the level of sound in decibel . such measuring are called sound level reading . Sound level meter (Marttin Hirschorn type 666231) is designed to meet all current

standards set by the International Acoustics Company (IAC) for impulse sound level meter . It consists of a microphone .amplifier , attenuator , weighting network and meter.

2-patients

In practice of dentistry, dentists & dental auxiliaries are exposed to noise of different sound levels, 40 patient of dentists and dental assistant were interviewed observed during practice. Workers from textile industry (factory) in the Erbil city were selected for this cross - sectional study 62 exposed subjects were randomly selected from a total work - force of 85 subjects from this factory similarly 23 non exposed subjects (non - industrial noise exposed subjects) were randomly selected . At the sites of the survey, for each subject two - steps required to be completed consecutively on the same day and by the same examiner:

A- Hearing survey questionnaire:

It includes information about age ; sex; address ; period of his work in the factory ; period of exposure to loud sound (hours in each day & how many days each week), type of his job in the factory , ther having any hearing protectors such as earplugs or ear muffs , did he received any medical advise , a hearing measurement or PTA (pure tone audiogram) done before , any symptoms (deafness tinnitus , otalgia , head ache , dizziness , vertigo , ear discharge and any ear disease or ear problem in the past).

B- Specialized Tests:

1- Pure tone Audiometer:

In most patients where hearing assessment is needed, pure tone audiometry will give all the information required. Testing should be carried out in a sound proof room. Each is tested separately for air and bone conduction through the frequency range 250 Hz to 8 KHz.

2- Typanometry:

Normally, clinical examination of the tympanic membranes is sufficient to show the typical changes of retraction and middle ear fluid in sero - mucinous otitis media. The presence of a negative middle ear pressure and fluid in the middle ear may also be confirmed by use of the impedance audiometer.

Results

A total 85 persons ; 35 females and 50 male .involving 62 exposed persons " composed 40 male and 22 female" and 23 non exposed persons "composed 10 male and 13 female" randomly selected examined in textile industry . A total 40 persons ; 14 females and 26 male .involving 28 exposed persons " composed 18 male and 10 female" and 12 non exposed persons "composed 8 male and 4 female" examined in Dental laboratory. Table (1), shows distribution of the sample examined in Erbil city. Most of workers worked on average a 36 h in a week (6 h/ day; 6 days / week).

Table (1): Distribution of the persons examined eudiometrically.

Total no. of persons.	Exposed persons: N=62		Non Exposed persons: N=23	
	Male	Female	Male	Female
Textile industry/85	40	22	10	13
Dental laboratory /40	18	10	8	4

The noise levels in the factories ranged between 75 and 105 dB (A). It exceeded the 105 dB (A) criterion adopted in the Hole Textile, 85 dB (A) in the mechanical room, 75 dB (A) in the prepared textile and 95 dB (A) in the Brim room. Both exposed and non exposed persons worked in those places are never used hearing protection devices.

Hearing threshold levels: It was found that the distribution of the data (hearing levels) of all persons was positively skewed. No statistically significant difference was found ($P > 0.01$) between right and left ears of mean hearing threshold (HTL) in both exposed and non exposed persons (table2&3) ,(figure1).

Table (2): Comparison between right & left ears of total exposed & non exposed persons. (Textile factory)

Frequency Hz	Exposed persons N=62		Non - exposed persons N-23	
	Mean (HTL) /dB	Mean (HTL)/dB	Mean (HTL) /dB	Mean (HTL) /dB
	Right ears	Left ears	Right ears	Left ears
250	15	15	10	5
500	15	15	10	10
1000	20	25	10	10
2000	30	30	20	15
4000	55	60	10	10
8000	35	35	5	5

Table (3): Comparison between right & left ears of total exposed & non exposed persons. (Dentals)

Frequency Hz	Exposed persons N=28		Non - exposed persons N-12	
	Mean (HTL) /dB	Mean (HTL)/dB	Mean (HTL) /dB	Mean (HTL) /dB
	Right ears	Left ears	Right ears	Left ears
250	20	30	20	30
500	20	30	20	20
1000	20	30	20	25
2000	20	20	15	25
4000	40	50	15	20
8000	35	30	5	15

After controlling age affect through stratification figure (2), table (4), the T- Test showed that the mean threshold of the exposed persons was still significantly worse ($P< 0.01$) than that of the non-exposed persons at all frequencies tested. The differences between exposed and non exposed persons were more significant at the frequencies 4 and 8 KHz ($p< 0.01$).

Table (4): Mean hearing thresholds of exposed persons and non exposed persons in different age groups.

Frequency Hz	Age (20-29) years		Age (30 -39) years		Age (40-49) years		Age (50 -59) years	
	Mean (HTL) /dB		Mean (HTL) /dB		Mean (HTL) /dB		Mean (HTL) /dB	
	Exposed	Non-Exposed	Exposed	Non-Exposed	Exposed	Non-Exposed	Exposed	Non-Exposed
250	5	0	20	0	20	5	25	0
500	10	5	25	5	20	5	25	0
1000	10	5	25	5	15	10	25	5
2000	10	5	25	10	5	0	30	10
4000	40	5	40	5	50	10	50	5
6000	5	5	20	5	15	5	35	5
8000	5	0	10	0	10	0	20	0

Analysis of variance showed there was no interaction between the noise exposure and the age effect at any of the six frequencies tested indicating that the effect of factors is additive. The effect of noise on hearing was statistically significant ($P < 0.01$). This means that at every frequency tested the exposed persons had worse measured hearing threshold values than the non exposed persons regardless of age. The effect of the age was also statistically significant ($p < 0.01$) for all frequencies. This indicates that as age group increased , the mean of the measured hearing threshold values increased too , whether the persons were exposed to noise or not .

Table (5&6), figure (3), show threshold shift for differing durations of exposure, the mean of measured hearing threshold values increased with increasing the duration of the work.

Table (5): Noise induced threshold shift for differing duration of work exposure.

Frequency Hz	(1-5) years.	(6-10) years.	(11-20) years.	(21-30) years.
	Mean (HTL) /dB N=18	Mean (HTL)/dB N=8	Mean (HTL) /dB N=17	Mean (HTL) /dB N=19
250	0	10	20	20
500	0	10	20	25
1000	5	10	20	25
2000	5	10	20	30
4000	10	25	40	55
6000	5	15	30	45
8000	0	10	25	30

Table (6): Shows the relation between the severities of deafness to duration of exposure to noise.

Degree in /dB	(1-5) years.	(6-10) years.	(11-20) years.	(21-30) years.
Mild (10-30)	0	6	5	6
Moderate (30-60)	0	2	11	12
Sever (60-90)	…	…	1	1
Total (>90)	…	…	…	…

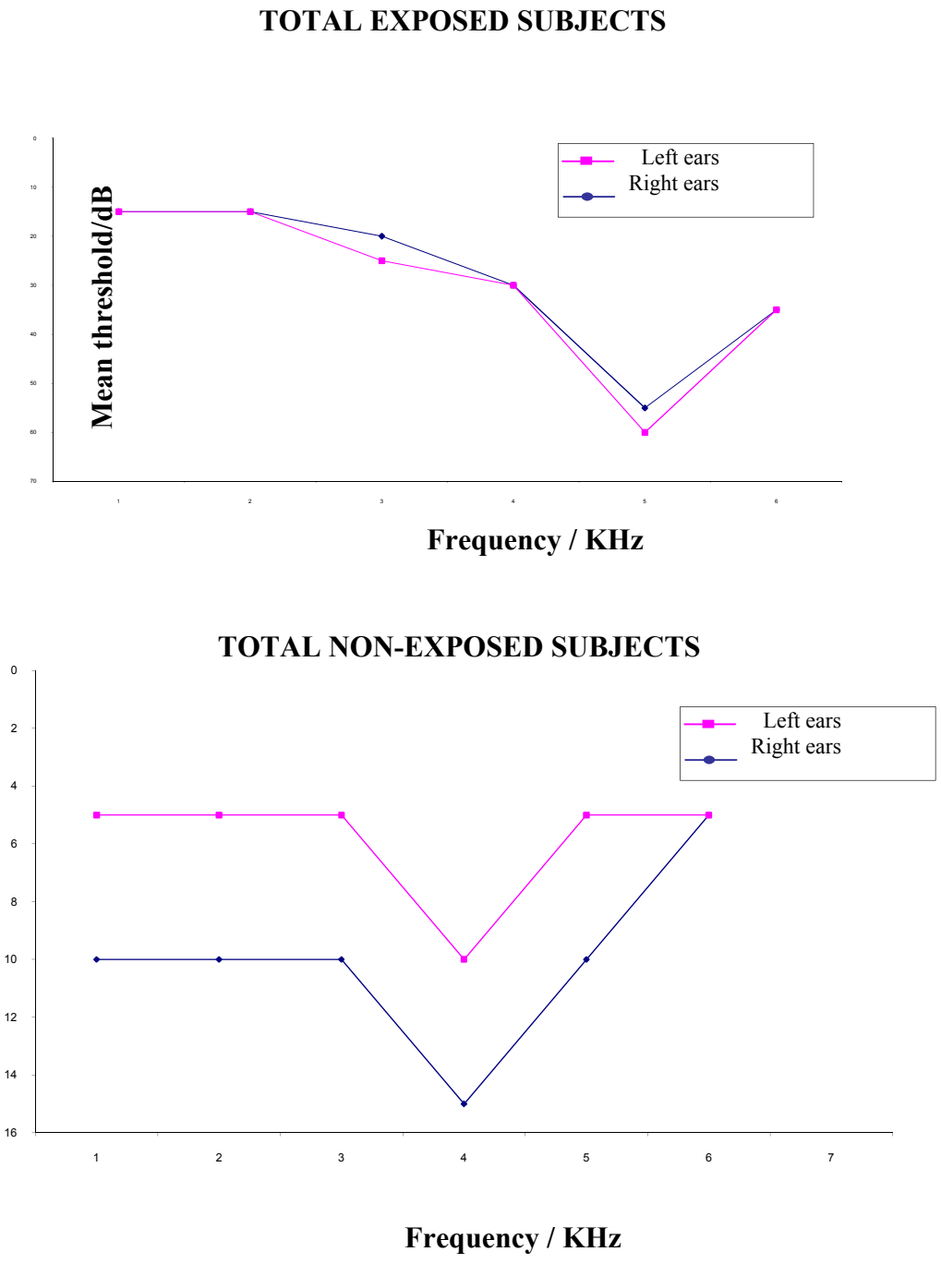

Fig (1): Comparison between right and left ears of total exposed (upper) and non-exposed subject (lower)

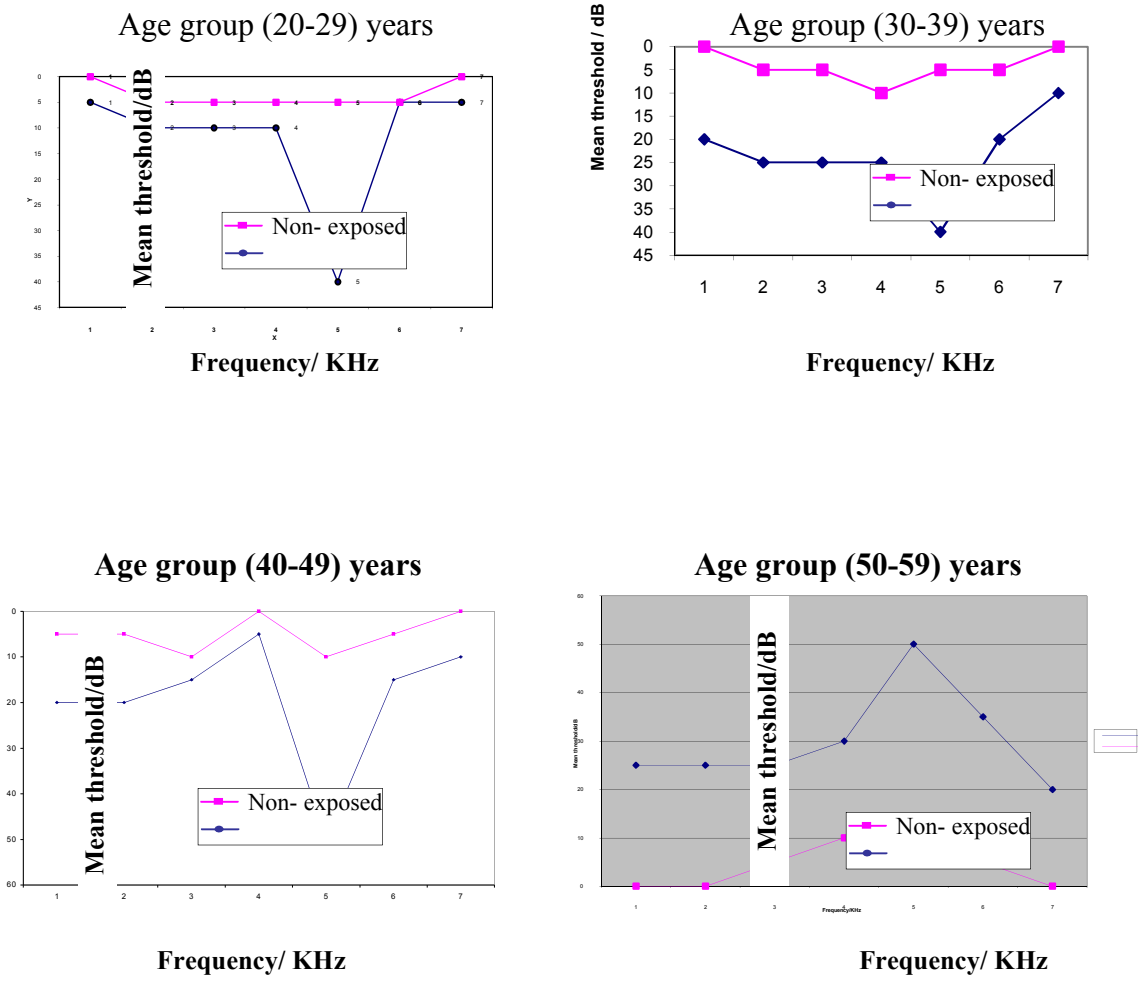

Fig (2): Mean hearing threshold of exposed subjects and non-exposed subjects in different age groups.

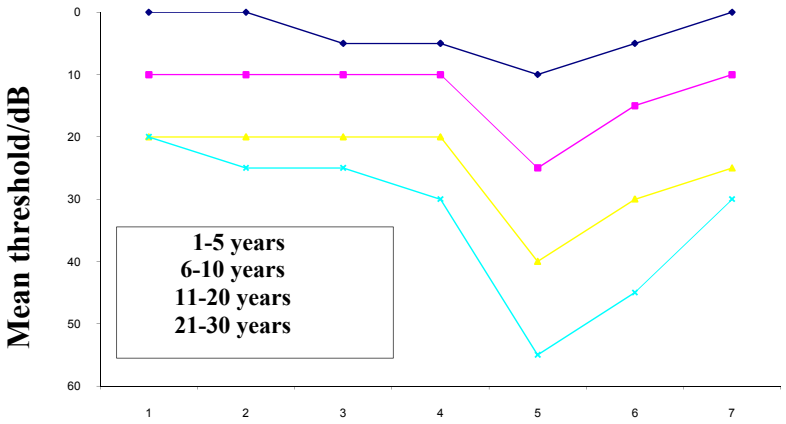

Fig (3): Noise induced threshold shift for differing duration of work exposure

Discussion

No significant difference was found between right and left ears of the exposed subjects. This finding indicates that the adverse noise effect is generally bilateral and symmetrical, as defined by Alberti [9]. The occurrence of hearing loss as a result of prolonged exposed to a noise level greater than 85 dB (A) with out ear protection is well documented in the literature [10,11,12]. The present study also found that subject exposed to daily greater than 85 dB (A) had significantly higher mean thresholds than the non-exposed across frequencies tested. The difference between the two groups was attributed to occupational noise exposure as this was the sole hearing risk factor in which the exposed group differed from the non exposed group after controlling for age.

The results of this study are in agreement with previous studies that noise induced hearing loss predominantly affects frequencies between 4 & 8 KHz [13,14,15,16,17,and 18]. The present study found , on a group basis (mean threshold) , a maximum hearing loss (dip) localized at 4KHz , followed by a recovery at 8KHz without the inclusion of frequencies 5 & 6 KHz , it is difficult to conclude that

noise - induce hearing loss can be maximal for some individuals at 8 KHz . However this finding may suggest that for some individuals the maximum hearing loss is not at 4 KHz. The investigators believe that if the frequency where the maximum hearing loss localized is determined on individual basis and if the audiometry is extended beyond 8 KHz, the pattern of the audiogram will be different.

The results of this study in this aspect is agreement with the conclusion of Irwin [19] that the location of maximum hearing loss on the audiogram may depend on factors other than a single measure of dB(A) intensity , including the type of the noise , the physical characteristic of the noise , duration of exposure , and individual variation .

In this study found that no interaction between noise exposure and age, the effects of them are additive is in agreement with findings of the previous studies [20,21] but in contrast to the finding Novotny [22] of that no additively occurs between the two variables. In this study 30 percentage of the total exposed subjects claimed to have tinnitus, compared to none within the non -exposed [23, 24, 25, 26].

The effect from impulse sound can be instantaneous and can result in an immediate hearing loss that maybe permanent. The structures of the inner ear may be severely damaged. This kind of hearing loss may be accompanied by tinnitus.... ringing, buzzing or roaring in the ears or head which may subside over time. Hearing loss and tinnitus maybe experienced in one or both ears, and tinnitus may continue or intermittently throughout a life time.When damage first occurs, it usually effects the part of the ear corresponding to the higher frequencies of the voice, creating a "noise notch ". These frequencies respond to many of the consonant sounds and a person with this type of hearing loss may have trouble understanding speech [27].Also the symptoms of NIHL that occur over a period of continuous exposure increase gradually sounds may become distorted or muffled , and it may be difficult for the person to understand speech . The individual may not aware of the loss, but it can be detected with a hearing test. However this study

has same result in (National Institutes of Hearing & the word health organization).

People assume that if the symptoms go away, their ears have "bounced back" to normal. This is not nearly true. Even if there are no more symptoms, some of the cells in the inner ear may have been destroyed by the noise. The hearing returns to normal if enough healthy cells are left in inner ear. But we will develop a lasting hearing loss if the noise exposure is repeated and more cells are destroyed [28].

Studies by another worker [29] involve potential drug therapies for NIHL. For example, scientists are studying how changes in blood flow in the cochlea affect hair cells. When a person is exposed to loud noise, however, a drug that is used to treat peripheral vascular disease (any abnormal condition in blood vessels outside the heart) maintains circulation in the cochlea during exposure to noise.

The National Institute for Occupational Safety and Health (NIOSH) [30] has established standards for noise exposure that are based on the best available research. These standards are used to indicate what length of exposure to, what strength of sound will result in a measurable, permanent hearing loss. According to these standards, exposure to sound at 85 dB over a single 6-hour period can cause measurable permanent hearing loss and is agreement with the result of the study.

This cross sectional study examined the prevalence of hearing problems in dental laboratory by means of a self -report questioner. Although the response rate for this study was good, one of the major limitations of this type is that participants are self - selected which may lead to a form of selection bias influenced non - responders . if ears are exposed to any loud noise for long time hearing ability will be permanently damaged. [31,32,33]

Conclusions

1-This study has clearly shown that the workforces within factories are at high risk of developing noise induced hearing loss due to excessive occupational exposure to noise.

2- Hearing loss was found to be bilateral and symmetrical in exposed subjects.

3-Analysis showed a significant hearing loss in the exposed subjects with a characteristic dip at 4 KHz.

4- Analysis indicated exposure to noise was the primary, and age the secondary predictor of hearing loss.

5- Hearing conservation program could be usefully established within the textile factory. The components of which might include; Noise assessment, hearing protection devices, education to raise the awareness of employees about the adverse effects of noise.

6- The hearing problems among dental personal are not of severe nature.

7- Hearing problems can happen due to dental field noise.

Recommendations

The highest average sound level a worker can be exposed to is 75-105 dB (A) averaged over an 6 hour work day. When this is identified , employee exposure will be reduced through the use of:

1- Administrative controls: (i.e. rotating workers duties to decrease exposure time, posting sign in high noise areas and requiring the use of hearing protectors). 2- Engineering controls: (i.e. install noise mufflers, increase maintenance and repair, use of quieter machines, enclose noisy areas and change the equipment or process).

3- Personal protective equipment (PPE) (ear muffs and plugs):

PPE will be used only when administrative or engineering controls fail to effectively reduce noise exposure, during implementation of engineering controls, or when engineering controls are not feasible. Hearing protection devices decrease the intensity of sound that reached the eardrum. They come in two forms: ear muffs and ear plugs, properly fitted earplugs or muffs reduce noise 15 to 30 dB. The better earplugs and muffs are approximately equal in sound

reduction, although ear plugs better for low frequency noise and ear muffs for high frequency noise.

4- Establish an audiometric testing program and periodic check up by otologist and form ENT when any ear symptoms stated to appear.

5-Dental fiald team should have ear protectors to reduce the hazards of dental field noise for long periods daily.

References

1- Francis B. Quinn , Jr., MD : Noise indused hearing loss. In, Grand Rounds Presentation, UTMB, Dept.of Otolaryngology ;(2001).

2- H.O.Ahmed , J.H.Dennis , O. Bardran,M.lsmail, S.G.Ballal, A. Ashoor and et al : " Occupational noise expsure and hearing loss of workers in two plants in eastern Saudi Arabia" ; (2001) , Vol. 45 , No. PP. 371- 380, British Occupational Hygiene Society, printed .

3- Peter M. Rabinowitz, M.D., M.P.H.: Noise induced hearing loss. Yale university school of medicine ; (2000).

4- Dobie R.:" Noise induced hearing loss and noise exposures in the construction industry". British ; (1995).

5- American Acad emy of family physicians: Noise induced hearing loss ; (2000).

6-Bahannan S,el-Hamid AA,Bahnassy A. Noise level of dental handpices and laboratory engines. J Prosthetic Dent 1993;70:356-360.

7-Setcos JC,Mahyuddin A. Noise level encounterd in dental clinical and laborator practice . Int J Prosthodont 1998;ii:150-157.

8- Maico diagnostic industry :," Operating Instruction MA- 53 "; (2000).

9- Alan G. Kerr :" Scott Browns ", Otolaryngology ,six edition , Queens university , Belfast; (1997).

10- Albert! PW. ,Noise and ear : In Stephens D.editor . Scott Browns Otolaryngology (Adult audiology) ,Vol.2. London : Butterworth- Heinemann ; (1988). P. 594-641.

11- Berger EH., Royster LH., Thomas WG: " Presumed noise induced permanent threshold shift resulting from exposure to an A - weighted Leq of 89 dB ". Journal of the Acoustic Society of America ;(1978), Vol. 64 , P. 192-198 .
12 - Dbbie RA :" Industrial audiometry and the otologist". Laryngoscope ; (1985)
13- World Health Organization ;" Preventation of deafness and hearing impairment". atahirty Ninth Health Assembly; (1986).
14- Nixon JC, Glorig A: "Noise induced permanent threshold shift": Journal of the Acoustic Society of America; (1961).
15- Burns W. Noise and Man: London Murray; (1973).
16- Kenney GD, Aayer HF :Noise exposure and hearing levels of workers in the sheet metal construction traders . American Industrial Hygie Association Journal; (1975).
17- Shida S, Yoshida M : Clinical observation on the dip location of industrial deafness and physiological considerations on the dip origin (in Japanese with English summary). Nippon Jibiinkoka Gakkai Kaiho ;(1990).
18- Bauer P , korpart K , Neuberger M , Raber A.Schwetz F : Risk factors for hearing loss at different frequencies in a population of 400 noise - exposed workers . Journal of the Acoustic Society of America; (1991).
19-Celik 0, Yalcin S , Ozturk A: Hearing parameters in noise exposed industrial workers . Auris Nasus Larynx; (1998).
20- Irwin J: Niose - Induced Hearing loss and the 4KHz dip . Occupational Medicine ;(1994).
21- Macrae JH : Noise induced hearing loss and presbycusis . Audiology ;(1971).
22-Chen TJ. Ching HC, Chen SS: Effects of aircraft noise on hearing and auditory path way function of airport employees . Journal of Occupational Medicine;(1992).
23-Novotny Z: Development of occupational deafness after entering into a noisy job at an advanced age . Cesk . Otolaryngology ;(1975).
24-Dilys J. : Noise induced hearing loss; (2001).

25- Albrti PW ; Tinnitus in occupational hearing loss . nosalogical aspects . Journal of Otolaryngology ;(1987).
26-Mcshane DP, Hyde ML, Alberti PW: Tinnitus prevalence in industrial hearing loss compensation claimants otolaryngology;(1988).
27-Phoon WH, Lee HS, Chia SA:Tinnitus in noise exposed workers . Journal of occupational medicine ;(1993).
28- Ylikoski ME, Ylikoski JS: Hearing loss and handicap of professional soldiers exposed to gunfire noise. Scandinavian work and environmental health ;(1994).
29- National Institutes of health and the world health organization: Noise induced hearing loss, medical college of Wisconsin ;(2003).
30- dark, w.w. and B.A. Bonne : Effect of noise on hearing ; (1999).
31-Occupational safety and health administration ,US Department of labor. Hearing Conservation, OSHA 3074,2002.
32- Coles RR,Hoare NW. Noise –indused hearing loss and the dentist. Br Dent J 1985;159:209-218.
33-Khalid A.Alwazzan,et.al " Hearing problems among dental personal'' , J.PDA Vol.14 No. 4 OCT-DEC 2005 .