

# Noise induced hearing loss (NIHL) in wasit corporation textile industries

## Abstract

**Background:** Noise Induced Hearing Loss (NIHL) is used to symbolize accumulative and persistent hearing loss due to progressive exposure to high levels of noise for months or year.

**Design:** A cross-sectional study.

**Setting:** Al-Karama Teaching Hospital and Wasit Co. Textile Industries.

**Aims and objective:** To specify frequency of hearing loss among workers in the knitting industry, to registration the level of the noise in the weaving department and to specify the realization about the impact of noise on the hearing.

**Materials and methods:** From June to August 2011, the level of noise in the weaving department has been recorded. 200 workers had been sent to our hospital, interviewed according to already prepared questioner and audio logically assessed.

**Results and discussion:** The mean level of noise at 12 measurement points was 87-96dB. Which was greater than the allowable noise level for continuous 8 hours working per day? It has been established that 113 workers had NIHL, 29% of hearing loss (the greater percentage) was in the mild category (26-40dB) at high frequency (4-6KHz) group and the minimal NIHL notch within 2 kHz and 4KHz were 6% and 22% from the workers respectively. The hearing difficulty was not the most common complaints 29.4%, while ear discomfort was 55.4% and tinnitus was 43%, because NIHL usually include the high frequencies at first hence the worker can promote the NIHL and he didn't complain from loss of hearing. No one used the personal noise protective devices (PPD) and only 44 workers (24%) (P-value  $\leq 0.1$ ) who considers that the noise is a hazard on health.

**Conclusion:** Wasit Co. Textile Industries Noise measurement is greater than the allowable noise scale for 8 hours. NIHL can be developed many years before worker will complain from hearing loss.

**Keywords:** NIHL, textile industries, SNHL, tinnitus hearing loss, noise, audiometry techniques, audiology, speech frequencies

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## Introduction

Hearing harm caused by NIHL arises from changes on internal structure of cochlea that cause permanent damage and symptoms such as tinnitus, hypoacusis, auricular profusion and ear pain. Higher noise levels more than 85 dB for continuous 8 hours/day with long period are sufficient to cause damage of cochlea.<sup>1</sup> Noise is the most dangerous of all the industrial pollutants, including all industries and leading to cause severe loss of hearing worldwide. Loss of hearing due to occupations, includes noise induced loss of hearing, traumatic acoustic injury, and defined as a complete loss of hearing or partial loss of hearing in one ear or in both as the result of one's job. Subjection to extreme noise is the great preventable reason of persistent hearing deterioration in all countries of the world, Noise Induced Hearing Loss is a significant public health preference because as peoples live longer and industrialization spreads, Noise Induced Hearing Loss will insert ultimately at the universal load of inability. In numerous regions, exaggerated noise is the largest occupational compensatable risk. Global, occupational noise represent about 16% of the incapacitate loss of hearing in adults, which ranging from 7%-21% in the different sub-regions.<sup>2</sup> In developed countries the calculated cost of the noise extent from 0.2%-2% of the gross domestic product (GDP), where it

is the cause of  $>1/3$  of the hearing loss. The effects of the exposition to occupational noise are elevated in the developing regions.<sup>3</sup>

There is reducing of epidemiological information on expansion, costs and risk factors of Noise Induced Hearing Loss in Iraq. Noise Induced Hearing Loss (NIHL) is generally used to indicate that the accumulative exposure to high levels of noise after months or years lead to permanent hear loss. It has been known that the problem in occupations related to eminent noise. The 2nd most popular form of gained loss hearing is Noise Induced Hearing Loss after age-related loss (presbycusis), workers who are exposure to noise with higher levels than 85db tolerate from Noise Induced Hearing Loss as showing by studies.<sup>4</sup> A typical Noise Induced Hearing Loss which involving injury to the inner ear is a sensory neural type. It is symmetrical and bilateral, affecting the higher level frequencies (3k, 4k or 6kHz) and then expanded to the lower level frequencies (0.5k, 1k or 2kHz).<sup>5</sup> At high level frequencies, failure of sense hearing will initially intervene with daily activities, loss of clarity in recognized speech and then loss of hearing progresses. Symptoms which correlated to hearing loss, such as disturb in telephone and normal discussion, elevating up volume of the television, radio and tinnitus, usually happen in the early stages of Noise Induced Hearing Loss.<sup>6</sup>

Noise Induced Hearing Loss diagnosis is done by taking history of exposure to high level noise environment, ENT examination by Otoscopy and audiometry. The continuous exposure to high levels of noise leads to gradual hearing loss in a period from 6-10years. Physical and Otoscopy examinations are normal. Examination by audiometry always detects that permanent loss of hearing, symmetric in general and sensor neural, in frequencies from 2000 Hz-4000Hz.<sup>7</sup>

Away from Noise Induced Hearing Loss information of identification and protection programs used in manufactures, this pathology still appears a serious troubles of occupational health, especially in knitting industries. Studies by Gitau et al.<sup>8</sup> Nguyen et al.<sup>9</sup> Berlachew and Berhane,<sup>10</sup> Osibogun et al.<sup>11</sup> and Shakhathreh et al.<sup>12</sup> showed a high spread of in subjects from knitting industry. The number of workers and peoples exposed to noise has been expressively increasing duo to the presence of the high number of industry in Brazil. Therefore, it is important to monitoring the hearing of workers, early diagnosing and preventing of Noise Induced Hearing Loss through a program of hearing conservation.

## Materials and methods

Across sectional study was conducted in weaving section of Wasit Textile Factory. It was initiated and data collected from June-August 2011 by convenient sampling. The study included 200 exposed workers to noise (representing about the 1/3 from the whole number of workers in knitting section), through randomizing sampling technique. As Noise Induced Hearing Loss needs about five years to be developed, excluded criteria was; the employees whom working was less than five years period.

During visiting the factory and the acceptance of the chief manager was taken the level of equivalent sound pressure was measured with the assistance of a Class-1 digital type sound level meter (Model NA-20, Rion, Digital, China), measurements of noise were done in 12 points at the pathways in between machines where the workers doing their jobs. All those 200 workers were brought up as groups in 10workers/day to the Audiology unit in Al Karama Teaching Hospital, to be examined.

## Interview and questioner filling

All the members of staff were personally meet with them. Meeting items done according to already prepared questionnaire paper which consisted of age, chief complain of employment, education level, residency, work department, noise exposure duration, personal symptoms, associated chronic illness, uses of the personal noise protective devices (PPD), smoking and food habits, and did they consider the noise is a hazard on health or not? The interviews were

conducted by trained nursing staffs that also did the Audiometric assessments for the workers. Hearing estimation of the workers was assessed through a clinical examination by (WEBER, WHISPER, and RINNE'S) test, and Pure Tone Audiometer.

## Audiometric test

After the using of otoscope, to exam the tympanic membranes of workers clinically, audiometric test were carried out. Those workers who have ruptured tympanic membranes (chronic otitis media- CSOM) consisted of 12workers, 4 had pervious acoustic trauma, and they were all excluded from the study. So the net total workers number of whom underwent the Audiometric tests were (n=184workers. The test was carried out before the workers undertake their work shift in order to inhibit pollution of hearing level figures with interim shift threshold due to exposure to recent noise. After the workers instruction, the audiometric test was done by using the (5dB-step method). The used audiometer (Model AD226, Amplid, Italy) was standardized before and after testing of the subjects. All tests for hearing were done by the selfsame researchers whom well trained on audiometric techniques.

## Statistics

To locate the relative importance of various variables, P-value $\leq$ 0.05Chi-square test was done and considered as significant statistic value and $\leq$ 0.01as highly significant.

## Results and discussion

### Measurement of noise

At the 12 measurement point sites, in knitting section, the mean level of noise was 87-96dB which is more than the allowable level of noise for continuous 8 hours daily working according to the OSHA.

### The Audiometric evaluation

The pure tone Audiometer: which done to ( n=184) worker shown as distributed in Table 1 & Table 2 for the right ear and left ear respectively, there were 113 hearing loss shown left ear in high frequency which reflect the real clinical apparent hearing loss worker (because all worker with R ear NIHL were bilaterally affected) and this (n1=113) will be used in all below statistics as the (n1 )to be compared to other values. The distribution of Noise Induced Hearing Loss in High frequencies(n1=113) by age groups were studied shown as in Table 3 and Figure1 which demonstrate the increasing in NIHL with age increasing and duration of exposure to noise per years of work. In this study: We found that only 34worker were from rural area while 150worker were from urban areas, while (n1=113) distribution appear to be 8 and 105worker among the rural and urban workers respectively as shown in Table 4.

**Table 1** The findings in the audiometric of the right ear

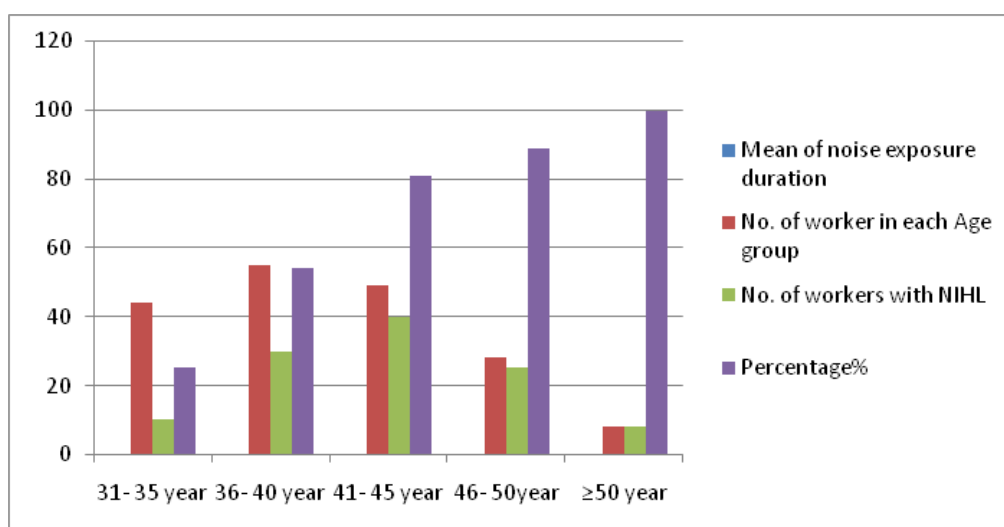
Audiometric findings	A Speech frequency	B High frequency	Percentage%
Normal	149	79	41%
Mild	25	45	25%
Moderate	4	34	17%
Moderately sever	5	11	6%
Sever	1	15	6.60%
Total hearing loss	35	105	
2kHz Notch		11	6%
4KHz Notch		41	22%

**Table 2** The findings in the audiometric of the left ear

Audiometric findings	A Speech frequency	B High frequency	Percentage%
Normal	141	71	38.50%
Mild	33	53	29%
Moderate	6	37	20%
Moderately Sever	3	11	6%
Sever	1	12	5.20%
Total hearing loss	43	113	
2k Hz Notch		11	6%
4K Hz Notch		41	22%

**Table 3** Distribution of the NIHL in high frequencies (n=113) by age groups and duration of noise exposure

Age group	Mean duration of exposure to noise	No. of workers in age groups	No. of workers with NIHL	Percentage%
31-35year	6year	44	10	25%
36-40year	11year	55	30	54%
41-45year	16year	49	40	81%
46-50year	21year	28	25	89%
≥50year	24year	8	8	100%



**Figure 1** Distribution of the NIHL in High frequencies (n=113) by age groups and duration of exposure to noise.

**Table 4** Distribution of the NIHL in High frequencies (n=113) according to their residency.

Residency	No. of workers	No. of workers with NIHL	Percentage %
Rural	34	8	23.50%
Urban	150	105	70%
Total No.	184		

The chief complaint regarding their ears had been survey also as shown its distribution in Table 5 and Figure 2 which demonstrate 54, 80, 108 and 55 worker complained from hearing difficulty, tinnitus, Ear discomfort and Vertigo/dizziness respectively.

**Table 5** Distribution of workers depending on their chief complaint

Chief complaint	No. of worker	Percentage%
Hearing difficulty	54	29.40%
Tinnitus	80	43.50%
Ear discomfort	102	55.40%
Vertigo/ dizziness	55	29.90%

The questioner also gave results about the No. of workers who have Vitamin uses, Special Diet uses (Garlic as example of Antioxidant food staff), uses of personal noise protective devices (PPD), Did not consider the noise as a hazard on health, all results are

seen in Table 6. Which demonstrate that? The smoking habit (mild, moderate or heavy) distribution among the workers and the influence of the smoking on the incident of Noise Induced Hearing Loss can be shown in Table 7. The questioner paper contained many other items which were asked to the employees, and the most remarkable thing which this study considered it as one of the aims are the Associated

chronic illness( HT, IHD, RF) as shown in Table 8. The questionnaire which done by the trained medical staff also got the distribution of the workers depending on their education level which shows 64, 100 and 16 workers distributed among primary, secondary and University Education level as can be detected in Table 9.

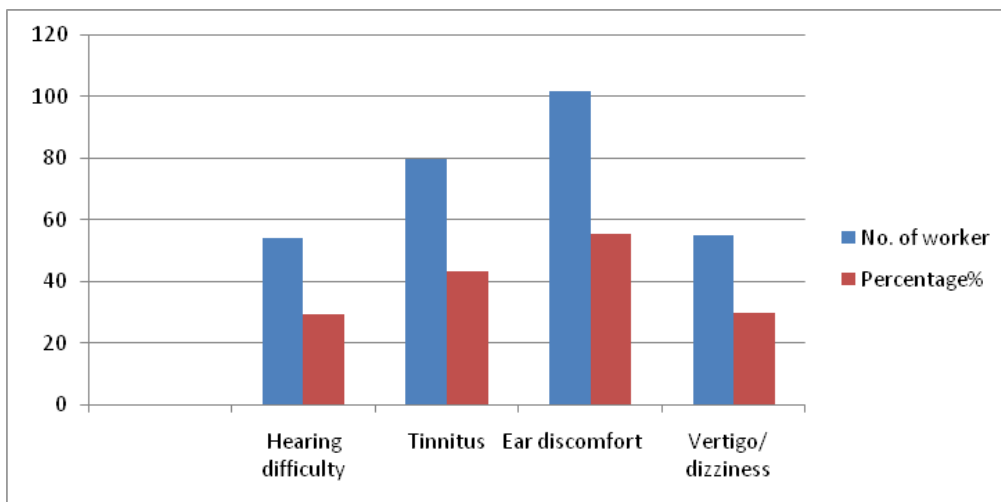


Figure 2 Distribution of workers depending on their chief complaint.

Table 6 Correlation between No. of NIHL (n1) and special diet, Vitamin uses and uses of (PPD)

Items	No. of worker	No. of NIHL worker	Percentage%
Vitamin uses	8	2	25%
Special Diet uses (Galic...)	40	10	25.50%
uses of personal noise protective devices (PPD)	0		
Did not consider the noise as a hazard on health	44		24%

Table 7 Distribution of workers depending on the habit smoking and correlation with NIHL

Type of smoking	No. of workers	No. of NIHL worker	percentage
mild	3	3	100%
moderate	4	4	100%
heavy	62	62	100%
Total	69		

Table 8 Distribution of workers according to their specific questioner items

Other questioner items	No. of worker	No. of NIHL worker	Percentage %
Family history of loss of hearing	8	1	12.50%
Associated chronic illness( HT, IHD, RF	30	11	37%
Drug uses	20	11	55%

Table 9 Distribution of workers depending on their education level

Education level	No. of workers	Percentage%
Primary	64	35%
Secondary	100	56%
University	16	9%
Total	184	100%

At the 12 measurement point sites, in knitting section, the mean level of noise was 87-96dBspl. Which is more than the allowable level of noise for continuous 8hours working/day depending on the OSHA (Occupational Safety and Health Administration)<sup>13</sup> which seen as below; although a limited number of weaving machines are still working till now (about 50% of all machine is working) those because many of them stop their working due to decrease in products orders to the factory in last year's, the condition which may share in prevent increasing of accumulative noise of considerable number engines when working simultaneously.

Safe Sound Level: The guidelines of The National Institute for Occupational Safety and Health (NIOSH) are declared that the upper time limit that you can be safely exposure to many Time Weighted Averages (TWAs) of level sound pressure on a daily basis over a 40years period.

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

Exposure to 115+dB or greater may pose a serious health risk.<sup>14</sup> In this study, it was found that weavers in the knitting factory observed were insecure to dangerous noise levels, which are mean above 90dBA, the threshold limit value set and this was the first noise and loss of hearing survey. The assessment Audiometric showed that 113 worker (left ear) had loss of hearing in the high frequency while only 54 worker complained from hearing difficulty, because Noise Induced Hearing Loss usually include at first the high frequencies (which is commonly away from the speech frequencies), therefore the worker can develop the Noise Induced Loss of hearing and he didn't complain from loss of hearing, the workers may complain only ear discomfort or tinnitus which could be the only presenting symptoms as they were in our study 80 and 102 respectively. The hearing loss classify according to WHO (International Classification of Impairment, Disabilities and Handicaps).<sup>15</sup> As below:

Hearing Loss (dB)	Degree of Hearing Loss
>26	Normal Hearing
26-40	Mild
41-55	Moderate
56-70	moderately severe
71-90	Severe
>90	Profound

And in our study we found the greatest percentage of loss of hearing was in the mild/ high frequency group and the minimal Noise Induced Hearing Loss notch at 2kHz and 4KHz were 6% and 22% of workers respectively in our study, even though some of them hadn't symptoms.

According to<sup>16</sup> show that the Noise Induced Hearing Loss ratio was remarkably more common on the exposed workers and it is not possible to found any clear cut difference between unsafe and safe exposure to noise. In general, restrict a reset with increase of the protecting to 90% or more of an exposed population.<sup>16</sup> David M Barrs et al they found that the minimum Noise Induced Hearing Loss notch at 3-6kHz in about 1/3rd of the workers (37%) in their study they hadn't symptoms.<sup>17</sup> It is reasonable now that the risk damage of hearing is negligible at noise levels of less than 75dB(A) for 8hours daily continuous exposure and even exposure at levels up to 80dB(A)

there was no obvious increase in the percentage of workers with loss of hearing<sup>18</sup> there was difference between worker in units level below 80dB(A) and the other groups of workers exposed to (80-85dB(A), above 85dB(A). it was shown that Noise Induced Hearing Loss prevalence on subjects exposed to noise level below 80dB(A) was not insignificant (grade 3:32.43% and grade 4-5:10.18%)(15). Non-existence of noise-reduction measures and no using of the protective devices, might explain the high spread of the Noise Induced Hearing Loss in Meliksah et al study.<sup>16</sup>

In our study we show that there was a strong association between Age of worker/the duration of exposure to the noise of employment and hearing level, when it was 89% and 100% for the late two age groups the( 46\_50 year) and (≥50) giving the p-value≤0.05 and≤0.001 respectively. According to Barrs MB<sup>19</sup> the influence of age has another effect on the primary noise induced hearing loss.<sup>17</sup> Always these investigations it was established that the duration of occupation was the most definitive cause for obvious increase hearing loss.<sup>19</sup> In order to show the influence of noisy environment, age factor must be regulated. Ivarsson A et al.<sup>20</sup> show that age can only regard as insignificant amount of variability across the subjects in their tendency to Noise Induced Hearing Loss.<sup>20</sup> U.G.Olero et al declare that hearing threshold for the exposed workers increased with both age and duration of occupation and were significantly corresponding to ( $r=0.26$ ,  $p\leq 0.05$ ) with duration of occupation.<sup>21</sup> Gunter Rosler found that combination of eleven investigations by many authors regarding the advancement of hearing retro gradation during severe long-term exposure to noise.

Günter Rösler found a weak correlation between duration of employment and hearing level. This might be explained by the long duration of employment. While according to<sup>16</sup> the majority of the workers' occupation durations were>ten years. It should be significant to comparison between the first attending hearing levels with today hearing levels but we had no data about the levels of hearing of the workers' before they had presented to the factory many years ago. In our study we found that 69 workers were smokers distributed among mild, moderate and heavy smoking types making a 38% of the smoker worker out of 184 workers ( $p\text{-value}\leq 0.05$ ) which might indicate a strong relation also between smoking and the enhancement of NIHL occurrence. According to Cruickshanks KJ et al it: the smoking increased the chance of loss hearing about doubled, as seen similarly in many smaller groups of studies<sup>22-24</sup>

Cruickshanks KJ found that diabetes increased the chance of loss hearing by double fold, giving more information about the effect of diabetes on the loss of hearing.<sup>25-27</sup> Cruickshanks KJ study also prove that a significant relation between noise exposure particularly firearm exposure to noise and hearing loss.<sup>28-31</sup> The effects of these specific frequency exposures further refines their knowledge of these relations.<sup>32</sup> Diabetes and smoking were significantly related with loss of hearing across the frequency spectrum (affecting the cochlea in the inner ear from the apex to the base). In contrast, only in high frequencies noise exposure was significantly associated with loss of hearing.<sup>33-35</sup>

In our study 30 workers they had an associated chronic illness (DM or IHD), only 11 (37%) workers out of them showed NIHL ( $p\text{-value}\leq 0.05$ ) which might indicate a strong relation between diabetes/or Ischemic heart disease and the enhancement of NIHL occurrence. In our study no one of the survived workers used the personal noise protective devices (PPD) and only 44 workers (24%) ( $p\text{-value}\leq 0.1$ ) who considers the noise as a hazard on health, and

this represent a small group who can be regarded as a well cultured people against pollution and NIHL. Moreover there was no distinction or impactation of the level of learning upon the use of special noise protective devices (PPD) where Table 9 Show us that we got adversity of level of learning among the workers. In spite of that it was not the case in (PPD) application study done by Pranee Chavalitsakulchai et al.<sup>36</sup> who found that usage of the personal noise protective devices (PPD) in 469 weaving workers were checked. 215 workers (45.8%) claimed that they often use (PPD), 73 workers (15.6%) sometimes use (PPD), and 181 workers (38.6%) never use (PPD).

There was no variation in average length of appointments among these groups shows the reasons why 181 workers never use (PPD). Discomfort was the most common reason. The “never use” workers group had considerable loss hearing at 2000Hz, 4000Hz frequencies ( $P<0.01$ ), 8000Hz resemble to the “often use” workers group. Compared with the “sometimes use” workers group, the level hearing of the “never use” group were considerably worse at the level of 2000Hz ( $P<0.01$ ), 4000Hz ( $P<0.05$ ), and at the level of 8000Hz ( $P<0.05$ ). A surprising finding was that the workers whom using PPDs also establishing to have loss of hearing. Loss of hearing appeared even in the group of workers who used the personal noise protective devices (PPD). The same occurrence was described in a Singapore stud5). One probable cause is that the personal noise protective devices (PPD) manufactured in the developed countries might not be well probable to Thailand workers. Another reason is that many workers use only plugs of cotton as (PPD) and they are not effective.<sup>36–38</sup> However in the Swedish industries it was clarified that, the more commonly use of the protectors of hearing and noise-reduction measures had reduced hearing damage to teeny workers.<sup>39–42</sup>

Regarding the utilize of special food staff, in this study it has been found that 40workers out of 184workers examined usually use garlic regularly within their food items, however 10worker ( 25.5%) who had NIHL were also use garlic regularly( $P<0.5$  ) which shows a week correlation. Clifford RE et al.<sup>43</sup> demonstrate that protective effects of antioxidant medicines on animal studies showed opposite to Noise Induced Hearing Loss and it is unclear whether antioxidants would protect humans from NIHL.<sup>43</sup> also performed a study to decide whether N-Acetyl-cysteine (NAC) preserve workers versus noise induced temporary threshold shift (TTS).<sup>43</sup> Considered that after continuous noise exposure to only DMET or both of low-dose DMET/ NAC a significant recovery of hearing was noticed, demonstrating a lot of small dose of antioxidants required than previously reported for hearing recovery following acoustic trauma.<sup>44</sup> While showed The administration of the antioxidants to animals in which free essential forming had already been reduced by previous injection of furosemide didn't have an extra preventative action on the NIHL.<sup>45</sup>

## Conclusion

- Noise measurement in the knitting department is more than the allowable level of noise for 8hours.
- The worker in Textile factories can promote the Noise Induced Hearing Loss and he didn't complain from loss of hearing. The tinnitus or ear discomfort could be the only complaining symptoms.
- There was a potent relation between Age of worker/the period of noise exposition of employment and hearing level.
- There was potent relation between diabetes/or Ischemic heart disease and smoking on one hand and the enhancement of NIHL occurrence on another hand.

- Only limited number of workers who can be believed educated against noise hazards.
- There was weak correlation between food containing antioxidant staff and occurrence of NIHL.

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Further and detailed studies are required regarding the relation between NIHL from one side and the chronic illness each specifically, the benefit of particular vitamins and special food items consumption on another side. We suggest the adoption of the next standard by manufactory or any other group where exposure to noise is dangerous to their employees:

- Periodical baseline audiogram and screening for all the workers.
- Special auditory preservation by utilizing safety apparatus.
- Engineering monitoring by preservation of equipment and machines, machines isolation, exchange of machines, damping supports and absorption of sound.
- Regularly monitoring by revolving occupations, transporting employees, and timetable machine work.
- Promoting the workers education to increase their knowledge of the risk of exposure to noise.
- Exposure to noise should be continuously analyzed and assessment.
- Persistent analysis of the efficiency of the hearing maintenance program.

## Conflicts of interest

Author declares that there are no conflicts of interest.

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