Original Article

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Prevalence of Noise-Induced Hearing Loss in Workers with Noise Exposure in Panyananthaphikkhu Chonprathan Medical Center, Srinakharinwirot University

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Abstract:

Objective: To determine the prevalence of noise-induced hearing loss (NIHL) in workers in Panyananthaphikkhu Chonprathan Medical Center, Srinakharinwirot University (PCMC). The risk factors associated with noise-induced hearing loss were evaluated.

Material and Methods: A cross-sectional study was conducted to analyze the data of 82 patients (43 males and 39 females) between June 2018 and July 2018. Subjects were between 20 and 59 years of age. All of them worked in loud environments in PCMC, using extended high-frequency audiometry (EHFA). The results of hearing loss in the group of EHFA and conventional audiometry were compared using the chi-squared test, McNemar's chi-squared test and Fisher's exact test. Multivariate logistic regression analysis was used for evaluating the risk factors.

Results: The prevalence of NIHL was 41.5%. The risk factors associated with NIHL were smoking [odds ratio (OR)=5.6, p-value=0.002 (95% confidence interval (CI)=1.66-18.86)] and age over 40 years [OR=10.38, p-value<0.001 (95% CI=2.82-38.24)].

Conclusion: Epidemic NIHL continues to increase in the workplace, particularly in individuals with an age of over 40 years who smoke. Early detection of this irreversible disorder of the inner ear should be attempted.

Keywords: extended high frequency audiometry, high frequency audiometry, noise-induced hearing loss, Thailand

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Introduction

Noise-induced hearing loss (NIHL) is permanent damage to hearing caused by prolonged loud noise exposure. However, this condition can be prevented with ear protection. NIHL is the second most common cause of hearing loss, second to only presbycusis. Patients with NIHL, whether from the general environment or the workplace, experience a permanent disability. It also causes significant loss to the nation because these people are usually working age.

Factors showing a statistically significant association with NIHL from previous studies were male, a history of smoking, but not a history of sensorineural hearing loss among relatives, age of more than 40 years, department, and duration of working years.[1] While the study of Siriboonrit et al.[2] found a significant correlation between NIHL and a duration of more than 10 working years, but not age, department, or use of hearing protection. However, Worrawannotai et al.[3] showed age and number of working years significantly increased the prevalence of NIHL. Conventional audiometry is the method that examines the pure tones at each of the frequencies, including 250, 500, 1,000, 2,000, 3,000, 4,000, 6,000 and 8,000 Hz and reports the hearing threshold in decibel hearing levels (dBHL) at each frequency. We may miss out on early hearing loss which occurs sooner with higher frequencies. Hearing testing that increases the frequency range of the examination will help with the early diagnosis of NIHL. Hence, ear protection from a loud environment could be initiated early.

The purpose of this research was to study the prevalence of NIHL in hospital personnel who work in a loud environment using conventional audiometry and extended high-frequency audiometry (EHFA). And to determine the risk factors associated with NIHL.

Material and Methods

A total of 82 participants (43 males and 39 females) were included in this study, which was conducted between June 2018 and July 2018. Subjects were between 20 and 59 years of age. All participants worked in loud environments with noise levels beyond the standard of 85 decibels hearing level (dBHA), including the Physical and Environmental Unit, Maintenance and Repairman Unit, Nutrition and Cooking Unit, Central Service Unit, and the Vehicle and Transportation Unit of Panyananthaphikkhu Chonprathan Medical Center (PCMC). None of the subjects were exposed to loud noise before the hearing test for at least 12 hours. Patuzzi[4] found that the recovery time of the temporary threshold shift in humans follows a multiple-exponential course of time, with a time constant for the onset of 800 minute. Thus, the subjects were required to avoided exposure to noise before being included in this study. The time limit was 12 hours prior to investigation by audiometry corresponding to the workers' normal work shift. After signing the informed consent, history taking (including noise exposure) and ear examinations were performed by otolaryngologists. Exclusion criteria: candidates with ear and hearing disorders, prior ear surgery or treatment with an ototoxic drug. The Ethics Committee of PCMC approved the study (PCMC No. 10/2561).

Audiometry was performed in an audiological room in accordance with the American National Standard Institute 2004, and standardized with the American Speech Language Hearing Association 1978, by the same audiologist. The hearing test was performed through air and bone conduction. The audio frequencies were 250, 500, 1,000, 2,000, 3,000, 4,000, 6,000, 8,000, 10,000, 12,000, 14,000, 16,000, and 18,000 hertz (Hz). The measurement technique was the ascending- descending 5-dB technique in both conventional and EHFA. All thresholds were calculated in dBHL. The instrument used for the study was the clinical audiometer, GSI AudioStar Pro™, 2012.

Diagnostic criteria for NIHL.

1. The conventional audiometric frequency is 250-8,000 Hz divided into:

a. Registered auditory impairment hearing loss 500, 1,000, 2,000 Hz when the hearing level is not more than 25 dBHL, but at 2,000-8,000 Hz, especially 3,000, 4,000, 6,000 Hz when the hearing levels are more than 25 dBHL.

b. NIHL results in a hearing impairment of more than 25 dBHL in the 500, 1,000, and 2,000 Hz and will worsen in frequencies above 2,000 Hz.

Criteria a. or b. were used in both ears as the diagnostic of NIHL.

2. EHFA detection occurs at the frequencies of 10,000, 12,000, 14,000, 16,000 and 18,000 Hz; it is abnormal when the hearing level is more than 20 dBHL at all measured frequencies.[5]

The EHFA was studied consecutively after conventional audiometry. The participants were placed into 4 groups by age: 21-30, 31-40, 41-50 and 51-60 years, work unit, duration of work, time of noise exposure (hours), underlying disease, social behavior, and protective behavior.

Categorical data were expressed as numbers and percentages. The results of hearing loss in the group of EHFA and conventional audiometry were compared using the chi-squared test, McNemar's chi-squared test, and Fisher's exact test. A p-value of<0.05 was considered to be statistically significant. Multivariate logistic regression analysis was used for exploring the relative contributions of the various risk factors. All statistical analyses were carried out using R Core Team (2018). R: a language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria.

Results

Of the 82 participants in the study (43 males and 39 females), ages were between 20 and 59 years. Thirty-three participants (41.5%) had NIHL by conventional audiometry. All of them had a drop of more than 20 dB in EHFA, which also gave them an abnormal result of EHFA. Thirty-three participants (40.2%) had abnormal EHFA alone, and 15 (18.3%) had no hearing impairment. Sensitivity of EHFA in the detection of NIHL was 100% (95% CI=89.72-100), specificity was 31.3% (95% CI=18.66-46.25) (Table 1), positive likelihood ratio was 1.5 (95% CI=1.20-1.76), positive predictive value was 50.8% (95% CI=45.99-55.49), and the accuracy was 59.8% (95% CI=48.34-70.44). Table 2 summarizes the demographic and work practice of the participants by conventional audiometry: no statistically significant intergroup differences were found with regard to sex, work unit, hours of noise exposure per day, the use of ear protection, underlying disease of diabetes, and hypertension. Age, duration of work (in years), drinking behavior and current smoking>1 pack/day had statistically significant differences in hearing status. Odds ratio of current smoking was 5.6 (95% CI=1.66-18.86) p-value= 0.002, when adjusted for age. Age of more than 40 years had an odds ratio of 10.4 (95% CI=2.82-38.24) p-value< 0.001 (Table 3). Table 4 shows the results of conventional audiometry and EHFA; hearing loss we determined using conventional audiometry, which also had abnormal EHFA as well, while abnormal EHFA had a normal conventional audiometry, and no significant differences were found with regard to sex, work unit, time of noise exposure per day, the use of ear protection (ear plugs), underlying diseases of diabetes, hypertension and drinking. Age, duration of work (in years), and current smoking had significant differences. An age of 51-60 years had a higher prevalence of NIHL by both methods and only EHFA (67.9% and 32.1%, respectively); 41-50 years had 41.7% and 58.3% in both methods and EHFA alone, respectively. Duration of work of more than 18 years had the highest prevalence of NIHL; 18-24 years had 70.0% and 30.0% in both methods and EHFA alone, respectively (Table 4), and more than 24 years of working had a 44.4% in conventional plus EHFA and 55.6% in EHFA alone, while no one had normal hearing (Figure 1 and 2). Current smoking had a higher incidence of NIHL than no smoking, 59.3% vs 25.9%, respectively (Table 4). Using conventional audiometry, the hearing levels at 2,000, 3,000, 4,000, 6,000 and 8,000 Hz had statistically significant differences between patients with and without NIHL (Table 5). However, when using EHFA the hearing levels at 10,000, 12,000, 14,000, and 16,000 Hz had statistically significant differences between patients with and without NIHL (Table 6).

Table 1 Hearing loss detection using extended high-frequency audiometry

EHFA	Conventional audiometry		Total
	Hearing loss	No hearing loss	
Hearing loss	34	33	67
No hearing loss	0	15	15
Total	34	48	82
Statistics	**Result**	**95% CI**	**P-value/Test**
Sensitivity	100.0%	89.7% to 100.0%	<0.001/McNemar's chi-squared test
Specificity	31.3%	18.7% to 46.3%	

EHFA=extended high-frequency audiometry, CI=confidence interval

Table 2 Demographic data and characteristics of participants of conventional audiometry

Demographic profiles	Hearing loss (%)	No hearing loss (%)	Test stat	P-value
Total	34 (41.5)	48 (58.3)		
Sex			Chisq.	0.099
Female	12 (30.8)	27 (69.2)		
Male	22 (51.2)	21 (48.8)		
Age (years)			Chisq.	0.001
21-30	1 (9.1)	10 (90.9)		
31-40	4 (21.1)	15 (78.9)		
41-50	10 (41.7)	14 (58.3)		
51-60	19 (67.9)	9 (32.1)		

Chisq.=chi-squared test

Table 2 (continued)

Demographic profiles	Hearing loss (%)	No hearing loss (%)	Test stat	P-value
Units			Fisher's exact test	0.100
PE	7 (63.6)	4 (36.4)		
MR	9 (52.9)	8 (47.1)		
NC	6 (23.1)	20 (76.9)		
VT	3 (60.0)	2 (40.0)		
CS	9 (39.1)	14 (60.9)		
Duration of work (years)			Fisher's exact test	0.176
≤6	8 (26.7)	22 (73.3)		
6.1-12	8 (44.4)	10 (55.6)		
12.1-18	7 (46.7)	8 (53.3)		
18.1-24	7 (70.0)	3 (30.0)		
>24	4 (44.4)	5 (55.6)		
Hour/day			Fisher's exact test	0.527
≤3	14 (50.0)	14(50.0)		
3.1-6	6 (37.5)	10 (62.5)		
6.1-9	13 (40.6)	19 (59.4)		
>9	1 (16.7)	5 (83.3)		
Ear protection			Chisq.	1.000
No	28 (41.2)	40 (58.8)		
Yes	6 (42.9)	8 (57.1)		
DM			Fisher's exact test	0.441
No	30 (40.0)	45 (60.0)		
Yes	4 (57.1)	3 (42.9)		
Hypertension			Chisq.	0.624
No	26 (39.4)	40 (60.6)		
Yes	8 (50.0)	8 (50.0)		
Smoking>1 pack/day			Chisq.	0.040
No	18 (32.7)	37 (67.3)		
Yes	16 (59.3)	11 (40.7)		
Drinking			Chisq.	0.023
No	18 (32.1)	38 (67.9)		
Yes	16 (61.5)	10 (38.5)		

PE=Physical and Environmental Unit, MR=Maintenance and Repairman Unit, NC=Nutrition and Cooking Unit, CS=Central Service Unit, VT=Vehicle and Transportation Unit, DM=diabetes mellitus, Chisq.=chi-squared test

Table 3 Factors associated with noise-induced hearing loss in workers

Demographic profiles	Crude OR (95% CI)	Adjusted OR (95% CI)	P-value (LR-test)
Sex			
Male vs female	2.36 (0.95-5.83)	-	-
Age			
>40 vs ≤40	6.30 (2.09-19.04)	10.38 (2.82-38.24)	<0.001
Units			
ref.=PE			-
MR	0.64 (0.14-3.04)	-	
NC	0.17 (0.04-0.79)	-	
VT	0.86 (0.10-7.51)	-	
CS	0.37 (0.08-1.62)	-	
Duration (years)			
ref.=≤6			-
6.1-12	2.20 (0.64-7.55)	-	
12.1-18	2.41 (0.66-8.81)	-	
18.1-24	6.42 (1.33-31.03)	-	
>24	2.20 (0.47-10.30)	-	
Hour/day			
ref.=≤3			-
3.1-6	0.60 (0.17-2.10)	-	
6.1-9	0.68 (0.25-1.90)	-	
>9	0.20 (0.02-1.94)	-	
DM			
Yes vs No	2.00 (0.42-9.58)	-	-
HT			
Yes vs No	1.54 (0.51-4.61)	-	-
Lipid			
Yes vs No	1.80 (0.58-5.56)	-	-
Smoke			
Yes vs No	2.99 (1.15-7.75)	5.60 (1.66-18.86)	0.002
Drink			
Yes vs No	3.38 (1.28-8.90)	2.90 (0.72-11.08)	0.133
Ear protect			
Yes vs No	1.07 (0.33-3.43)	-	-

OR=odd ratio, LR=likelihood ratio, ref.=reference, DM=diabetes mellitus, HT=hypertension, PE=Physical and Environmental Unit, MR=Maintenance and Repairman Unit, NC=Nutrition and Cooking Unit, VT=Vehicle and Transportation Unit, CS=Central Service Unit

Table 4 Demographic data and characteristics of participants classified by hearing status

Demographic profiles	Hearing loss (%)	Abnormal EHFA (%)	Normal hearing by both methods (%)	Test stat	P-value
Total	34 (41.5)	33 (40.2)	15 (18.3)		
Sex				Chisq.	0.167
Female	12 (30.8)	19 (48.7)	8 (20.5)		
Male	22 (51.2)	14 (32.6)	7 (16.3)		
Age (years)				Fisher's exact test	<0.001
21-30	1 (9.1)	1 (9.1)	9 (81.8)		
31-40	4 (21.1)	9 (47.4)	6 (31.6)		
41-50	10 (41.7)	14 (58.3)	0 (0.0)		
51-60	19 (67.9)	9 (32.1)	0 (0.0)		
Units				Fisher's exact test	0.361
PE	7 (63.6)	2 (18.2)	2 (18.2)		
MR	9 (52.9)	6 (35.3)	2 (11.8)		
NC	6 (23.1)	13 (50.0)	7 (26.9)		
VT	3 (60.0)	2 (40.0)	0 (0.0)		
CS	9 (39.1)	10 (43.5)	4 (17.4)		
Duration (years)				Fisher's exact test	0.034
≤6	8 (26.7)	10 (33.3)	12 (40.0)		
6.1-12	8 (44.4)	9 (50.0)	1 (5.6)		
12.1-18	7 (46.7)	6 (40.0)	2 (13.3)		
18.1-24	7 (70.0)	3 (30.0)	0 (0.0)		
>24	4 (44.4)	5 (55.6)	0 (0.0)		
Time with noise exposure (hours/day)				Fisher's exact test	0.477
≤3	14 (50.0)	10 (35.7)	4 (14.3)		
3.1-6	6 (37.5)	5 (31.2)	5 (31.2)		
6.1-9	13 (40.6)	15 (46.9)	4 (12.5)		
>9	1 (16.7)	3 (50.0)	2 (33.3)		
Ear protection				Chisq.	0.912
No	28 (41.2)	27 (39.7)	13 (19.1)		
Yes	6 (42.9)	6 (42.9)	2 (14.3)		
DM				Fisher's exact test	0.512
No	30 (40.0)	30 (40.0)	15 (20.0)		
Yes	4 (57.1)	3 (42.9)	0 (0.0)		
Hypertension				Chisq.	0.687
No	26 (39.4)	27 (40.9)	13 (19.7)		
Yes	8 (50.0)	6 (37.5)	2 (12.5)		
Smoking>1 pack/day				Chisq.	0.004
No	18 (32.7)	29 (52.7)	8 (14.5)		
Yes	16 (59.3)	4 (14.8)	7 (25.9)		

Table 4 (continued)

Demographic profiles	Hearing loss (%)	Abnormal EHFA (%)	Normal hearing by both methods (%)	Test stat	P-value
Drinking				Chisq.	0.042
No	18 (32.1)	26 (46.4)	12 (21.4)		
Yes	16 (61.5)	7 (26.9)	3 (11.5)		

PE=Physical and Environmental Unit, MR=Maintenance and Repairman Unit, NC=Nutrition and Cooking Unit, CS=Central Service Unit, VT=Vehicle and Transportation Unit, DM=diabetes mellitus, EHFA=extended high-frequency audiometry, Chisq.=chi-squared test

Table 5 Comparison of hearing levels between subjects with and without hearing loss in different frequencies measured using conventional audiometry

Total Ear/frequency	No hearing loss N=48 (median, IQR) dBHL	Hearing loss N=34 (median, IQR) dBHL	P-value
Lt. 250	20.0 (13.8, 20.0)	15.0 (15.0, 20.0)	0.942
Rt. 250	15.0 (15.0, 20.0)	20.0 (10.0, 20.0)	0.646
Lt. 500	15.0 (10.0, 20.0)	15.0 (10.0, 23.8)	0.565
Rt. 500	15.0 (15.0, 20.0)	15.0 (15.0, 20.0)	0.841
Lt. 1000	15.0 (10.0, 16.2)	20.0 (15.0, 25.0)	0.018
Rt. 1000	15.0 (15.0, 20.0)	20.0 (15.0, 25.0)	0.061
Lt. 2000	15.0 (10.0, 15.0)	20.0 (15.0, 25.0)	<0.001
Rt. 2000	15.0 (10.0, 20.0)	25.0 (15.0, 25.0)	<0.001
Lt. 3000	15.0 (10.0, 20.0)	30.0 (20.0, 43.8)	<0.001
Rt. 3000	15.0 (10.0, 20.0)	30.0 (20.0, 40.0)	<0.001
Lt. 4000	15.0 (10.0, 20.0)	37.5 (25.0, 48.8)	<0.001
Rt. 4000	15.0 (10.0, 20.0)	35.0 (25.0, 45.0)	<0.001
Lt. 6000	20.0 (10.0, 25.0)	35.0 (30.0, 46.0)	<0.001
Rt. 6000	15.0 (10.0, 20.0)	37.5 (25.0, 48.8)	<0.001
Lt. 8000	15.0 (10.0, 20.0)	27.5 (20.0, 43.8)	<0.001
Rt. 8000	17.5 (10.0, 25.0)	30.0 (21.2, 43.8)	<0.001

IQR=interquatile range, dBHL=decibels hearing level, Lt.=left, Rt.=right

Table 6 Comparison of hearing levels between subjects with and without hearing loss in different frequencies measured using extended high-frequency audiometry

Total Ear/frequency	No hearing loss N=15 (median, IQR) dBHL	Abnormal EHFA N=67 (median, IQR) dBHL	P-value
Lt. 250	15.0 (10.0, 20.0)	20.0 (15.0, 20.0)	0.150
Rt. 250	15.0 (12.5, 20.0)	15.0 (15.0, 20.0)	0.344
Lt. 500	15.0 (15.0, 15.0)	15.0 (10.0, 20.0)	0.702
Rt. 500	15.0 (15.0, 20.0)	15.0 (15.0, 20.0)	0.512
Lt. 1000	15.0 (10.0, 15.0)	15.0 (10.0, 20.0)	0.066
Rt. 1000	15.0 (15.0, 15.0)	20.0 (15.0, 20.0)	0.053
Lt. 2000	15.0 (10.0, 15.0)	15.0 (10.0, 20.0)	0.049
Rt. 2000	15.0 (10.0, 15.0)	20.0 (15.0, 25.0)	0.021
Lt. 3000	15.0 (10.0, 15.0)	20.0 (15.0, 30.0)	<0.001
Rt. 3000	15.0 (7.5, 15.0)	20.0 (15.0, 30.0)	0.002
Lt. 4000	10.0 (10.0, 17.5)	20.0 (15.0, 37.5)	<0.001
Rt. 4000	15.0 (5.0, 20.0)	25.0 (15.0, 35.0)	0.002
Lt. 6000	15.0 (10.0, 15.0)	25.0 (20.0, 35.0)	<0.001
Rt. 6000	15.0 (10.0, 20.0)	25.0 (17.5, 37.5)	0.002
Lt. 8000	10.0 (5.0, 15.0)	20.0 (15.0, 32.5)	<0.001
Rt. 8000	10.0 (5.0, 12.5)	25.0 (20.0, 35.0)	<0.001
Lt. 10000	10.0 (2.5, 15.0)	30.0 (20.0, 45.0)	<0.001
Rt. 10000	10.0 (7.5, 17.5)	35.0 (25.0, 50.0)	<0.001
Lt. 12000	5.0 (0.0, 12.5)	45.0 (25.0, 70.0)	<0.001
Rt. 12000	5.0 (5.0, 10.0)	45.0 (30.0, 65.0)	<0.001
Lt. 14000	10.0 (0.0, 22.5)	65.0 (50.0, 80.0)	<0.001
Rt. 14000	10.0 (2.5, 27.5)	60.0 (45.0, 77.5)	<0.001
Lt. 16000	20.0 (0.0, 37.5)	70.0 (55.0, 75.0)	<0.001
Rt. 16000	30.0 (12.5, 37.5)	65.0 (55.0, 75.0)	<0.001
Lt. 18000	15.0 (5.0, 30.0)	35.0 (30.0, 35.0)	<0.001
Rt. 18000	20.0 (5.0, 30.0)	30.0 (30.0, 35.0)	<0.001

IQR=interquatile range, dBHL=decibels hearing level, EHFA=extended high-frequency audiometry, Lt.=left, Rt.=right

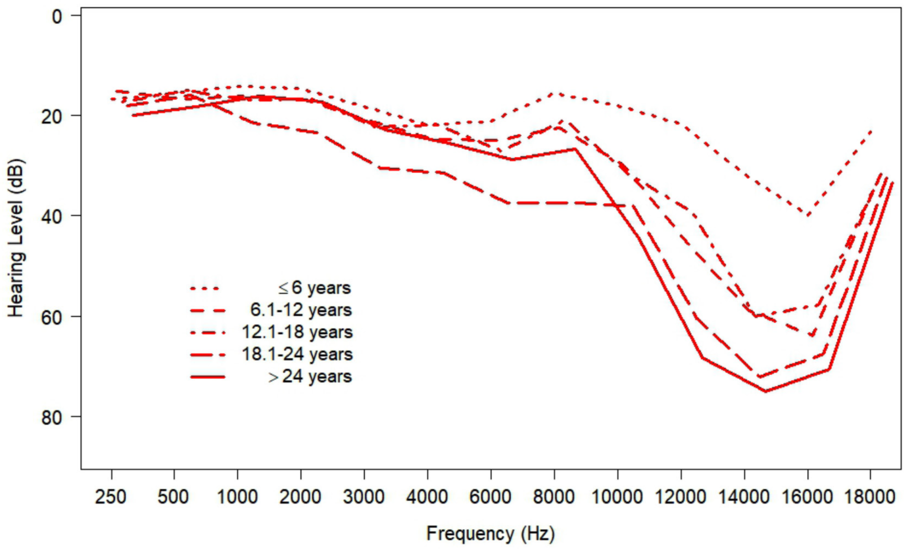

Figure 1 Graph shows mean hearing level of left ear according to duration of work (years)

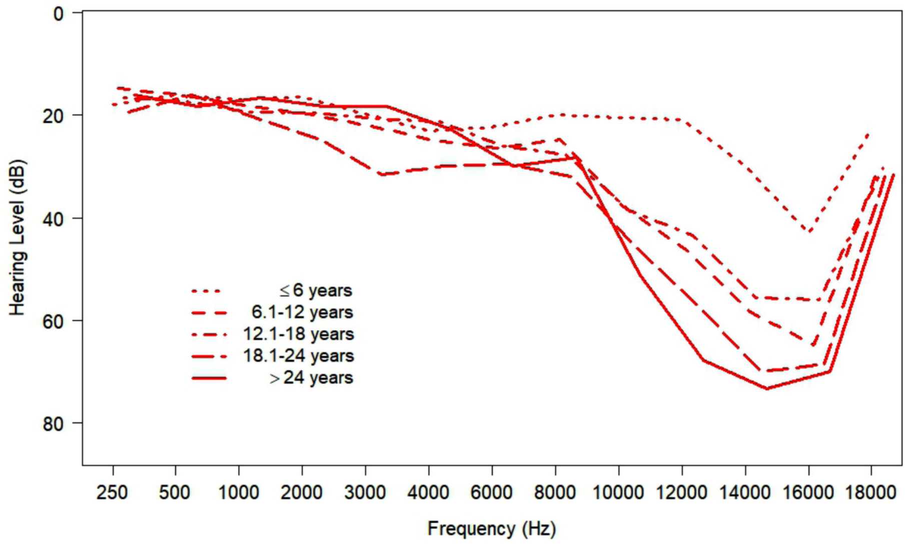

Figure 2 Graph shows mean hearing level of right ear according to duration of work (years)

Discussion

Occupational NIHL is hearing loss suffered due to continuous or intermittent noise exposure which usually develops slowly over several years. The current diagnostic criteria is the use of conventional hearing assessment, which can detect hearing loss at 250-8,000 Hz. Recently we have attempted to find a faster way to assess this condition by using EHFA. Mehrparvar et al.[5] and Kumar et al.[6] proved that EHFA is more sensitive in detecting NIHL than conventional audiometry. We conducted a cross-sectional study of the participants in 5 units who were surveyed by the occupational medicine department and claimed to have noise exposure of more than 85 dBHA. Although our study neither aimed to standardize thresholds nor comparisons of the control and study groups, we could demonstrate the fact in a real population of noise-exposed workers. The prevalence of NIHL in our study was 41.5%, which is higher than in other tertiary hospitals in Thailand (21.2-28.1%).[1-3] Only 20.6% of the participants used ear protection in comparison with the 71.9% proposed by Worrawannotai et al.[3] It is a challenge for us to organize a campaign for preventing noise exposure, even if there is no significant difference in hearing impairment between participants with and without ear protection. This study also confirmed that smoking can increase the risk of NIHL.[7] In the study of Barone et al.[7], it was found that smoking increased the risk of NIHL with an odds ratio of 1.39, p-value=0.002. Kim et al.[8] reported that in current smokers, the pure-tone thresholds increased more than in never- or ex-smokers (p-value=0.026 in the weighted four-frequency average and p-value=0.011 at 8,000 Hz, age-adjusted), while results in our study showed that smoking more than 1 pack/day was a risk factor of hearing loss with an odds ratio of 5.6 p-value=0.002 (95% CI=1.66, 18.86). Since presbycusis has a high prevalence in the elderly, 40.0% of the population aged over 65 years has some hearing difficulty.[9] Our study also supported the fact that people aged over 40 years have an increased risk of hearing loss with an odds ratio of 10.38 p-value<0.001 (95% CI=2.82, 38.24). We found that those aged 51-60 years had a higher incidence of NIHL by both methods and only EHFA (67.9% and 32.6%) more than in the younger populations, which could be related to the condition of presbycusis. Loss of threshold sensitivity in the high-frequency region of the hearing spectrum is the first sign of presbycusis, which can begin in a young adult but initially event in the 60 years of life. Gates et al.[10] has reported about a hearing threshold shift that can be caused by multifactorial origins, but is mostly the result of advancing age. However, it is known that aging alone does not cause the outer hair cell loss that is found in NIHL or ototoxicity.[11] Therefore, we should conduct a study of otoacoustic emissions in order to evaluate outer hair cell function for separate aging causes.

Porto et al.[12] found that with an increase in frequency, age and time of noise exposure, there was a greater decrease in the hearing thresholds for the group exposed to noise, and a higher incidence of hearing loss, 6,000 and 14,000 Hz. Ahmed et al. reported that a significant difference between conventional and EHFA in a noise-exposed population was mostly sensitivity at the frequencies of 14,000 and 16,000 Hz.[13] Turkkahraman et al. also found that the mean hearing thresholds of workers showed significant increases in all frequencies from 4,000 to 16,000 Hz (p-value<0.005), with the most affected frequencies being 4,000, 6,000, 14,000, and 16,000 Hz (p-value<0.0005).[14] Kumar et al. also found significant differences in the hearing thresholds of personal listening device users, which were seen at the frequencies of 3,000, 4,000, 6,000, 9,000, 10,000, 11,000, 13,000, 14,000, 15,000 and 16,000 Hz, with p-value<0.05. Elevated hearing thresholds were observed in personal listening device users that were directly proportional to volume and duration of usage.[6] While our study showed that increases in age and years of work can give a significantly abnormal EHFA, the mean hearing thresholds showed significant earlier increases in all frequencies from 2,000 to 18,000 Hz in both ears. As can be seen in Figures 1 and 2, the hearing thresholds dropped in the higher frequencies and more in the passing years of work. This is a cross-sectional study, but the time of noise exposure per day can be determined by using a questionnaire or direct interview. Mehrparvar et al. found that EHFA can be used for early detection of NIHL.[5] Our study also confirmed that our sensitivity of EHFA in the diagnosis of NIHL was 100.0% (95% CI=89.72-100), while specificity was 31.3% (95% CI=18.66-46.25), and accuracy was 59.8% (95% CI= 48.34-70.44). It can be useful for early detection of hearing sensitivity to noise which was found to be 40.2% in our study. The benefit of 40.2% in early awareness of abnormal hearing in those who still had normal routine testing will give them a close hearing monitor program every 6 months.

Conclusion

Treatments of NIHL are intended to minimize the consequences of hearing loss and to prevent any further loss. Cessation of smoking can prevent NIHL, as well as yearly routine audiological assessments after reaching 40 years of age.

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Conflict of interest

The authors have no conflict of interest to declare.

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