The Relation Between Noise Induced Hearing Loss and Years of Service Among Workers of a Paper Factory

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Abstract

Introduction

This study planned to investigate the occurrence time of noise induced hearing loss (NRHL) among workers in a loud work environment.

Material and Methods

For this study, the data of 70 workers who work in different departments of a paper factory was examined retrospectively. Workers were allocated in two groups as A (environment's noise level is under 80 dB) and B (over 85 dB) according to their departments' noise level. The workers with noise induced hearing loss were determined with the last Pure Tone Audiogram results.

Results

The median age was 36.98 of 70 workers included 2 females and 68 males. 15 workers with hearing loss were determined. Group B showed twice as many hearing loss results compared to the group A (5 in A and 10 in B groups), however, these results were not found to be statistically significant (p: 0.244). In the examination of the number of workers with noise induced hearing loss distributed by the years spent in this workplace, 14 of the workers who have been working in the factory over 10 years had hearing loss while only 1 worker in the group with up to 10 years of experience was affected. The difference of this distribution was statistically significant (p: 0.002).

Conclusion

The data of this study shows that there is a positive correlation between hearing loss incidence and years of service in a loud workplace. Particularly, individuals with over 10 years of experience show distinctive increase of hearing loss. Years spent in a loud workplace and accordingly, the amount of time being exposed to loud noise, increase the noise induced hearing loss.

Keywords: Hearing loss, noise induced, disease, occupational, exposure

Introduction

Noise induced hearing loss is a hearing loss related to severity of the noise and exposing time. The risk of noise induced hearing loss is considered to be increased by the years of service in a loud environment as much as the severity of the noise (1, 2).

In this study, the relation between the incidence of hearing loss, noise level of the environment and years of service were evaluated in a factory which is periodically assessed for noise level of environments and hearing levels of workers.

Material and Methods

For this study, the data of 75 workers who work in different departments with different noise levels in a factory that produces paper was evaluated retrospectively in order to determine the relation between incidence of noise induced hearing loss and years of service. Workers with symptom of otitis, sequel of otitis, autoimmune diseases, diabetes, usage of ototoxic drugs and less than a year of work experience were excluded from study, therefore the data of 70 cases were investigated.

The median age was 36.98(min.24 – max.48) of 70 workers included 2 females and 68 males. All workers' age were in range from 18 to 50 and they were evaluated in the same age group.

Environment Noise level tests

Environment Noise level tests of the factory were completed by a RION brand, NA-28 model, IEC 61672-1:2002 Class 1 and IEC 61260:1995 Class 1 mobile sound level meter and it was calibrated before each measurement.

To determine the level of noise in workers' environments, annual equivalent sound level (L_{eq}) measurements were considered. Workers were allocated in two groups as A (environment's noise level is under 80 dB) and B (over 85 dB) according to their departments' noise levels (Table 1).

Table 1. Noise levels of the environment and staff numbers

	Environment	Leq	Number of Workers	Total	
Group A	Office	55,8	14	37	75
	Laboratory	62,8	8		
	Maintenance	69,8	15		
Group B	Coiling	88,1	8	38	
	Stokehold	88,3	5		
	Pulp preparation	89,1	10		
	Pulper	89,4	8		
	Drier	89,7	7		

Hearing Threshold Measurements

Otoscopic examination of workers was completed when they were examined periodically. All participants were examined with pure tone audiogram which determines air conduction thresholds (250, 500, 1000, 2000, 4000, 8000 Hz) and bone conduction thresholds (500, 1000, 2000, 4000 Hz). Audiometric tests were completed with Danplex DA-64 audiometer in a sound proof room. Before the measurements, workers were required to stay away from working environments for at least 16 hours. According to audiogram results, the cases which had median air-bone gaps at 1,2,3,4 KHz less than 15 dB and sensorineural hearing loss and 4000 Hz hearing loss on both ears (Boilermaker's notch) were considered to have noise induced hearing loss (3-6). Hearing loss level was calculated as the average of values on 500-1000-2000-4000 Hz.

Statistical analysis for this study was performed by Trakya University, Faculty of Medicine, Department of Biostatistics, SPSS 20.0 (license no: 10240642) computer program was used. Chi-square/Fisher test was use and significance limit was accepted as $p < 0.005$.

Results

15 workers in total were detected to have hearing loss. According to average of hearing thresholds, all cases with noise induced hearing loss showed mild hearing loss (highest score of 35 dB).

When we compare the number of workers with hearing loss in groups, according the sound level of their working area, even though group B appeared to have twice as many workers with hearing loss compared to the group A, these results were not significant statistically ($p: 0.244$) (Table 2).

Table 2. Noise induced hearing loss compared by noise level distribution

	Group A	Group B	Total
NRHL +	5	10	15
NRHL -	30	25	55
Total	35	35	70
Fisher test	$p = 0,244$		

When we evaluate the distribution of the numbers of workers with noise induced hearing loss in groups according to years of service, 14 of the workers who have been working in the factory over 10 years were affected while only 1 worker in the group with up to 10 years of experience was affected. The work-

ers with less than 5 years of working showed no hearing loss determined. This distribution difference was statistically significant ($p: 0.002$) (Table 3). The median hearing loss was not higher than 35 dB for any of the workers, therefore, all cases considered as „mild hearing loss“.

Table 3. Hearing loss distributed to years of service

Year	NRHL (+)	NRHL (-)	Total
1 – 5	0	0	20
6 – 10	1	11	12
11 and more	14	24	38
Total	15	55	70
Fisher Chi-square	P:0,002		

Discussion

The study showed that there was different incidence rates of hearing loss in groups with different noise levels, however, these results were not statistically significant whereas related literature indicates that it is expected to see significant difference (1, 5, 7, 8). In the work place where the study took place, the workers may visit departments with different noise levels throughout the day and the possible worker replacements between the departments with different noise levels in the previous years could be an explanation of this discrepancy. Moreover, it is worth mentioning that these results could be more significant if the sample was larger.

In this work place, personal protection wear was in use and reviewed since 2009, environment's noise level was decreased, new measures were taken about personal protection wear and application controls were implied as a discipline.

The results indicates that there is a positive correlation between years of service and hearing loss. In particular, individuals with over 10 years spent working showed significantly higher rates. The results of this study could be interpreted in two ways. Firstly, the amount of time spent working in an environment with high sound level hereupon exposure to the noise, increases the risk of noise induced hearing loss. This is an expected and compatible result with the related literature (1, 2, 7). The workers with less than 5 years of work experience did not show hearing loss. This result can be perceived as noise induced hearing loss can appear after 5 years. Secondly, recent effective precautions towards noise protection can be the reason for those workers with fewer years of service showed smaller incidence of hearing loss. It is suggested to take the study further to investigate this second interpretation.

References

1. H. Alexander Arts. Sensorineural Hearing Loss in Adults; in Ed Flint PW, Haughey BH, Lund WJ et al. Cummings Otolaryngology Head & Neck Surgery 5th ed. Ch. 149 Philadelphia: Mosby 2010.
2. Occupational noise; Environmental Burden of Disease Series, No. 9, World Health Organization Protection of the Human Environment Geneva 2004. [Last accessed on 2013 September 07]. Available from: http://www.who.int/quantifying_ehimpacts/publications/en/ebd9.pdf
3. Prevention of Noise induced Hearing Loss, Report of an informal consultation. Geneva: World Health Organisation; 1997. [Last accessed on 2013 September 07]. Available from: <http://www.who.int/entity/pbd/deafness/en/noise.pdf>.
4. Paparella, Shumrick, Gluckman, Meyerhoff, editors. Otolaryngology (Otology and neuro-otology) 3rd ed. Vol. 2. Philadelphia: W. B. Saunders; 1991.
5. Occupational Exposure to Noise: Evaluation, Prevention and Control: NIOSH Cooperative Agreement with WHO for 1994-1995. [Last accessed on 2013 September 07]. Available from: http://www.who.int/occupational_health/publications/noise.pdf.
6. Guidelines for detection of Noise Induced Hearing Loss. American College of Occupational and Environmental Medicine. 2002. [Last accessed on 2013 September 07]. Available from: <http://www.acoem.org/guidelines.aspx?id=846>.
7. Bhumika N, Prabhu GV, Ferreira AM, Kulkarni MK. Noise-Induced Hearing Loss Still a Problem in Shipbuilders: A Cross-Sectional Study in Goa, India. Ann Med Health Sci Res. 2013 Jan-Mar; 3(1): 1-6.
8. Toppila E, Pyykko I, Starck J, Kaksonen R, Ishizaki H. Individual risk factors in the development of noise-induced hearing loss. Noise Health 2000; 2: 59-70.

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