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Effects of Blood Groups and Other Factors on Occupational Noise Induced Hearing Loss

Kan Grupları ve Diğer Faktörlerin Mesleki Gürültüye Bağlı İşitme Kaybı Üzerine Etkileri

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ABSTRACT

Objectives: This prospective study aimed to investigate the effects of the blood groups and the other factors such as blood pressure (systolic and diastolic), serum cholesterol, triglyceride and glucose values on hearing thresholds of the workers in Steel Working Factory.
Material and Methods: 18 male workers (8 bilateral and 10 unilateral hearing loss) and 26 ears of them with occupational noise induced hearing loss (ONIHL) consisted the study group. 15 male workers and 29 ears of them without NIHL included into the study as a control group. The subjects were asked to complete a self-administered questionnaire; and their audiograms in the screening programme; and blood pressure (systolic and diastolic), blood group, serum cholesterol, triglyceride and glucose values were evaluated.
Results: Systolic and diastolic blood pressure, serum cholesterol, triglyceride and glucose values were not different between two groups. For the study group with ONIHL, 6.0 kHz values of patients with A; and for AB blood groups were higher than O blood group. Older age, higher blood pressure, serum cholesterol, triglyceride and glucose values; and exposing louder mean noise (MN) and maximum exposed noise levels caused more increase in the pure tone thresholds.
Conclusion: Workers with blood group A and AB may be more prone to have hearing loss at high frequencies. Hypertension, higher serum cholesterol, triglyceride and glucose levels may cause more ONIHL. These factors should be evaluated in workers studied at noisy work-places and metabolic factors should be treated in an earlier time to prevent the rapid progression of hearing loss.

Keywords
Occupational noise, noise induced hearing loss, ABO blood-group System, hypertension, serum cholesterol, serum triglyceride, serum glucose

ÖZET

Amaç: Bu prospektif çalışmanın amacı, kan grupları ve kan basıncı (sistolik ve diastolik), serum kolesterol, trigliserit ve glukoz değerleri gibi diğer faktörlerin Çelik İş Fabrikasındaki işçilerin işitme eşikleri üzerine olan etkilerinin araştırılmasıdır.
Yöntem ve Gereçler: 18 erkek işçi (8 bilateral ve 10 unilateral işitme kaybı) ve mesleki gürültüye bağlı işitme kaybı (MGBİK) olan 26 kulağı çalışma grubunu oluşturmuştur. 15 erkek hasta ve NIHL olmayan 29 kulağı kontrol grubu olarak çalışmaya dahil edilmiştir. Kişilerin kendilerinin-dolduracağı anketi tamamlamaları istenmiş; ve tarama programında yapılan odyogramları; ve kan basıncı (sistolik ve diastolik), kan grubu, serum kolesterol, trigliserit ve glukoz değerleri değerlendirilmiştir.
Bulgular: İki grupta**,** sistolik ve diastolik kan basıncı, serum kolesterol, trigliserit ve glukoz değerleri farklı değildi. ONIHL olan çalışma grubunda, 6.0 kHz değerleri, A ve AB kan grubundaki hastalarda, 0 grubundan daha yüksekti. Daha yaşlı olmak, daha yüksek kan basıncı, serum kolesterol, trigliserit ve glukoz değerleri; ve daha yüksek ortalama gürültü (OG) ve maksimum gürültü seviyesine maruz kalmak, saf ses eşiklerinde daha fazla yükselmeye sebep olmuştur.
Sonuçlar: A ve AB kan grubundaki işçiler, yüksek frekanslarda işitme kaybına daha yatkın olabilirler. Hipertansiyon, yüksek serum kolesterol, trigliserit ve glukoz seviyeleri, daha fazla ONIHL'a sebep olabilir. Bu faktörler, gürültülü işyerlerinde çalışan işçilerde değerlendirilmelidir ve işitme kaybının hızlı progresyonunu engellemek için metabolik faktörlerin tedavi edilmesi gereklidir.

Anahtar Sözcükler
Mesleki gürültü, gürültüye bağlı işitme kaybı, ABO kan-grup Sistemi, hipertansiyon, serum kolesterol, serum trigliserit, serum glukoz

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INTRODUCTION

Noise can cause various harmful effects in humans, which can occur in the cardiovascular, gastrointestinal, endocrine, vegetative and nervous systems. The most deleterious effect of noise occurs in the hearing organ.[1] Occupational noise-induced hearing loss (ONIHL), is generally considered to be a more serious problem because high levels of noise may be sustained on a regular basis for many hours each day over many years. For the mechanism of NIHL development, iner ear injury is considered to be essentially dependent on metabolic alterations rather than mechanical destruction.[1,2]

The following treatable conditions have been alleged to exacerbate NIHL and appropriate management of these considerations might influence the development or progression of NIHL: Cardiovascular disease, diabetes mellitus, hyperlipidemia, exposure to ototoxic drugs.[2] Systolic blood pressure and cholesterol level were shown as independently associated with decline in auditory sensitivity.[3] Many investigators who have analyzed the possible correlation between hearing loss and high serum cholesterol levels have found that hearing appears to be influenced by high blood lipids. Noise, as is well known, also influences hearing, particularly at high frequencies.[4] Topila, et al.[5] analyzed the association of noise-induced hearing loss with various risk factors. Systolic blood pressure, smoking, cholesterol level and the use of painkillers explained 36 % of the variation in hearing level at 4 kHz, whereas noise exposure alone explained 25% of the corresponding variation.

It was found that ABO group substances are present in the perilymph of secretors.[6] The possible structure of human blood-group antigens were investigated in cochlear hair cells of rats; and anti-B, anti-AB and anti-H antibodies displayed specific positive immunoreactive patterns, but anti-A-related antigens were not found.[7] Human blood-group antigen expression on developing cochlear hair cells of rats may be related to afferent nerve fiber influence.[8] Certain diseases have been reported to be nore common in particular blood groups.[1] In Doğru, et al's[1] study, NIHL was determined to be significantly more frequent in workers with blood group O.

In the present study, we investigated hearing thresholds of the workers exposed to occupational noise in different blood groups. And, the other metabolic factors which may affect the hearing levels of the workers were also studied in Steel Working Factory, such as blood pressure (systolic and diastolic), serum cholesterol, triglyceride and glucose.

MATERIALS AND METHOD

This prospective study was carried out in the Ear Nose Throat (ENT) Department of Kırıkkale University Faculty of Medicine between March and May 2006.

Subjects

The study was carried out in patients exposed to noise during their works in Steel Working Factory in Turkey. 18 male workers (8 bilateral and 10 unilateral hearing loss) and 26 ears of them with Noise induced hearing loss (NIHL) included into the study with their agreement by written informed consent to participate the study, and to give permission for the use of their all of the laboratory data. Their mean age was 46.1±5.5 (Ranged from 34 to 53). 15 male workers and 29 ears of them without NIHL, included into the study as a control group. Their mean age was 43.0±6.3 (Ranged from 34 to 53).

The workers were evaluated by periodic health check-up in the factory. Under the Industrial Safety and Health Law, auditory examination was performed as a screening program included in periodic health checkups by pure tone audiometry at 1.0 to 6.0 kHz. In the factory, the noise level in the factory was measured and the noise level map of the all departments in the factory was made. Noise levels varied between 73 dB and 110 dB SPL (Sound Pressure Level). There were no ototoxic chemical exposures in the factory. The workers were instructed to wear hearing protection devices (protective earheadings or earplugs).

The subjects were asked to complete a self-administered questionnaire; and blood pressure (systolic and diastolic), blood groups, serum cholesterol, triglyceride and glucose values were evaluated. Any of the patients in the study group had head trauma; and in the present time, any symptoms and findings of the infectious ear diseases.

Instrumentation

1. Questionnaire: A history of occupational noise exposure: mean noise for per hour (MN), maximum exposed noise (MEN), daily noise exposure time (DNET) and total noise exposure time (years) (TNET); the type of the noise (temporary, continuous; and continuous with temporary increase); the complaints of the subjects (hearing loss, tinnitus, vertigo, ear ache, fullness of the ear, etc.); the usage of the hearing protection devices (protective earheadings or earplugs) (never, rare, often, always).

2. Audiologic examination: All patients of the study and control groups were evaluated with 1.0 to 6.0 kHz pure tone audiologic examination. Results were evaluated according to American National Standards Institute (ANSI-1969) standards.[9]

All steps of the study were planned and continued according to the principles outlined in the Declaration of Helsinki.[10]

Statistical analysis

Statistical packet for SPSS (Version 8.0) was used for statistical evaluation. The difference for age, systolic blood pressure, serum cholesterol, triglyceride and glucose values; and characteristics of the noise (MN, MEN, DNET, TNET); and each of the hearing threshold levels at 0.25 to 6.0 kHz of the study and control groups were analyzed by Mann Whitney U Test.

In the study group, the difference for each of the hearing thresholds (0.25-6.0 kHz) between blood groups (O, A, B, AB) were analyzed by Kruskal Wallis Variance Analysis with Bonferroni correction. If statistically significant difference was present, to find the value (or values) which caused difference, pairwise comparisons were done by Mann Whitney U Test with Bonferroni correction.

In the study group, effects of age, blood pressure, serum cholesterol, triglycerides and glucose values; and MN, MEN and TNET on hearing thresholds were analyzed by Linear Regression Analysis.

p value < 0.05 was considered statistically significant.

RESULTS

Blood pressure, serum cholesterol, triglycerides and glucose values; characteristics of the noise, and pure tone audiometry results (0.25 to 6.0 kHz) of the study and control groups are given on Table 1. The distribution of blood groups in the study group were O (38.4%), A (26.9%), B (19.2 %) and AB (11.5 %); and in the control group, O (44.8%), A (13.7%), B (27.5%) and AB (13.7%).

The difference for age, systolic and diastolic blood pressure, cholesterol, triglyceride and blood glucose values; and characteristics of the noise (MN, MEN, DNET, TNET) of the study and control groups were analyzed by Mann Whitney U Test. No significant difference was present (p> 0.05) (Table 1).

The difference between each of the hearing threshold levels at 0.25 to 6.0 kHz of the study and control groups were analyzed by Mann Whitney U Test. In the study group with NIHL, hearing thresholds were significantly higher at pure tones, except 2.0 kHz. For 2.0 kHz, hearing thresholds of the study group were insignificantly higher than the control group (Table 2).

Table 1. Blood pressure, serum cholesterol, triglycerides and glucose values; characteristics of the noise, and pure tone audiometry results (0.25 to 6.0 kHz) of the study and control groups.

	ONIHL(+) Mean±St. Dev.	ONIHL(–) Mean±St. Dev.	P*
Age	46.1±5.5	43.0±6.34	0.096
Systolic BP	125.0±8.1	125.8±9.0	0.678
Diastolic BP	79.6±8.2	74.4±21.3	0.930
Serum Cholesterol	163.5±66.1	157.6±67.5	0.926
Serum Triglycerides	137.6±88.2	144.2±135.8	0.472
Serum Glucose	93.5±40.6	85.1±22.5	0.926
Characteristics of the noise			
MN	88.5±6.94	90.2±4.8	0.899
MEN	99.5±9.4	101.1±8.3	0.478
DNET	7.1±0.3	7.0±0.4	0.639
TNET	20.3±7.1	21.4±6.2	0.565
Hearing Thresholds			
0.25 kHz	30.9±17.3	22.7±8.0	0.001
0.5 kHz	28.6±13.3	21.7±2.41	0.003
1.0 kHz	22.8±13.3	16.8±2.4	0.023
2.0 kHz	23.0±14.0	15.8±4.6	0.074
4.0 kHz	46.5±16.2	21.8±8.2	0.000
6.0 kHz	47.6±17.2	20.8±3.2	0.000

* Shows results of Mann Whitney U test.

In the study group, the difference for each of the hearing thresholds (0.25-6.0 kHz) between blood groups (O, A, B, AB) were analyzed by Kruskal Wallis Variance Analysis with Bonferroni correction. For 6.0 kHz, statistically significant difference was present (p= 0.008) (Table 2). To find the value (or values) which caused difference, pairwise comparisons were done by Mann Whitney U Test with Bonferroni correction. 6.0 kHz values for the patients with A blood group (Mean=59.2 dB) (p= 0.014); and for AB group (Mean: 68.3 dB) (p= 0.012) were significantly higher than O blood group (Mean=38.6 dB).

In the study group, effects of age, blood pressure, serum cholesterol, triglycerides, and glucose values; and MN, MEN and TNET on hearing thresholds were analyzed by "Linear Regression Analysis (Table 3).

-Older age caused increase of the hearing thresholds at 0.25-6.0 kHz.

-Higher systolic blood pressure caused 2.0-6.0 kHz hearing loss, whereas higher diastolic blood pressure cause increase in the hearing thresholds at 0.5-1.0 kHz.

-Higher cholesterol levels caused 0.25 kHz hearing loss. Higher triglyceride levels caused hearing loss at all of the pure tones.

Table 2. Kruskal Wallis Variance Analysis results about the difference for hearing thresholds between blood groups of the study group.

Blood groups	Hearing thresholds of the study group											
	0.25 kHz		0.5 kHz		1.0 kHz		2.0 kHz		4.0 kHz		6.0 kHz	
	Mean	St.Dev.	Mean	St.Dev.	Mean	St.Dev.	Mean	St.Dev.	Mean	St.Dev.	Mean	St.Dev.
O n=11	32.2	9.8	26.8	10.5	20.9	11.1	16.8	7.5	40.0	12.4	38.6	12.6
A n=7	32.8	3.9	22.8	2.6	17.8	2.6	27.1	19.7	48.5	17.4	59.2	16.1
B n=5	21.0	20.1	31.0	8.9	25.0	7.0	22.0	10.3	42.0	5.7	39.0	11.9
AB n=3	38.3	45.3	45.0	30.4	38.3	31.7	38.3	12.5	73.3	12.5	68.3	10.4
p*	0.541		0.077		0.121		0.148		0.060		0.008	

*p value shows the results of Kruskal Wallis Variance Analysis with Bonferroni correction.

Table 3. Linear Regression Analysis results about effects of age, blood pressure, serum cholesterol, triglycerides, glucose values; and MN, MEN and TNET on hearing thresholds.

	Hearing thresholds											
	0.25 kHz		0.5 kHz		1.0 kHz		2.0 kHz		4.0 kHz		6.0 kHz	
	Beta	p	Beta	p	Beta	p	Beta	p	Beta	p	Beta	p
Age	0.016	0.963	0.247	0.443	0.262	0.417	0.687	0.008	0.421	0.145	0.329	0.233
Systolic BP	-0.354	0.511	-0.046	0.929	-0.010	0.984	0.349	0.352	0.466	0.305	0.012	0.978
Diastolic BP	-0.037	0.925	0.132	0.727	0.076	0.841	-0.364	0.193	-0.380	0.257	-0.155	0.627
Serum cholesterol	0.036	0.905	-0.282	0.328	-0.281	0.330	-0.454	0.039	-0.359	0.161	-0.422	0.092
Serum triglycerides	0.294	0.403	0.449	0.189	0.460	0.179	0.603	0.021	0.237	.418	0.023	0.934
Serum glucose	-0.045	0.905	0.074	0.836	0.109	0.761	0.084	0.745	-0.055	0.859	-0.429	0.167
MN	0.406	0.309	0.225	0.550	0.243	0.520	0.458	0.106	0.417	0.214	0.419	0.197
MEN	-0.470	0.237	-0.378	0.316	-0.384	0.310	-0.291	0.288	0.244	0.457	0.148	0.637
TNET	-0.353	0.245	-0.051	0.858	-0.100	0.726	-0.209	0.316	0.018	0.943	-0.237	0.329

* Shows results of Mann Whitney U test

-Higher serum glucose levels caused increase in the hearing thresholds at 0.5-2.0 kHz.

-Higher MN values caused hearing loss at all pure tones; higher MEN values caused 4.0-6.0 kHz hearing loss.

DISCUSSION

Assessing the degree of noise exposure an individual experiences can be extremely difficult. In most working environments, noise is not continuously sustained and is therefore intermittent. Moreover, many individuals are mobile and move through noise environments of different intensities for various periods during the workday.

In the present study, we investigated the effects of the blood groups and the other factors such as blood pressure (systolic and diastolic), serum cholesterol, triglyceride and glucose values on hearing thresholds of the workers in Steel Working Factory. These factors were investigated in the ONIHL group and non-ONIHL groups which were both exposed to the Occupational noise. Systolic and diastolic blood pressure, serum cholesterol, triglyceride and glucose values; and characteristics of the noise were found as not different between two groups. In the study group, pure tone thresholds were higher than the control group. 6.0 kHz values for the patients with A blood group; and for AB group were significantly higher than O blood group.

Human blood group antigens are transiently expressed in developing cochlear hair cells in the fetus. This temporary antigen expression seems to correspond to the main events of inner ear differentiation, e.g. hair cell development, synaptogenesis and ciliogenesis [1, 11]. Maternal blood group A is also a risk factor for occurrence of acute otitis media and secretory otitis media in children.[1,12] It was reported that patients presenting with blood group A may have a genetic predisposition to otitis externa caused by Pseudomonas aeruginosa whose lectins apparently adhere to terminal blood group A determinant.[13] The ABO blood groups were investigated in secretory otitis media (SOM) and a preponderance of group A or shortage of group O was statistically significant.[14]

In the present study, it was found that older age and high triglyceride levels caused increase of the hearing thresholds at all frequencies. High systolic blood pressure caused 2.0-6.0 kHz; high diastolic blood pressure caused 0.5-1.0 kHz; high cholesterol levels caused 0.25 kHz; and increased serum glucose levels

caused 0.5-2.0 kHz hearing loss. Higher MN values caused hearing loss at all pure tones; higher MEN values caused 4.0-6.0 kHz hearing loss.

The effect of noise, age and confounders in noise-induced hearing loss (NIHL) was evaluated in workers exposed to the occupational noise. In analysis where the subjects were matched with pairs by age, exposure, blood pressure and serum cholesterol level, the elderly subjects were more susceptible to NIHL than younger subjects. Factors independently but causally related to age were important in the development of NIHL among workers exposed to noise levels below 98 D.[15]

In sailors, the degree of hearing loss correlated with systolic blood pressure in both groups of seamen as well as with diastolic blood pressure in the engine-room personnel. The results do not allow drawing a clear conclusion regarding correlation between ship noise and arterial hypertension, although some indicators point to a certain effect of noise on blood pressure.[16] Another study on occupational noise exposure and hypercholesterolemia was conducted in a group of 1.209 workers exposed to industrial noise; and it was reported that there was no relation between noise induced hearing loss and hypercholesterolemia.[17]

Our results showed that workers with blood group A and AB may be more prone to have hearing loss at high frequencies. Older age, higher blood pressure, serum cholesterol, triglyceride and glucose values; and exposing louder mean noise (MN) and maximum exposed noise levels caused more increase in the pure tone thresholds.

Level of vitamin B12 was found low in employees with hearing loss due to noise. Because of this, vitamin B12 in routine control of the people who are working in noisy environment may be useful.[18] Oral magnesium intake may be beneficial in the prevention of cochlear damage in noise-induced hearing loss.[19]

It was concluded that blood pressure, serum cholesterol, triglyceride and glucose levels should be evaluated and treated in an earlier time to prevent the rapid progression of hearing loss in workers studied at noisy work-places. The workers with blood group A and AB are more frequently evaluated with audiological examinations to detect high frequency hearing loss initially. All of the workers exposed to occupational noise should be educated for harmful effects of the noise and prevention by ear heading or earplugs.

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