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Quality of Life and Self-Reported Symptoms in Workers Exposed to Excessive Noise

Aşırı Gürültüye Maruz Kalan İşçilerde Yaşam Kalitesi ve Öz-Bildirim Semptomları

ABSTRACT

Objective:
Noise can cause physiological and psychological changes by affecting human health. This study aims to investigate the quality of life and self-report symptoms of tinnitus, hearing loss, dizziness, sleep, attention, anxiety and fatigue in workers exposed to excessive noise.

Material and Methods:
The study included 111 workers working in noisy environments and 74 individuals not working in noisy environments (control group). The Short Form (SF)-36 scale was used to evaluate the participants' quality of life, and the visual analogue scale (VAS) was used to assess the self-report symptoms.

Result:
Self-report tinnitus, hearing loss, dizziness, sleep, attention and anxiety scores of the workers were worse than the control group ($p<0.05$). In addition, the physical function, physical role restriction, social functionality, pain and general health scores of the workers, which are the sub-dimensions of SF-36, were worse than the control group ($p<0.05$). However, there was no difference between the groups in terms of emotional role, mental health, and energy/vitality scores ($p>0.05$).

Conclusion:
Noise increases workers' self-report symptoms and reduces their quality of life. By taking more precautions against workplace noise, workers' health and working performance can be protected.

Key Words:
Workers, Hearing, Balance, Sleep, Anxiety

ÖZ

Amaç:

Gürültü, insan sağlığını etkileyerek fizyolojik ve psikolojik değişikliklere neden olabilir. Bu çalışmanın amacı, gürültülü ortamlarda çalışan işçilerde yaşam kalitesini ve öz-bildirim kulak çınlaması, işitme kaybı, dizziness, uyku, dikkat, kaygı ve yorgunluk semptomlarını araştırmaktır.

Gereç ve Yöntemler:

Çalışmaya, gürültülü ortamlarda çalışan 111 işçi ve gürültülü ortamlarda çalışmayan 74 birey dahil edildi (kontrol grubu). Katılımcıların yaşam kalitelerini değerlendirmek için Kısa Form (KF)-36 ölçeği, öz-bildirim semptomlarını değerlendirmek için görsel analog skala (GAS) kullanıldı.

Bulgular:

İşçilerin öz-bildirim kulak çınlaması, işitme kaybı, dizziness, uyku, dikkat ve kaygı skorları kontrol grubuna göre daha kötüydü ($p<0.05$). Ayrıca işçilerin KF-36 alt boyutlarından fiziksel fonksiyon, fiziksel rol kısıtlaması, sosyal işlevsellik, ağrı ve genel sağlık skorları kontrol grubuna göre daha kötüydü ($p<0.05$). Ancak gruplar arasında emosyonel rol, ruhsal sağlık, enerji/canlılık skorları arasında bir fark yoktu ($p>0.05$).

Sonuç:

Gürültü, işçilerin öz-bildirim semptomlarını artırır ve yaşam kalitesini azaltır. İş yerinde gürültüye karşı daha fazla önlem alınması ile işçilerin sağlıkları ve çalışma performansları korunabilir.

Anahtar Kelimeler:

İşçiler, İşitme, Denge, Uyku, Kaygı

INTRODUCTION

Noise, defined as unwanted and unpleasant loud sounds, is one of the most important causes of occupational disease. It is known that approximately 22 million individuals in the USA are exposed to excessive noise (1). The prevalence of exposure to excessive noise at work has been reported as 25% in the USA, 15% in Canada and 20% in the European Union countries (2-4). This rate is even higher in developing countries where cheap labour is available (5). Work-related occupational diseases as a result of noise cause irreversible problems in the health of workers and loss of workforce in workers. Compensation and health expenditures paid for these occupational diseases negatively affect the economy of employers and countries (6).

The noise exposure level is limited to 85 dB(A) for one working day (8 hours) to prevent noise-related health problems (7). The primary effect of noise is on the auditory system. Excessive noise damages the hair cells in the inner ear, and noise-induced hearing loss (NIHL) occurs. Unrehabilitated hearing loss causes communication problems, stress, social isolation, loss of workforce and a decrease in cognitive capacity in workers (8). In many countries, the rights of workers exposed to noise are guaranteed by laws. The hearing levels of these workers are monitored with a pure tone audiometry test, which is routinely applied annually, and various protection programs are applied to these workers (9). Recent studies have reported that vestibular loss may also occur in workers exposed to noise due to the anatomical proximity of the hearing and balance systems (10). As it is known, vestibular losses can increase the risk of falls and occupational accidents in workers working under challenging conditions. In addition to inner ear injuries, it has been reported that there is a relationship between excessive noise and depression, anxiety, cardiovascular diseases and annoyance (11, 12).

While it has been stated that noise affects many systems and quality of life, studies investigating self-reported symptoms from a broad perspective are limited (8-13). Knowing the self-reported symptoms of workers exposed to excessive noise also provide valuable information in estimating the prevalence of at-risk workers. Thus, this study aims to investigate the quality of life and self-report symptoms in workers exposed to excessive noise. In our study, workers' tinnitus, hearing loss, dizziness, sleep, attention, anxiety and fatigue were questioned as self-report symptoms.

MATERIAL and METHODS

This prospective case-control study was conducted on 111 workers who applied to the otolaryngology outpatient clinic and worked in noisy environments for at least one year (noise group). Seventy-four individuals who were similar to the study group in terms of age and gender and who had not worked in noisy environments before were included in the study as the control group. Participants' demographic information, smoking and alcohol use status were noted. The Short Form (SF)-36 scale was used to assess the participants' quality of life, and the visual analogue scale (VAS) was used to assess self-report symptoms. Participants were excluded if they had work-related accidents, neurological diseases (except migraine), visual impairment that cannot be corrected with lenses, musculoskeletal disorders (such as amputation, joint replacement, rheumatoid arthritis) and uncontrollable systemic disease. Written and verbal consent was obtained from all individuals. The study was carried out in accordance with the Declaration of Helsinki Principles. In addition, permission was obtained from the Ethics Committee of Karabük University Non-Interventional Clinical Research for the study (2021/657).

Occupation of Workers and Noise Measurement

All of the workers in the noise group were working in the same metal industry-machinery field. According to noise measurements carried out routinely annually by international standards (ISO 9612), workers were exposed to daily (8-hour working hours) average Lex was 93.2 dB(A), and the P peak C was 137.98 dB(C).

Evaluation of quality of life

The SF-36 scale was used to assess the quality of life. The Turkish validity and reliability study of the scale was performed by Kocyigit et al. (14). SF-36 has eight sub-dimensions and consists of 36 items. These dimensions are; physical function, physical role restriction, emotional role, energy/

vitality, mental health, social functionality, pain and general health. A high score indicates a high quality of life.

Evaluation of self-reported symptoms

A visual analogue scale (VAS) was used to evaluate self-reported symptoms. Tinnitus, hearing loss, dizziness, sleep, anxiety, attention and fatigue were evaluated with VAS. A 10 cm line was drawn for each symptom to be evaluated on paper, and the endpoints of the line were numbered 0 (no complaints) to 10 (I have extreme complaints). The individual was asked to mark a point on this line suitable for the severity of their complaint. Then, the point marked by the individual was measured with a ruler, and the individual's VAS score was determined.

Statistical analysis

IBM SPSS 21 software was used for statistical analysis. The normality distribution was checked with the Shapiro-Wilk test. Normally distributed data were presented as mean± standard deviation (sd), and non-normally distributed data were presented as median (minimum (min)- maximum (max)). To compare the quality of life and VAS scores between the groups, the T-Test was used if the data were normally distributed, and the Mann Whitney-U test was used if they were not. Which of the two tests was used is presented in the tables. The relationship between working time, VAS scores and quality of life was examined with the Spearman correlation test. In all statistical analyses, $p<0.05$ was accepted as the statistical significance level.

RESULTS

Of the 111 workers in the noise group, 84 (75.7%) were male; 27 (24.3%) were female, and the mean age was 39.03±10.72 (22-60) years. Of the 74 workers in the control group, 49 (66.2%) were male; 25 (33.8%) were female, and the mean age was 37.71±7.95 (27-60) years. There was no difference between the groups in terms of gender and age (p:0.161, 0.469, respectively).

Seventy-two (64.8%) workers in the noise group were working in iron and steel, 19 (17.1%) in textile, 8 (7.2%) in carpentry, 6 (7.7%) in laundry and 6 (7.7%) in scrap workshop. The workers' working time in noisy environments was 13.37±9.96 (1-47) years. The incidence of workers' self-report symptoms was 91 (82%) tinnitus, 82 (73.9%) hearing loss, 75 (67.6%) dizziness, 90 (81.1%) sleep problem, 104 (93.7%) inattention, 106 (95.5%) anxiety and 108 (97.3%) fatigue. The incidence of self-report symptoms in the control group was 25 (33.8%) tinnitus, 25 (33.8%) hearing loss, 34 (45.9%) dizziness, 47 (63.5%) sleep problem, 56 (75.7%) inattention, 64 (86.5%), anxiety and 68 (91.9%) fatigue. Forty-eight (43.2%) of the workers in the noise group were smoking, and 45 (40.5%) were using alcohol. Forty (58.1%) of the workers in the control group were smoking, and 31 (41.9%) were using alcohol. There was no difference between the groups in terms of use (p: 0.149, 0.855, respectively).

When the VAS scores of the groups were compared, the tinnitus, hearing loss, dizziness, sleep problem, inattention and anxiety scores of the workers working in a noisy environment were worse than the control group ($p<0.05$). However, there was no difference between the groups in terms of fatigue score ($p>0.05$). VAS scores by groups are presented in Table I.

Table I. Visual analogue scale (VAS) scores by groups.

VAS	Noise Group Median (min-max) n:111	Control Group Median (min-max) n:74	p*
Tinnitus	3 (0-6)	0 (0-5)	<0.001
Hearing Loss	2 (0-7)	0 (0-9)	<0.001
Dizziness	2 (0-8)	0 (0-5)	<0.001
Insomnia	3 (0-7)	1 (0-10)	<0.001
Inattention	3 (0-6)	2 (0-9)	0.003
Anxiety	4 (0-10)	3 (0-10)	0.048
Fatigue	5 (2-9)	5 (0-10)	0.523

*Mann Whitney-U test

When the quality of life was compared between the groups, the physical function, physical role restriction, social functionality, pain, and general health scores of the noise group were worse than the control group ($p<0.05$). However, there was no difference between the groups in terms of emotional role, mental health, and energy/vitality scores ($p>0.05$). SF-36 sub-dimension scores according to the groups are presented in Table II.

Table II. Short Form-36 sub-dimension scores by groups.

Short Form-36	Noise Group Mean±sd or Median (min-max) n:111	Control Group Mean±sd or Median (min-max) n:74	p*
Physical function	85.00 (10-100)	90 (20-100)	0.005[a]
Physical role restriction	75.00 (0-100)	100 (0-100)	0.048[a]
Emotional role	83.33 (0-100)	100 (16.66-100)	0.056[a]
Energy/vitality	52.34 ±18.21	52.64±21.75	0.921[b]
Mental health	64 (36-92)	59.46±18.68	0.189[a]
Social functionality	62.50 (0-100)	75 (0-100)	<0.001[a]
Pain	65 (0-100)	77.50 (0-100)	<0.001[a]
General health	52.88±14.24	62.77±17.18	<0.001[b]

a: Mann Whitney-U test, b: T-test

Considering the relationship between working time, quality of life and self-report symptoms; a positive relationship between working time and tinnitus, hearing loss, sleep problems, inattention, and fatigue. There was a negative correlation with the sub-dimensions of the quality of life index ($p<0.05$). The relationship between working time, VAS scores and quality of life is presented in Table III.

Table III. The relationship between working time in noisy environments and VAS scores and quality of life.

		Working Time (years) 11 (1-47)	
	Mean±sd or median (min-max)		
VAS		correlation coefficient (r)	p*
Tinnitus	3 (0-6)	0.19	0.039
Hearing Loss	2 (0-7)	0.42	<0.001
Dizziness	2 (0-8)	0.25	0.007
Insomnia	3 (0-7)	0.36	<0.001
Inattention	3 (0-6)	0.21	0.023
Anxiety	4 (0-10)	0.08	0.386
Fatigue	5 (2-9)	0.27	0.004
SF-36			
Physical function	85.00 (10-100)	-0.54	<0.001
Physical role restriction	75.00 (0-100)	-0.63	<0.001
Emotional role	83.33 (0-100)	-0.40	<0.001
Energy/vitality	52.34 ±18.21	-0.56	<0.001
Mental health	64 (36-92)	-0.51	<0.001
Social functionality	62.50 (0-100)	-0.29	0.002
Pain	65 (0-100)	-0.34	<0.001
General health	52.88±14.24	-0.37	<0.001

VAS: Visual Analogue Scale, SF-36: Short Form-36

DISCUSSION

Noise, which harms human health, is examined under two headings; acoustic trauma and chronic workplace noise. Acoustic trauma describes sudden, short-term, very loud sounds (such as a shotgun explosion). It mainly damages human health directly mechanically, and some recovery can be observed after trauma. Chronic workplace noise describes prolonged exposure to loud sounds. Health problems due to chronic exposure occur over a period of time but are more permanent (15). This study investigated the quality of life and self-reported symptoms in individuals exposed to chronic workplace noise. In our study, the quality of life and self-report tinnitus, hearing loss, dizziness, sleep problem, inattention and anxiety scores of the workers working in noisy environments were worse than the control group.

Workplace noise is thought to affect the peripheral organs in the inner ear both metabolically and ischemically (16). Reactive oxygen species (ROS) is a normal byproduct of cellular respiration metabolism. Noise causes an increase in the level of ROS in the inner ear. Increased ROS level causes oxidative damage to DNA, proteins, cell surface receptors and membrane lipids (17). In addition, vasoconstriction occurs in the blood vessels supplying the cochlea due to noise exposure. Thus, slowing the blood flow to the cochlea affects the hair cells. These theories also explain the vestibular loss observed in some individuals with NIHL. Both vestibular and auditory receptors share the membranous labyrinth, and the same end artery provides blood flow. Therefore, increased ROS or decreased blood flow to the inner ear can cause auditory and vestibular symptoms. Although there are many studies on NIHL in the literature, noise-induced vestibular loss and tinnitus are current issues, and interest is increasing daily. A study conducted in the USA reported that the prevalence of self-report hearing loss and tinnitus in individuals exposed to noise was higher than in individuals not exposed to noise, and the prevalence of hearing loss and tinnitus was 23% and 15%, respectively (18).

Another study using VAS reported that the prevalence of tinnitus, hearing loss and vertigo attacks in workers was 76.2%, 52.4% and 30.9%, respectively (19). In our study, the prevalence of tinnitus, hearing loss and dizziness were 82%, 73.9% and 67.6%, respectively. These differences in prevalence may be due to the method used to reveal the symptoms and the differences in the questions. Yes/no answers are very sharp decisions, and individuals must respond according to the dominant side. The VAS, which is used as a useful tool for grading pain, can be used to detect and rate many other symptoms, as we used in our study. With VAS, symptoms can be graded from 0 to 10. Therefore, mild symptoms are also considered in the evaluations with VAS, and the prevalence may increase. The reason why dizziness is more prevalent in our study may be our questioning of all types of dizziness (vertigo, disequilibrium, presyncope or lightheadedness).

Noise is a non-specific biological stressor that can affect the entire physiological system of the body beyond the inner ear. The effects of noise on stress have been investigated, and it has been reported that it causes negative changes in stress hormones (20). Due to these hormonal changes, individuals' heart rate, respiratory rate and blood pressure increase while their attention level decreases. Consistent with the literature in our study, it was determined that the noise group experienced more sleep problems, inattention and anxiety than the control group (21-24). These negatives have often been associated with sleep annoyance. Beheshti et al., stated in their study that noise causes annoyance, and annoyance also causes sleep problems (21). In other words, they emphasized that noise indirectly causes sleep disturbance by causing noise annoyance. Similarly, Beutel et al., stated that noise annoyance triggers stress, and stress can worsen psychiatric disorders such as anxiety (24).

Quality of life, defined as individuals' perception of their position in life about their goals, expectations, standards and concerns, is directly related to the health status of individuals. Therefore, the noise exposure of workers who have to work to survive can affect the quality of life and the health of workers. Otoghile et al., evaluated the workers' quality of life working in the sawmill with the World Health Organization Quality of Life (WHO-QoL) (25). They reported a significant decrease in the general, physical and psychological components of the workers' quality of life due to occupational noise. In another study, the quality of life of workers working in noisy environments was evaluated with the WHO-QoL (13). The authors reported that the workers' social and physical quality of life scores were worse than the control group, and there was no difference between the mental and environmental quality of life scores. In our study, unlike these studies, we evaluated workers' quality of life with SF-36. Physical function, physical role restriction, social functionality, pain and general health scores, which are sub-dimensions of the scale, were worse than the control group. Therefore, the physiological and psychological effects of noise on individuals may have reduced their quality of life (21-24).

Although noise is a type of pollution, such as soil and water pollution, it is considered less important because it is not permanent (it disappears with the termination of the noise). However, the effects of noise can cause permanent health problems. The effects of noise can be reduced by some applicable methods, such as informing the workers more about noise, encouraging them to use hearing protection, and making noisy/quiet environment rotations at specific intervals. In this way, the adverse effects that will affect the workers' health and work performance can be reduced.

CONCLUSION

Our study determined that the quality of life and self-reported tinnitus, hearing loss, dizziness, insomnia, inattention and anxiety scores of the workers working in noisy environments were worse than the control group. By taking more precautions against workplace noise, workers' health and working performance can be protected.

Ethics Committee Approval:

This research complies with all the relevant national regulations, institutional policies and is in accordance with the tenets of the Helsinki Declaration, and has been approved by the Ethics Committee of Karabük University Non-Interventional Clinical Research (approval number: 2021/-657).

Informed Consent:

All the participants' rights were protected and written informed consents were obtained before the procedures according to the Helsinki Declaration.

Author Contributions:

Concept – E.S., Ç,K.; Design - E.S., Ç,K.; Supervision – N.Y.; Resources - E.S., Ç,K.; Materials - E.S., Ç,K.; Data Collection and/or Processing - E.S., Ç,K.; Analysis and/ or Interpretation - E.S., Ç,K. N.Y.; Literature Search E.S., Ç,K. N.Y.; Writing Manuscript - E.S., Ç,K. N.Y.; Critical Review - N.Y.

Conflict of Interest:

The authors have no conflict of interest to declare.

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