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HEARING HEALTH AND OCCUPATIONAL SAFETY RISKS FOR CONSTRUCTION WORKERS

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Gönderi Kimliği

trn:oid:::1:3086393244

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20 Kas 2024 14:28 GMT+3

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21-22 NOVEMBER 2024, ÇANKIRI, TÜRKİYE

HEARING HEALTH AND OCCUPATIONAL SAFETY RISKS FOR CONSTRUCTION WORKERS

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Abstract

Noise is a significant public health problem, especially in the auditory system, but also in general health. Workers with hearing loss face challenges in terms of personal safety. They are also at higher risk of work-related injuries and are more likely to be unemployed. Noise has become an increasingly important issue, and its effects are being discussed in many sectors. Noise, which can affect individuals in many cognitive, social, and physiological aspects, is important to address from many angles, especially since it is a large part of the working lives of construction sector workers. In noisy work environments, communication is critical for work performance and/or safety. It is known that noise negatively affects interpersonal communication and reduces work efficiency. It has been determined that the effects of noise are evaluated in many sectors, but there is no comprehensive research in the construction field in Turkey. Today, it is essential to determine the share of occupational health and safety practices applied in all business areas in the construction sector and the measures to be taken. Unlike businesses in the industry in general, activities in the construction sector are not always fixed and carried out in a single location. Therefore, noise levels are constantly changing. It is important to discuss the national regulations and assessments that address general occupational health and safety practices in relation to hearing health and noise, and the effects of these measures on hearing health. This review discusses the interactions of noise with hearing loss and tinnitus and the rules that workers must follow in this sector.

Keywords: *hearing loss, noise, workplace health and safety, civil engineering*

1. Introduction

Noise is a major public health problem, with particular effects on the auditory system but also with adverse effects on general health. Hearing loss and tinnitus are common risks associated with occupations with high levels and prolonged exposure to noise, such as construction, agriculture, and music industries [1]. Between 7% and 21% of hearing loss in adults is attributable. Noise-induced hearing loss is one of the most common occupational diseases [2]. In a study conducted in the United States, hearing loss and tinnitus symptoms of workers exposed and not exposed to noise were evaluated and hearing loss was detected in 7% of workers who were not exposed to noise and 23% of those who were exposed. In this study, the proportion of patients with tinnitus complaints was 15% in workers with noise exposure and 5% in those without noise exposure. [3]. In another study involving different sectors, hearing loss was reported in 25% of American construction workers and 37-58% of musicians exposed to noise [4], [5]. In different studies evaluating the noise exposure of construction workers, musicians, and agricultural workers, the average noise equivalent exposures were 72-112 dBA for construction workers, 75-98 dBA for musicians, and 62.6-92.1 for agricultural workers for 8 hours. [6], [7].

When international and national studies are evaluated, it is seen that different sectors have been investigated together. Still, especially in Turkey, there is no comprehensive research on noise exposure of construction workers and general occupational health and safety measures. This review investigated international studies in the field of construction, occupational health and safety regulations in Turkey, and the measures taken.

Some studies have reported that noise is not the only workplace risk factor for hearing loss. Some chemicals used in industrial processes have also been shown to have ototoxic effects in combination with noise or other chemicals. Ototoxic chemicals fall into four main categories: solvents (e.g., toluene, styrene, ethylbenzene, trichloroethylene), asphyxiants (e.g., carbon monoxide, hydrogen cyanide, acrylonitrile), heavy metals (e.g.,

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mercury, lead, tin) and polychlorinated biphenyls. The effects of ototoxic chemicals can sometimes mimic the effects of noise through similar physiological processes, making it difficult to determine the specific impact of individual factors on workers [8].

Noise-induced hearing loss is caused by damage to the outer hair cells present in the cochlea. The damage can occur through multiple mechanisms, including mechanical, ischemic, or metabolic. Regardless of the pathway leading to hair cell destruction, hair cells in mammalian species do not regenerate, so noise-induced hearing loss is permanent [9].

An auditory exposure of sufficiently high intensity can separate the organ of Corti, located in the inner ear, from the basilar membrane and reach a force that can disrupt the integrity of the barrier between endolymph and perilymph [10].

Studies show that noise exposure of at least 130 dB sound pressure level (SPL) is required to cause direct mechanical damage to the ear [9].

Permanent sensorineural hearing loss is the most common and most serious effect of noise-related occupational exposure, characterized by a "notch" in the configuration of audiometry thresholds. The weakest thresholds occur in the 3000-6000 Hz range, with better thresholds above and below these frequencies. The primary notch frequency is related to the spectrum of the noise source, the size of the ear canal, and its associated resonant frequency. With continuous exposure, the noise notch deepens and spreads to adjacent frequencies, as shown in Figure 1. Noise has been found to be associated with and potentially affects the auditory system and cardiovascular health. Whether there is a causal relationship between noise and cardiovascular pathologies is still debated. Although the pathophysiology is unknown, it is theorized to work through the autonomic nervous and endocrine systems. The stress response to noise can trigger elevated heart rate and blood pressure. Over time, chronic stress leads to a chronic stress response and can contribute to risks of hypertension (chronically high blood pressure), high cholesterol, and coronary heart disease. The literature has consistently shown a moderate association between occupational noise exposure and hypertension [11], [12].

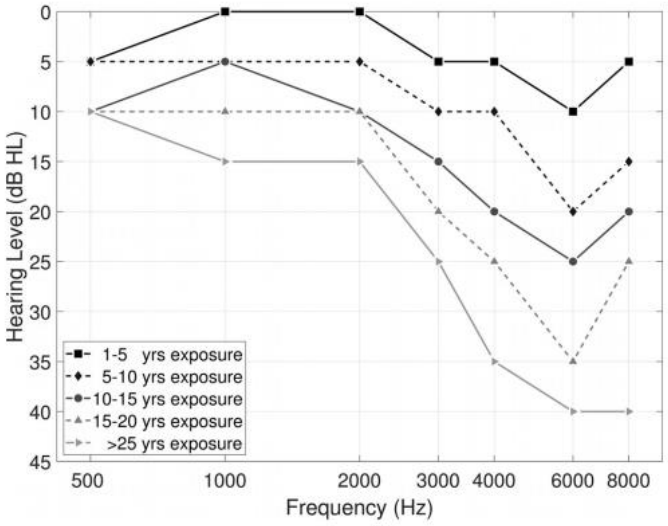

Figure 1. Progression of noise-induced hearing loss with repeated exposure [13].

Middendorf et al. (2004) reported that in their study between 1979 and 1999, the highest average exposure levels were recorded in Construction (94.9-96.7 dBA), followed by Mining (93.6-93.7 dBA), Manufacturing (89.9-91.9 dBA), Agriculture (89.9-91.6 dBA) and Wholesale Trade (89.7-91.2 dBA). [14].

Choi et al. (2012) analyzed occupational information network data to identify the occupations where noise exposure occurs most frequently. They reported that Transportation and Material Handling technicians, Extraction and Precision Manufacturing occupations, Vehicle and Mobile Equipment Mechanics and Repairers, and Machine Operators ranked highest in noise exposure assessments [15].

In many work environments, communication is critical to work performance and safety. High noise levels especially have a negative impact on speech communication. In general, a signal-to-noise ratio between 6-12 dB is required for clear speech understanding [16].

Studies have shown that noise exposure is the primary cause of preventable hearing loss. The most common protective equipment used to protect against the effects of noise and maintain healthy communication is ear protection plugs. Ear protectors used to protect against the effects of loud noise can change speech intelligibility in noise. Studies have shown that noise levels of 90 dbA and above have a very positive effect on speech intelligibility, but if the noise level is below 85 dBA, speech intelligibility is negatively affected. [9], [13], [17].

Although ear protectors can improve the ability of normal hearing individuals to accurately detect speech signals in the presence of loud background noise, workers with hearing loss are reported to have more difficulty hearing warning signals [18]. However, left untreated, hearing loss can lead to stress and fatigue, as well as communication difficulties and social isolation. [17].

Stress is reported to be associated with depression, cognitive decline, dementia, falls, increased hospitalizations and healthcare costs, and mortality associated with the effects of fatigue and social isolation. Workers with hearing loss face challenges not only psychosocially but also in terms of their personal safety. Individuals with sensory deficits are at higher risk of work-related injuries and are more likely to be unemployed [13], [17], [19], [20], [21].

Unlike other noisy environments, in construction work sites, the sound elements are not always constant and in one place. Therefore, noise levels and exposures are constantly changing. Construction work is often done outdoors, under the influence of weather conditions, wind tunnels, topography, atmosphere, and the environment. In addition, noise sources in construction, e.g., heavy excavation machinery, may move from one location to another; their intensity may vary considerably during working hours [22].

The equipment commonly used in the construction industry and the sound levels they generate are presented in Table 1. Looking at this frequently used equipment, it is seen that the sounds at construction sites are at serious heights.

Table 1. Noise Levels of Construction Equipment [22]

Construction Equipment	Audio Range dBA	Construction Equipment	Audio Range dBA
Wheel Loader	85-91	Battering-Ram	82-105
Digger Loader	79-89	Hydraulic Breaker	90-100
Road Roller	79-93	Generator	<85
Dozer	89-103	Asphalt Paver	100-102
Truck	88-103	Skreyper	84-102
Concrete Mixer	<85	Pneumatic Breaker	94-111
Crane	97-102	Greyder	<85

2. Results

The construction sector has always been the locomotive sector of countries with the added value and employment opportunities it provides to the economy. However, occupational accidents in the sector constitute major problems for our country as in many countries of the world. In order to prevent occupational accidents, minimize losses, and raise awareness of all parties in the sector, the occupational health and safety legislation in the European acquis within the framework of the European Union harmonization process was introduced into the working life of our country with the regulations published in 2003 and 2004 based on Article 78 of the Labor Law No. 4857. These legislations were updated within the scope of the Occupational Health and Safety Law No. 6331 dated 20/6/2012.

Among these regulations, the “Regulation on Occupational Health and Safety in Construction Work”, which is based on the Council Directive 92/57/EEC of the European Union, determines the minimum health and safety requirements for construction workplaces.

In order to reduce noise-related accidents and diseases in construction work sites, a detailed analysis of sound sources should be made as a priority. Workers working with sources that produce noise above the risky level must use their personal protective equipment fully and completely. In addition, efforts should be made to reduce

the sound production of these noise elements as much as possible. All employees and employers should be made aware of occupational health and safety. This study presents a preliminary investigation of noise and its effects at construction sites.