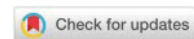


# OCCUPATIONAL EXPOSURE TO NOISE DURING AIRPORT GROUND HANDLING - IMPACT AND RECOMMENDATIONS TO REDUCE THE OCCUPATIONAL RISK OF DAMAGE TO THE HEALTH OF WORKERS. CURRENT STATE OF LEGISLATION IN THE FIELD OF NOISE PREVENTION IN THE WORKPLACE IN BULGARIA

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**Abstract:** Those working in the ground handling of aircraft at the airport in the process of performing their activities are exposed to the impact of a complex of harmful and dangerous risk factors, including noise. Noise in the working environment above 85 dB(A) is one of the first unfavorable factors at the airport that affect the functional state of various organs and systems in the human body. Exposure to noise in the work environment at or above 85 dB(A) can cause a number of complaints related to the central and autonomic nervous systems, disorders in the vestibular and auditory apparatus up to permanent hearing loss, reduced work capacity, impaired concentration, fatigue, difficulty in verbal communication, the ability to hear warning signals, respond to environmental sounds, etc. All this affects the general safety and is a prerequisite for the occurrence of aviation accidents caused by the human factor. The purpose of the present study is to present the results of research conducted on noise at the airport itself and its impact on ground staff, by deriving good practices and examples, to make general conclusions and proposals with a practical orientation for the introduction of a standard for health monitoring and prevention of the risk of noise exposure among airport ground handling workers. The methods used are documentary, formal-logical with analysis of official documents, systematic review of articles and data in the surveyed area. The results of the survey show the lack of clear legal rules and standards in the Republic of Bulgaria regarding the health screening of hearing for those working in environments with excessive noise levels, including for ground handling operators at airports. Therefore, solutions to this problem must be implemented, in particular through the introduction of a standard and the introduction of clear criteria for health monitoring, engineering, ergonomic knowledge and preventive measures. Hearing prevention, early screening and health monitoring among workers at excessive levels of noise in the work environment should be a priority of every legislation, responsibility and obligation of every employer.

**Keywords:** aviation noise, ground personnel, noise-induced hearing loss, legislation, airports  
Field: Medical Sciences and Health Care

## 1. INTRODUCTION

Airport ground handling workers are exposed to noise in the work environment. Sources of noise in the airport area are the aircraft itself (taxiing, landing, starting, take-off) and a number of ground operations such as the use of auxiliary equipment in preparing the aircraft for flight, engine tests, baggage handling equipment, maintenance activities at the airport, auxiliary power units, traffic to and from the airport, etc. Aviation noise can be characterized as broad-spectrum, non-constant, high-frequency /100-125 dBA/. Studies in this field indicate that long-term exposure of workers to this noise, without the use of protective equipment, adversely affects their organism. The negative influence of noise can be potentiated by other factors such as general vibrations, unfavorable microclimatic conditions when working outdoors during a transitional, cold and warm period of the year, emotional overstrain, working in an environment with a shortage of time, fatigue, etc. /1, 2,4,12/

A number of clinical studies conducted among workers in an environment with excessive noise levels show a direct impact and damage to the auditory analyzer of the sensorineural type during continuous work in this environment, limiting the worker's ability to hear high-frequency sounds, with a disturbance in the understanding of speech and impaired communication, psychological and physiological disorders, sleep disorders, poor cognitive ability, etc. Exposure to noise is thought to cause a response

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in the autonomic nervous system and the endocrine system, leading to increased secretion of the stress hormone, which can lead to an increased risk of hypertension, cerebrovascular disease, stroke, coronary heart disease./ 6/. A correlation was established between the mentioned changes and the degree of sensorineural hearing loss. /12/. Studies show that exposure to high levels of noise is associated with higher morbidity and mortality from cardiovascular diseases /3/ This important issue is not discussed enough even today.

Studies worldwide show that Noise-Induced Hearing Loss (NIHL) is one of the most common occupational diseases and is the second most common form of sensorineural hearing loss after presbycusis / hearing loss associated with age changes/. The World Health Organization (WHO) defines NIHL as “a persistent reduction in hearing threshold levels (HTLs), with a characteristic reduction in hearing sensitivity at frequencies of 3–4 kHz and/or 6 kHz of more than 25 dB and relatively better hearing sensitivity at close frequencies (2 or 8 kHz) for 25 dB or less”. /10/

The National Institute for Occupational Safety and Health (NIOSH) has recommended that all worker exposures to noise should be controlled below a level equivalent to 85 dBA for eight hours to minimize occupational noise induced hearing loss.

The aim of the present study is to present results with conclusions and conclusions from research carried out at large airports in different strata on the impact of occupational noise on the health and safety of airport ground handling workers, by deriving good practices and examples, making generalizations conclusions and proposals with a practical orientation for the introduction of a standard for health monitoring and prevention of the risk of exposure to occupational noise among workers in the Republic of Bulgaria, including those working in ground handling at airports.

## 2. MATERIALS AND METHODS

The report preparation approach includes methods and tools for collecting and researching information from a variety of sources. A large number of publicly available regulatory documents, online database, articles from PubMed, Embase, Web of Science, Scholar Commons, Google Scholar and literature surveys were reviewed. The inclusion criteria for the review papers were “occupational noise exposure”, “hearing loss”, “relationship between occupational noise and hearing loss”, etc. The main methods of research are documentary, the methods of logical connection and sequence, which are used for the purpose of scientific systematization and summary of the facts related to the discussed topic. Worldwide, there have been many reported cases of occupational hearing loss in workers exposed to excessive noise levels in the workplace in more than four decades of findings. The dangers of exposure to occupational noise are recognized and documented in many countries. Therefore, solutions to this problem must be implemented, in particular through engineering, ergonomic knowledge, preventive and medical-prophylactic measures /3/

## 3. RESULTS AND DISCUSSIONS

A number of studies have been conducted on the prevalence of noise-induced hearing loss (NIHL) at several international airports.

The results of a study /2/, published 2019 on occupational noise exposure among ground handling workers at Sultan Ahmad Shah Airport, Kuantan, Malaysia, conducted through questionnaires and direct measurement of noise around Boeing 737-800 model aircraft, show:

- When 11 persons from the ground handling unit of the ramps, technician, operator of ground equipment, aviation security and general workers were studied, three of them reported hearing problems related to their work, and two of them had a professional work experience of more than 10 years .

- During the noise measurements during take-off, landing and servicing of the aircraft with the engines on, there are peak moments when noise values of 111.4 dBA were measured on average /in the part of the aircraft's landing gear/.

- The average value for a total of 3 days of measurement is 94.2 dBA, which exceeds the permissible level of 85 dBA.

Given that at every landing and servicing of an aircraft, ground staff workers check the condition of the aircraft, including its undercarriage, there is a risk for workers of exposure to high levels of noise in the working environment. This gives grounds in the analysis to recommend the implementation of preventive measures, awareness and training of workers about safety rules when working in the aircraft service area. When applying HPD - internal antiphons / earplugs / the noise level can be reduced by about 30 - 36 dBA

and reach a protection level of 67.9 - 58.2 dBA, which is very effective for workers. /2/

In a survey in 2011 in a commercial airline in Sweden on the hearing status of aircraft maintenance workers found that the Equivalent Noise Exposure Level during working days was 70-91 dB(A) with a maximum noise level of 119 dB(A), which is above Swedish professional standards. /12/

For the period of July 2019 until August 2020 conducted a study of the prevalence and risk factors for NIHL among runway workers at Muscat International Airport in Oman. The methods used in the study are measuring the daily noise exposure level of the workers and questionnaires. The study covered 312 workers in the aircraft take-off and landing area. The results show that 22.30% of workers were exposed to high levels of noise at work. NIHL was found in 21.79% (n = 68), which is lower than the reported prevalence of NIHL in the literature, which is about 33.5-49.4%. / In a 2014 Korean study, the prevalence of NIHL was 49.4%. /1/

In 2001 and 2018 published studies at a major urban airport in Seoul, Korea regarding factors associated with airport workers' hearing loss and the use of hearing protection devices (HPD). The results of the study showed that workers who regularly used HPDs had significantly lower levels of NIHL than individuals who did not wear HPDs or used HPDs less often. /5,6/

In Sudan Journal of Medical Sciences / Vol. 3 no. 3 (2008) published a study on the impact of noise and hearing loss NIHL among Khartoum International Airport Employees /Noise Induced Hearing Loss among Khartoum International Airport Employees/. The results showed that the prevalence of NIHL was 55% among employees who work in the high noise areas of the airport and who do not wear appropriate HPD hearing protection devices. In a 2018 study in Saudi Arabia at King Khalid Airport, the prevalence of NIHL among ground staff was 48% . /7/

In a 2018 study conducted at an airport in a large American city in South Florida, USA, showed increased levels of noise exposure for those working in the airport's ground staff work areas. This necessitates the implementation of Workers' Hearing Protection Programs, including the use of hearing protection devices HPD, which have a sufficiently high level of noise reduction /NRR/. /11/ As early as 1970, the Occupational Safety and Health Act ( OSHA) includes a noise standard for all US industries, making them mandatory to prevent occupational hearing loss.

In published report Zinkin V.N., & SHeshegov P.M.. (2021). Mehanizmy-deystviya-aviatsionnogo-shuma-na-professionalnuyu-rabotosposobnost-i-nadezhnost. *Noise Theory and Practice*, 7 (2 (24)), 165-182, clinical-audiological studies of the hearing analyzer in aviation specialists in civil aviation showed that sensorineural hearing loss was found in 33% of the subjects studied, as 47% of of them are employed by the engineering and technical staff, and 28% by the flight staff. /13/

Pure-tone tone threshold audiometry is used to detect and quantify hearing threshold reduction in frequencies of 16 -18 kHz at the earliest stage of exposure. This can be used as an early diagnostic sign of NIHL. At a later stage, hearing loss occurs around 4000 Hz. The main features of NIHL are symmetrical involvement, characteristic changes in high frequencies of 3000, 4000 or 6000 Hz with recovery at 8000 Hz. Late manifestations of NIHL affect the range of conversational speech in frequencies 500-2000 Hz. /13,14/

Studies of airport groundhandlers have shown that the first signs of permanent impairment in the auditory analyzer of the NIHL type appear from 2 to 5 years into aviation service. Nasir and Rampal stated that age over 45 years and working in a noisy environment for more than 5 years are two important risk factors that can cause permanent hearing loss Other factors that can affect the severity of NIHL and increase the risk is the presence of chronic diseases such as diabetes, hypertension, intake of ototoxic drugs, as well as household hazards such as smoking more than 20 packs per year. A higher rate of NIHL among smokers has been found in the literature and has been reported to be as high as 55% of enrolled smoking participants in some studies. /1,13/.

Studies have shown that the infrequent use of HPDs in environments with excessive noise levels may be a contributing factor to NIHL. In this regard, the Occupational Safety and Health Administration (OSHA) recommends that airport employers provide HPDs to all of their employees to be worn whenever noise exposure is equal to or greater than 85 dBA. Also implement a Hearing Protection Program. /1/

Our study on the health status of ground staff at an airport in the Republic of Bulgaria, conducted using a police method of studying morbidity through the analysis of temporary incapacity for work for the period 2017-2019, shows a higher burden of diseases with temporary incapacity and specific changes in the structure of diseases / a higher frequency of diseases from the group of diseases of the cardiovascular system, nervous system, diseases of the auditory analyzer, etc. / among those working related to the maintenance of the aircraft at the airport and with higher levels of noise exposure in the working environment, compared to the administrative structures of the airport and those working with low exposure and lower values of occupational noise. /9/

## 4. NIHL PREVENTION

A safe and healthy working environment is a basic requirement for all employers and workers. The main objective of prevention measures for NIHL include monitoring occupational noise exposure (e.g. through periodic noise measurements in the work environment), reducing workplace noise exposure (e.g. engineering control, administrative control and personal protective equipment for hearing loss), early detection of changes before permanent damage to the inner ear (eg routine audiometric examinations and health education) Noise prevention programs are an important preventive measure to prevent and reduce the incidence of NIHL among workers. / 3/

Eliminating or reducing noise below 80 dBA through engineering or administrative controls is the best way to prevent the risk of NIHL. The noise exposure limit recommended by the National Institute for Occupational Safety and Health (NIOSH) is a sound level of 85 dB for 8 hours per work day and for a 3 dB change in level (ie for every 3 dB increase at the noise level, the allowable exposure time is halved).

Organizational and administrative measures include reducing the time spent by airport workers in the area affected by high-intensity noise and controlling the wearing of HPD hearing protection devices./13/

Periodic monitoring of noise intensity, duration of exposure of airport ground handling workers, age, other risk factors such as diabetes mellitus, hypertension, intake of ototoxic drugs, smoking, use of hearing protection devices (HPD) are important in the assessment of the occupational risk for the health and safety of workers.

Health monitoring includes preliminary professional selection of workers in environments with excessive noise levels, periodic preventive medical examinations including the general condition of the body to identify persons with increased sensitivity and reduced resistance, susceptible workers / such as those who are older, with certain diseases or had more years of exposure to excessive noise/ and audiometric hearing test. The anamnestic data during the examination are important: family history of hearing loss; lived near the airport; engaged in hobbies with possibly high noise levels (such as riding a motorcycle, shooting a gun, or playing loud music); accompanying diseases that may affect hearing such as diabetes mellitus, hypertension or the use of medications that could affect hearing.

It has been established that in healthy people, after exposure to loud noise, hearing returns to the initial level within 24 hours ie. the temporary decrease in hearing threshold is within 24 hours. Hearing recovery time reflects the degree of fatigue of the hearing analyst and his adaptive capabilities. The temporary decrease in the hearing threshold can be used as a criterion in the occupational selection of personnel for aviation specialists in airport ground handling, to identify individuals with increased sensitivity and reduced resistance to noise.

Laboratory studies show that when exposed to noise with a sound pressure level of 100 dB for 1-6 hours, the magnitude of the temporary decrease in the hearing threshold increases to 7-17 dB, and the recovery time of the auditory analyzer 10-30 min. When the sound pressure level increases to 110 dB, the temporary decrease in the hearing threshold increases to 20 dB, and the recovery time to 2-3 hours. When the sound pressure level increases to 115 dB, the temporary decrease in the hearing threshold increases to 30 dB and the recovery time to 24 hours. /8, 13/

The pure audiometric screening test has a sensitivity of 92% and a specificity of 94% in detecting sensorineural hearing loss and in distinguishing between NIHL and presbycusis (age-related hearing loss). It is important that periodic audiometric screening and training of hearing prevention workers be carried out in order to improve the good practices of aircraft ground handling personnel in order to detect and/or prevent future hearing loss. /1/

An important point in the prevention of NIHL in workers in environments with excessive noise levels is the provision of high-quality personal protective equipment for the hearing of workers, raising awareness of their importance and training in wearing personal protective equipment during work. Data from studies show that earplugs may not provide the regulated level of protection if employees are not instructed in their proper use Infrequent use of HPDs increases the risk of developing NIHL. Continuous training of workers on the proper use of HPDs in environments with excessive noise levels and the implementation of various strategies to encourage the wearing of HPDs is required. /3/

In Bulgaria, in the last 10-15 years, there have been no published data with the results of conducted studies on occupational noise at airports and its impact on the auditory analyzer of those working there. According to data from the National Insurance Institute for Recognized occupational diseases caused by noise for all branches of industry - in 2020. a total of 3 cases were registered in 2019. – 1 case, in 2018 - no registered cases, in 2017 - 3 cases.

The health monitoring of persons working in an environment with excessive noise levels is regulated in Section III of Ordinance No. 6/ 15.08.2005. on the minimum requirements for ensuring the



health and safety of workers at risks related to noise exposure in the work environment and is carried out under Ordinance No. 3/28.02.1987. for the mandatory preliminary and periodic medical examinations of workers. In Ordinance No. 3/1987 there are no clearly regulated requirements and criteria for evaluating changes in the auditory analyzer, accounting for changes in hearing with age, evaluating additional risk factors, evaluating the effectiveness of wearing HPD in workers in environments with excessive levels of occupational noise.

## 5. CONCLUSIONS AND RECOMMENDATIONS

The studies show that the predicted and measured noise values in the vicinity of the aircraft during its ground handling at airports report high noise values above the permissible norms for workers. This noise can significantly affect the health of workers if they are exposed for a long period of time without HPD hearing protection. Also, if workers ignore safety procedures and regulations, working in an environment with high levels of occupational noise can cause hearing problems, cardiovascular system and other diseases. NIHL has been found to be associated with and occur in workers with longer tenure, older age, and irregular wearing of HPD hearing protection.

The purpose of this report was to present results of studies conducted on aviation noise, the prevalence and prevention measures of NIHL. An integrated approach is important in managing the risk of damage to the health of workers in an environment with excessive levels of noise at workplaces. The analysis highlighted the importance of preventive measures, including regular audiometric screening for early detection of hearing loss and ongoing hearing protection programs. In addition, the study demonstrates the importance of administrative and engineering control./1,3/

Hearing loss caused by occupational noise (Occupational Noise-Induced Hearing Loss (ONIHL)) can be prevented. Prevention is the best approach to limit the deterioration of hearing and the extra-aural impact of noise on a person's body. It is important to introduce, apply and the observance of safe work practices, a comprehensive hearing conservation program among airport groundhandlers. The elimination of ONIHL worldwide is a major and long-term challenge at the level of the individual and the overall policy of the organization and the state. Applied measures to prevent ONIHL need from periodic evidence-based evaluations that can provide management with evidence of the effectiveness of ONIHL's Prevention and Control Programs implemented./3/.By implementing effective measures to prevent or reduce exposure to high levels of noise in the work environment at airport ground handling staff, efficient work can be ensured and maintained and the occupational risk of damage to workers' health can be reduced. Engagement of employers and workers is needed; well-defined hearing conservation goals and programs. Managing the occupational risk of exposure to aviation noise for aircraft groundhandling workers at airports would lead to increased safety and performance, staff motivation and the formation of a more favorable workplace environment, which in turn leads to prevention and reduction of the risk of accidents.

In the EU member states, incl. and in the Republic of Bulgaria the standard of the International Civil Aviation Organization ICAO is followed in order to achieve compliance on international standards and recommended practices for civil aviation SARP and policies in support of a safe, secure, efficient, responsible for the environment and working environment, economically sustainable sector of civil aviation, but in the Republic of Bulgaria it is necessary to introduce a standard with regulated criteria for assessing the health status and changes of the auditory analyzer for those working in an environment with excessive levels of occupational noise. It is important to introduce a legal framework and standards with a defined algorithm and clear criteria for personnel selection, dynamic monitoring of health status, including changes in hearing analyzer and risk prevention for workers in excessive noise environments, in order to detect early health effects of the noise impact, preserving the health and working capacity of the workers and the safety of the flights.

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