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Exposure to Industrial Noise in a Naval Maintenance Workshop of the Colombian Caribbean

E.A. Bedoya-Marrugo[1], C.A. Severiche-Sierra Jr[2], J. Del C. Jaimes-Morales[3], L.P. Navarro-Villalobos[4] and Y.A. Marrugo-Ligardo[5]

[1,2] Fundacion Universitaria Tecnologico Comfenalco - Cartagena, Faculty of Engineering, Comfenalco Technological Process Research Center - CIPTEC. Cartagena de indias - Bolivar, Colombia
[3-5]Universidad de Cartagena, Faculty of Nursing, Research Group on Environment, Food and Health - MAAS. Cartagena de indias - Bolivar, Colombia

[1]Orcid: 0000-0002-2931-9600, [2]Orcid: 0000-0001-7190-4849, [3]Orcid: 0000-0002-2931-9625, [4]Orcid: 0000-0002-0113-5594, [5]Orcid: 0000-0003-1653-5408

Abstract

The noise levels were determined in a naval maintenance workshop to determine the degree of exposure and to deduce the exposure time to noise in workers in relation to their working age with the aim of preventing diseases in their hearing. Use was made of the sound meter with integrating filter, duly calibrated, Ques brand with octave band filters and with weighting in A and following the ANSI S1 standards. 1-2004, 1.4-1983 and S1. 1-43-1997. IEC 6162- 2 and 61260 microphone QE 052. The results obtained in the present investigation showed that the equivalent sound levels (Leq) in the work centers are above the 85 dB established by the current Colombian regulations. It could be concluded that the risk is relatively high in the total of workers in acquiring a hearing loss.

Keywords: Industrial maintenance, Hearing loss, Noise, Occupational health, Industrial safety.

INTRODUCTION

The modern industry and the vertiginous advance of the science have given rise to the appearance of new diseases, of which the auditory apparatus is not excluded [1]. The man of today is immersed in a "sea" of noise of all kinds, which appears not only in daily life, work and routine [2]. The damage of auditory acuity, which was once the exclusive property of workers who worked in factories, is now "within reach" of all people [3].

Noise is one of the main causes that potentially produce hearing impairment in most communities [4]. It is estimated that it is worrisome that approximately 20 million or more people in the US they are exposed daily to loud noises, which can permanently damage their hearing [5]. If to this global situation the occupational exposure to noise risks is attached, we definitely have to consider that this is an important health problem [6].

Due to different occupations such as construction, mining and smelting, textile industry, petroleum and petrochemical industry, and electricity generation plants, among others, employees may be exposed to high levels of noise, considering the use of turbines to produce electricity and equipment used for production processes [7].

In some workers who have early hearing loss it is not possible to establish the causal association, because they have only been exposed to low intensity noise; and in addition, the history of previous exposure to noise and / or diseases associated with this phenomenon is unknown or not recorded in the medical history [8]. It has been determined that studies of noise in the industry should be conducted to establish a correlation between hearing loss and noise exposure, emphasizing the need for reliable and valid records [9].

It also has as a result of exposure to high levels of industrial noise there is hearing loss or professional deafness that is nothing more than the hearing loss of both ears, irreversible and cumulative sensoneural nervous type that affects the conversational frequencies [10].

In Chile, hypoacusis caused by exposure to noise represents 80% of permanent disabilities due to occupational diseases, while in Mexico, in a retrospective investigation from 1992 to 2002, it was reported that hearing loss from chronic acoustic trauma represented 41% of the work diseases. During this period, the average number of cases of permanent disabilities, the incidence rate and the valuation percentage showed an upward trend [11].

For Venezuela, hearing loss induced by industrial noise has been placed among the ten leading causes of occupational pathology, with the aggravating factor that little has been done to prevent it [12]. In Colombia, according to a study, carried out by DANE, in the years from 2001 to 2005, it showed that the furniture manufacturers and distributors in Colombia have had an increase, highlighting, that the carpentry presents many of the risks for health and safety of the workers that are common in the industry in general, but with a more obvious proportion of noise where, people subjected to continuous loud noises, experienced serious physiological disorders, such as loss of hearing, alteration of brain activity , cardiac and respiratory, gastrointestinal disorders, among others [13].

In relation to the above, the World Health Organization (WHO) estimated for 2013 that 360 million people have

hearing loss, which represents 5.3% of the world's population, of these, 32 million are boys and girls. Considering what was previously stated, WHO established maximum noise levels in different environments [14]. In Colombia it was established that the maximum allowed during daylight hours in residential areas is 65 decibels (dB); in commercial and industrial areas, up to 70 dB and in quiet areas 45 dB; while at night the maximum allowed is 45 dB in residential areas; 60 dB, in commercials; 75 dB, in industrials; and 45 dB, in tranquility [15].

In the naval maintenance workshops the noise exposure should establish the development of programs of technical measures aimed at reducing the spread of noise, as well as organizational measures aimed at reducing exposure during work, and in this way, recommend a plan of contingency and mitigation directed towards the intervened population with the objective of preventing a work-related illness. In workplaces where 80 dB is exceeded, hearing protectors must be provided to all exposed workers who request it [16].

In this sense, for this research, from the theoretical point of view, it offers a scientific and up-to-date support in relation to exposure to industrial noise in workers in the wood sector, obtaining timely information for future degree work in the area of health and safety at work.

Analyzing from the practical point of view, it is sought to diagnose the alterations in the workers by the exhibition to the noise in order to be able to offer improvements to the company, being able to increase its productivity and quality of life. Since when evaluating the noise levels they can establish preventive strategies and thus generate a safe work environment by minimizing and / or controlling the noise and even the use of personal protection measures.

In this sense from the methodological point of view, since the results obtained after evaluating by means of a sound level meter the noise levels to which the personnel assigned to said company is exposed, it is proposed to determine preventive measures necessary for the control of noise and noise. The promotion of auditory conservation and thus protect the health of workers and their physical and mental integrity.

Seeing from the social approach the previous study seeks to create in the carpentry of transformation of the wood of the naval base of the city of Cartagena and other companies dedicated to this economic activity to the care of the heard sense of the workers exposed to the noise generated by the different machines and / or equipment used throughout this transformation process.

METHODS AND MATERIALS

Type of investigation: For the above, the methodology used in our research is a case study and descriptive type, with regard to the source of research, since the objectives are developed in a purely descriptive, where the information collected was related with the real state of the workers and applied to solve the existing problem, in a naval maintenance workshop of the Colombian Caribbean. In addition, this research has a quantitative approach, since a questionnaire with closed questions was used as a relevant technique to obtain necessary information related to the opinions among the interviewees, about the aspects studied.

Population and sample: It is the finite or infinite set of elements with common characteristics for which the conclusions of the investigation will be extensive. For this case, the population consists of 6 workers in the maintenance area of the naval carpentry workshop, these being the case; the total of individuals studied objects so the sample is the same population.

Define the population census as the number of elements on which it is intended to generalize the results. In this sense, for the present investigation, the population consists of 4 maintenance technicians, 1 supervisor and a department head, who are the ones who intervene in the different naval maintenance processes and therefore are directly exposed to industrial noise.

Noise emission points: inspections of the workstations were made to consider the same characteristics or working conditions in reference to the time and use of the machines within the process developed in the Naval Maintenance Workshop, discarding those equipment and machines, which were in poor operational condition therefore, specific data were recorded such as: the number of operating machines, time of employment, job descriptions, among other information. This process ends once all the information has been collected, where the data referring to each objective study variable was classified and validation, editing, coding, data entry, and analysis activities were carried out to be subsequently represented graphically and quantitatively. The Microsoft Word program was used, which allowed to represent them through the design of a table where the information captured helped to obtain the results of the objectives of the research.

Determination of sound pressure levels: Determinations of the noise levels from fixed sources were made by work posts in the naval maintenance workshop, using as instrument a sound meter with integrating filter, duly calibrated, Ques mark with octave band filters and with weighting in A and BIH 20019 series that meets at least the requirements indicated for a type 2 instrument, established in the ANSI S1 standard. 1-2004, 1.4-1983 and S1. 1-43-1997. IEC 6162
- 2 and 61260 microphone QE 052.

The methodology consisted of placing the meter in operating conditions and off to 1.5 meters in front of each machine and 1.2 meters from the minimum level where they were installed (floor, legs or support of the source) in short periods of fifteen minutes, in a working day of eight hours (measurement time less than the exposure time), being able to consider that the rest of the day would have the same characteristics of exposure to noise, in addition to common work conditions: workers in their jobs, doors open or closed according to daily practice, which was representative of the workday, obtaining

the results of the continuous equivalent sound level (Leq) represented in decibels (dB) as the unit of measurement of sound intensity with frequency weighting (A) which is used for low levels.

The calculation of the sound pressure levels generated by the different sources under study was obtained by subtracting, logarithmically, the corrected residual noise, from the value of the sound pressure level corrected continuous weighted equivalent A, -LRAeq, T as expressed in the following Formula (26):

Leq emission = 10 log (10 (LRAeq, 1h) / 10 - 10 (LRAeq, 1h, Residual) / 10)

Where: Leq emission: Sound pressure emission level, or contribution of the sound source (s), weighted A, LRAeq, 1 h: Corrected level of continuous weighted equivalent sound pressure A, measured in one hour, LRAeq, 1 h, Residual: Corrected level of continuous sound pressure equivalent A weighted, Residual, measured in one hour.

Deduction of the time of exposure to noise in workers: Initially, it was implemented through the instrument type questionnaire ^Direct Observation Guide^ with closed questions allowing to collect information about the workers object of study, especially data on the time in years of exposure to noise to which they are subjected. These data, after being classified and organized, are transcribed in a customized Excel format of surveys / questionnaire and this allowed to create the base of information required for its tabulation and representation in pie charts.

RESULTS ANALYSIS

Sources of noise emission: By collecting the data generated by the workers through direct observation and a survey carried out in the workshop under study, it was possible to specifically define the sources of noise emission in each work post to subsequently carry out the measurements. The inclusion of other existing machines in the place that did not meet the evaluation criterion due to being in poor operational condition was ruled out. For which, the defined sources were: Profiling machine, planer, edger, moulder and circular saw being; in total 5 sources corresponding to each one of the intervened jobs. In addition, it was observed that exposed workers do not carry and use hearing protection (double-cupped) adequate for the level of noise still generated, when the perceived intensity is quite considerable, putting their hearing health at risk.

Subsequently, the information is organized, processed, presented and designed in the Microsoft Word tables program, yielding as results the amount mentioned above in relation to the selected machines, as shown in Table 2 below.

Table 1: Sources of noise emission and their functions in the workplace

Quantity	Sources And Functions	Job	Noise Class Emitted
1	Bilateral profiler. Machine used for sanding and profiling of straight edges on wood	Profiled	Continuous noise
1	Planer Machine for the production of flat surfaces, grooves and other geometric shapes in the pieces	Brushed	Continuous noise
1	Planer Machine for the production of flat surfaces, grooves and other geometric shapes in the pieces	Cutting and thickening	Continuous noise
1	Molding machine. Central cutting system, machine for sectioning and slotted parts	Moldings and slots	Continuous noise
1	Circular Saw / Apparatus for sectioning and grooving small cut pieces	Small cuts	Continuous noise

It is to be considered, that the machinery used in the processes is operated without interruption generating continuous or constant noise, which indicates that the noise level is permanent exposing in a great way the health in the workers.

To classify the type of noise is to consider variables such as the intensity and frequency of its emission, which in a closed space is a condition that has greater relevance due to the level of concentration in the work environment, which is why workers are exposed to 8 hours a day, and without mitigation measures.

Determination of noise levels: Taking into account the procedure given by Res. 0627 of 2006 [17], of the Ministry of Environment, Housing and Territorial Development that establishes the national noise and environmental noise emission standard (Art. 3 and 8), it was possible to find the measurements of the levels of noise emission in each one of the jobs, yielding as first results that of the area of cutting and regruesado with a continuous noise level of 97 dB (A), also highlighting the department of small cuts with 94.4 dB (A) and the one of moldings and grooves and profiling with 92 dB (A) where workers from different areas rotate and finally; the brushing with a value of 87 dB (A), the previous results are reflected in the following Figure 1.

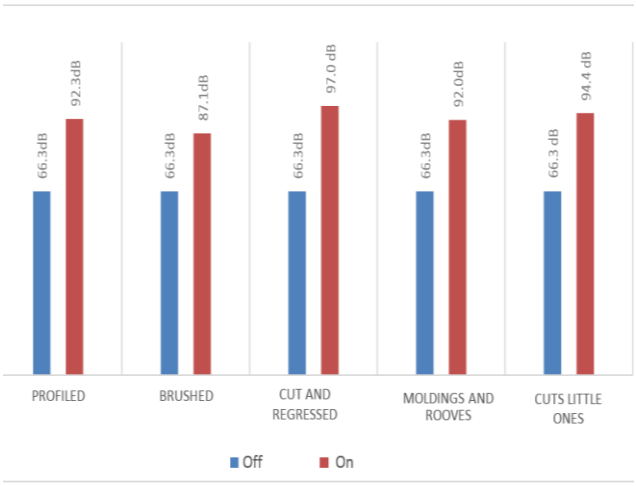

Figure 1: Noise measurements in the workplace

It shows the measurements of the noise levels made in the five workstations where 66.3 dB is considered the base noise level or turned off for later, continue with the measurements with the equipment turned on. Of the measurements made, it is worth highlighting the cutting and thickening work stations with 97 dB (A), small cuts 94 dB (A) and profiling, Molding and grooving with 92 dB (A). These results are worrisome, as the levels of noise emission are greater than 85 dB (A), which is the maximum limit for 8 hours of exposure per day in a work environment without causing a hearing impairment.

On the other hand, after obtaining the results of the noise levels in each work post, it was possible to make the comparison of said levels with the permissible limits for continuous noise, as established by the Colombian norm as shown below in the Table 2 (Res. 1792/2000 Ministry of Housing, Security and Health) [18].

Table 2: Noise levels Vs Permissible limits for continuous noise in Colombia

Noise levels (db)	Job positions	Permissible limit
97	Cutting and thickening	85 DB
94	Small cuts	
92	Moldings and slots	
92	Profiled	
87	Brushed	

From the above it was possible to analyze that the noise levels obtained in the measurements made in the work posts are well above what is established by the Colombian regulations (Res. 1792 of 2000 [18] of the Ministry of Housing, Labor and Health) in relation to the permissible limit for continuous noise that is 85 DB. So it is to note that the probability of suffering a hearing loss is quite high in the population operated, in addition, considering other factors such as exposure time (8 hours), the non-existence of hearing protection in workers, lack of control in the propagation of noise at the source and the medium (acoustic barriers) among other factors.

Time of exposure to noise in workers versus working age: The information about the time of exposure to noise was made through the tabulation of the survey, this instrument, allowed to collect information about the object of study (6 workers), especially data on the exposure time to noise that comes subject the working population carried out in each of the workers where the result obtained is in a range between less than 5 and 15 years. The results could be presented through Graph 2, where the range of more than 15 and less than 5 years showed a 33% change; between 10 and 5 years 17% of exposure to occupational noise.

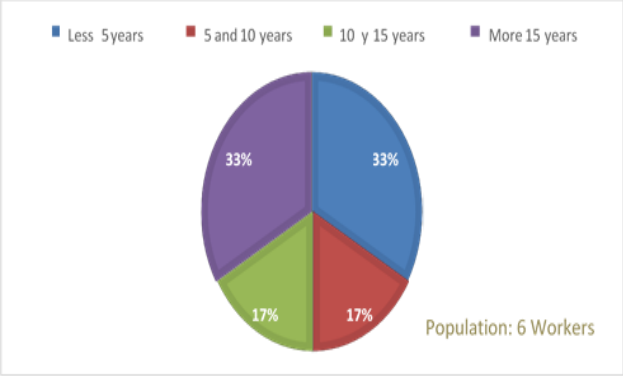

Figure 2: Years of occupational exposure in the population

Among the previous results, those presented between the range of more than 15 years with 33% and those between 10 and 15 years with 17% of occupational exposure stand out; These are the highest value ranges in terms of exposure time, which means that there is a high possibility that the studied workers suffer a hearing loss or any alterations in their health in the short term, in addition to the occurrence of work accidents (AT) as well as a low production considered that the number of workers (6 workers) is low, which generates greater influence to the noise due to the low turnover of the personnel in the process machines, generating that the "exposure time" plays a role determinant in the occurrence of the events previously related.

Table 3: Health effects from exposure to industrial noise

Years of occupational exposition	Effects	Healthy conditions
More than 15 years	1. At the audition	Interference in communication, Hearing loss, Changes in behavior
	2. In the dream	Difficulty falling asleep, Interruption of sleep, Disturbance in the depth of sleep
	3. In physiological functions	Hypertension, Cardiovascular effects, Ischemic heart disease

Concerned with the above, it was possible to assess the possible effects on the health conditions of the population exposed to this pollutant, such as "industrial noise", taking the time of more than 15 years as the most relevant considering that the Existing literature (World Health Organization (2013)) [19] provides information about the effects caused by said agent, highlighting that the longer exposure time the affectation is greater, which allowed making Table 3.

CONCLUSION

From the results presented, from their discussion and from the background of the literature exposed through the article, the following main conclusions can be obtained:

Considering that the levels of noise emission obtained in the results were above 85 dB (A) which, is the permissible limit for an 8-hour day, it is presumed, the existence in the decrease of the auditory threshold in some of the workers by exposure to industrial noise generated from their daily activities. The notable ignorance of workers in the rules of protection against noise affects progressively their hearing health.

They have no culture in the use of hearing protection. The lack of implementation of noise emission monitoring and control programs does not allow measuring and standardizing, according to the regulations, the permissible levels for a healthy and safe environment for the working population.

The non-existence of a maintenance program in the equipment and machines used in the development of the production processes generate disturbances in their operation which stimulates a noisy work environment.

Absence of hygienist personnel and industrial safety to monitor compliance with noise control and mitigation measures that must be implemented in the environment, source and individual.

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