

Noise and Its Legislation. Where Does Health Stands?

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Abstract The WHO identifies noise, an undesired sound, as an environmental problem for humans. Sound is a change of air pressure entering the ear canal and then transmitted to the eardrum, which, in turn, will produce movement of the middle ear bones. The latter amplify the sound reaching the nervous system, where the generated impulses become auditory signal in the brain. Noise is an inarticulate and bothering auditory sensation for the ear that causes health alterations. Measured in decibels (dB), it is legislated at labor and environmental levels. This article explores the application of these legislations, together with a critical analysis. It is essential to take appropriate actions to limit and control exposure to noise, regardless of whether it be on environmental or labor grounds, through the appropriate support of a scientific evaluation.

Keywords: noise, sound, legislations, labor and environmental, health disorders

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1. Introduction

The World Health Organization (WHO) identifies noise as an environmental problem for human beings, its normativity going back even to Romans [1]. Nevertheless, what is noise? Simplistically, it can be defined as an unwanted sound; hence, it is necessary to understand what sound is. Sound is a pressure change of air, entering the ear canal and transmitted to the eardrum, which in turn, produces movement of middle ear ossicles that amplify sound as an auditory signal. Therefore, noise is an inarticulate auditory sensation, annoying to the ear, independently of its intensity [2].

Noise is comprised by two components. First, everything relevant to physics, like sound itself, or its magnitude. Second, its subjective component or sonority, which is the sensation produced by pressure variations in the ear [3].

Sound is measured in decibels (dB) and these increase because sound energy increases. Human ear can withstand sound pressure levels from 0 to 120 dB; being the latter the maximum humans can resist without presenting pain. If a sound already considered as noise increases, it could even cause tympanic rupture [3,4].

At present, noise comes from numerous and diverse sources, increasing its environmental, social, and undoubtedly, health problematics. Even though its everyday and elsewhere presence, position noise as a health risk factor, its health normativity is not specified within a norm. Instead, existing normativity for noise in our country is only focused on its management for the entire Mexican population. This is also true for other countries, including the first world [1,5].

Health damages are diverse and consensus has yet to be reached. It can be mentioned though, that exposure to noise, besides being able to generate hearing damage, or even total hearing loss, also disturbs sleep, affects children's cognitive development, and causes psychosomatic illness [4]. Likewise, occupational exposure to noise, along with uncontrolled blood pressure and physical burden, increases risk of cardiovascular diseases [3]. Table 1 shows some health effects caused by noise, as gathered by WHO [4].

Table 1. Health effects derived from noise, according to Environment, sound Level (dB), and time of Exposure (min)

Health effect	Environment	Level	Exposure
Annoyance	Home outdoors	50-55	16
Communication interference	Home indoors	35	16
Sleep interruption	Bedrooms	30	8
Communication disruption	School classrooms	35	Class duration
Auditory impairment	Industrial and commercial areas, traffic	70	24
Auditory impairment	Music in headphones	85	1
Auditory impairment	Recreational activities	100	4

Source: World Health Organization [4].

In order to guide health authorities and health workers, WHO has developed guidelines for presenting health consequences of noise; however, it just briefly addresses [1] noise control and health protection. There are indeed guidelines at global level, seeking to protect population against noise threat, but it is necessary to clarify that this bibliography is addressed only to working population, especially the one working at the industrial area [3].

2. The Official Mexican Norm (NOM)

In Mexico, the Secretary of Labor and Social Security, presents for these purposes, the Mexican Official Norm (NOM in Spanish), NOM-011-STPS-2001: safety and hygiene conditions in work centers where noise is generated; this norm has the objective to establish safety and hygiene conditions where there is noise that may alter health of workers, in the search to preserve their audition [6]. However as mentioned above, this OMN does not cover the entire population, which by the simple fact of being within a social environment with noise, is also exposed to risk factors for deterioration of their health.

Seemingly, this NOM only focuses in workers hearing loss, to the exclusion of other diseases that may affect their life quality. It considers both employers and workers as main responsible, having to be supported by hearing conservation programs that must be implemented by experts. The majority of the latter involves health personnel who is recommended to follow the reference guide at the end of the norm, though such guides states that its contents are only a complement for a better understanding of the NOM and are not mandatory.

Some sections of the NOM-011-STPS-2001 are transcribed below.

2.1. Objective

To establish: safety and hygiene conditions in work centers where noise is generated such that its characteristics, levels and time of action, be capable of altering workers health; maximum levels and maximum permissible exposure times per working day, its correlation, and implementation of a hearing conservation program.

2.2. Field of Application

This norm rules throughout the national territory and applies to all work centers where there is exposure of the worker to noise (...).

2.3. Obligations of the Employer

To show to the labor authority, when it so requests, documentation that this norm forces him/her to elaborate or possess.

To have recognition and evaluation of all areas at the work center with workers, where sound level is equal to or greater than 80 dB, including its characteristics and frequency components.

To verify that no worker is exposed to noise levels exceeding maximum permissible noise exposure limits. Under no circumstances, should be exposure without personal hearing protection equipment to more than 105 dB.

To provide personal hearing protection equipment, in accordance with NOM-017-STPS-1993, to all workers exposed to sound levels equal to or greater than 85 dB.

The Hearing Conservation Program applies in areas of the work center where workers are exposed to levels of 85 dB and above.

To implement, to maintain and to keep updated the hearing conservation program, necessary for control and prevention of alterations in the health of workers.

To monitor health of workers exposed to noise, informing each one of them about his or her results.

To inform the workers and the health and safety committee of the work center, of possible alterations to health by exposure to noise, and guide them on how to avoid, or attenuate them.

2.4. Obligations of the Worker

To collaborate on assessment of evaluation procedures and to follow statements in the Hearing Conservation Program.

To undergo necessary medical examinations, according to the Hearing Conservation Program.

To use personal hearing protection equipment, provided by the employer, in accordance with its instructions for use, maintenance, cleaning, care, replacement, and limitations (...).

2.5. Hearing Conservation Program

The program must take into account: nature of work; characteristics of the emitting sources (magnitude and frequency components of the noise); time and frequency of exposure by workers; possible alterations to health, and general and specific methods of prevention and control.

3. Reference Guide I

Health Surveillance

Contents of this guide is a complement to the best understanding of the norm and is not mandatory.

I.1. Employer must monitor health effects on workers under noise exposure levels, greater than 80 dB.

I.2. Monitoring of health effects should include at least:

A) Otological history including: 1) Family hereditary antecedents; 2) Pathological personal history; 3) Non-pathological personal history; 4) Current diseases; B) Physical examination including: 1) Clinical evaluation of ear, nose and throat; 2) Tonal audiometric evaluation.

I.3. Audiometric evaluations should be performed according to the following schedule:

a) Establishing of an initial reference audiogram for each worker assigned to a workplace where noise exposure level of 85 dB is exceeded; initial reference must be preceded by a period of at least 14 hours without exposure to noise in the work center and worker should no present upper respiratory tract infections.

b) To make verification audiograms, according to the following scheme: b.1) Exposure to noise level equal to or greater than 85 dB, every six months; b.2) Exposure to noise level between 80 and 85 dB, annually.

I.4. Tonal audiometric evaluation should contain at least airway scanning at the following frequencies: 250, 500, 1000, 2000, 3000, 4000, 6000 and 8000 Hz.

I.5. Audiometric tests with hearing aids should be performed in an environment not exceeding the sound pressure levels given below:

Central Frequency (Hz)	250	500	1000	2000	4000	8000
Maximum Acoustic Pressure Level (dB)	44	26	28	37	44	41

I.6. The audiometric test environment must have a respective recording document, in which sound pressure levels are referred.

I.5. This document must be delivered by provider of the audiometric evaluation services, or by employer when equipment and facilities are his property.

I.7. Calibration of audiometer used must be verified.

I.8. Biological calibration of the audiometer must be verified each time this equipment is used. There should be no alterations equal to or greater than 10 dB, and results of this verification must be recorded.

I.9. Results of audiometric study must be informed to the worker in an individually and strictly confidential manner.

I.10. Each verification audiogram must be compared to the initial reference audiogram; if any alteration in the latter is detected, suggesting that it has been caused by exposure to noise, the physician will perform complementary studies to allow him integrate nosological, etiological, and anatomical-functional diagnoses.

I.11. If the physician determines that the hearing impairment is not related to noise exposure but may be aggravated during work, the physician must advise the employer on health surveillance and on exposure of workers.

I.12. If the physician determines that the hearing impairment is indeed related to noise exposure during work, the employer must ensure that specified maximum-permissible-exposure-limits are not exceeded considering relocation of the worker to an area where sound level is less than 80 dB, or handling of exposure times, and he must evaluate their hearing capacity every 6 months.

I.13. Documentation of the hearing conservation program should include a summary of audiometric examinations results, the preventive measures taken, and the scheduling of the new examinations.

Normativity of environmental noise is also poor both at a global and national levels, a consensus is yet to be reached, and at most there are some international guidelines for its prevention. In our country, the Secretary of Environment and Natural Resources issued the NOM-081-SEMARNAT-1994 that establishes maximum permissible noise emission limits of fixed sources, and its method of measurement. The objective of this NOM is to mark maximum permissible emission limits of emitted noise towards the environment. Although it might seem that this norm extends beyond labor sphere, it is mainly focused on it, with the exception that it also encompasses the public thoroughfare [7].

Some sections of the NOM-081-SEMARNAT-1994 are showed below:

1. Objective: This Official Mexican Norm establishes maximum permissible emission limits of noise, generated by the operation of fixed sources, and the method of measurement by which level emitted towards the environment is determined.

2. Field of Application: This norm applies to small, medium and large industries, established businesses, public or private services, and activities on public thoroughfare.

3. Specifications: Maximum permissible limits of the sound level in score “A”, issued by fixed sources are those established in Table 2.

Table 2. Permissible maximum limits.

SCHEDULE	MAXIMUM PERMISSIBLE LIMITS
From 6:00 h to 22:00 h	68 dB (A)
From 22:00 hrs to 6:00 hrs	65 dB (A)

4. Surveillance: The Ministry of Social Development, through the Federal Procuratory for Environmental Protection, as well as the States and, where appropriate, the Municipalities, are the competent authorities to monitor compliance with this Official Mexican Norm.

5. Sanctions: Failure to comply with this norm shall be sanctioned in accordance with provisions of General Law on Ecological Equilibrium and Environmental Protection, and other applicable legal ordinances.

4. Human Health and Noise

The General Health Law states in its 3rd Article that Hearing Health is a matter of general health, which goes hand by hand with the 27th Article in which health education, promotion of basic sanitation, and improvement of sanitary conditions of the environment are described; in Article 116th, it is mentioned that health authorities need to establish standards that protect human health against any risk and / or damage that can be generated by alterations in the working environment, even in its sanitation; that is why 155th Article appears saying that noise emissions are prohibited, as soon as they surpass maximum established limits in the Official Mexican Norm issued by SEMARNAT [5].

As for the previous information, there are NOM with a thoroughly normativity towards all aspects of noise management for society and, especially, there is no NOM issued by the Secretary of Health addressing this problem.

Noise affects most of us at some time. Noise may become annoying if it intrudes into people's awareness or is heard against their wishes. An introduced noise that disturbs a person's everyday life or working environment can be very annoying or harmful, affecting their wellbeing [8].

Among specific health effects, WHO notes: noise-induced hearing impairment; interference with speech communication; disturbance of rest and sleep; psychophysiological, mental-health and performance effects; effects on residential behaviour and annoyance; and interference with intended activities [9].

“WHO/Europe is currently in the process of developing the WHO Environmental Noise Guidelines for the European Region as a regional update to the WHO Community Noise Guidelines. The Guidelines will include a review of evidence on the health effects of environmental noise to incorporate significant research carried out in the last years. The health outcomes for which the evidence will be systematically reviewed include: sleep disturbance, annoyance, cognitive impairment, mental health and wellbeing, cardiovascular diseases, hearing impairment and tinnitus and adverse birth outcomes” [10].

5. Conclusions

The environmental cannot be separated from health, thus normativity requires to be a joint work among diverse governmental and social entities. Noise control, as compared to other pollutants, has been limited by the lack of close joint work by these units. This kind of contaminant is found in developed and developing countries where exposure to it produces long-term health effects, together with consequences resulting in deterioration of life quality of population and the increase in expenditure to health.

Therefore, it is essential to take relevant actions in order to limit and control exposure to noise, regardless of whether it is environmental or labor, by supporting an adequate scientific evaluation of the available data on the effects of noise. This will enable us to achieve an appropriate assessment and management of the risks and to avoid any health damage that may result from this contaminant.

The noise pollution in an audible unwanted sound that represents a threat to the health of the population represents a real problem in public health. The association between noise and population health requires attention through the generation of public policies, regulations and their execution

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