OCCUPATIONAL NOISE EXPOSURE IN PORTUGAL

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ABSTRACT
Given its relevance, noise is one of the main occupational risks in industrial environments. However, a structured survey about Portuguese occupational noise exposure was never made. This paper focuses on the main aspects concerning noise occupational exposure, presenting yet an estimation of the number of people exposed to occupational noise in Portugal. This paper also focus some aspects related to the future research perspectives in this area and the need to develop more efficient evaluation and analysis methods, in order to reduce, or even eliminate, the consequences that occupational noise exposure still have in workers' quality of life.

1. INTRODUCTION

Noise is one of the occupational risks with higher expression in industrial environments. The results of some world inquiries and surveys show that 1 in each 10 people suffers from hearing problems, and, although not known, it was estimated that the total number of affected people is around 500 million (Hear it, 2001). On the other hand, it is known that noise exposure, almost in the workplace, is responsible for many of these problems.

In the United States, according to NIOSH – National Institute for Occupational Health and Safety, about 30 million workers are exposed to potentially hazardous noise levels in the workplace (NIOSH, 1998 and 2001).

Noise exposure is not a recent risk. Before industrial revolution, although in small number, there was already occupational exposure to noise. The advent of the steam boiler machine, jointly with the industrial revolution, had come to awake the interest for the study of noise as an occupational risk. Workers who manufactured steam boilers developed hearing losses in such extension, that the associated pathology was then designated as "steam boilermakers" disease.

The increasing mechanization in all industries and economic activities lead to an increasing noise exposure. Until few years ago noise was seen as an industrialization indicator, i.e., "quiet" societies were associated to lower development, in the opposite side, the "noisy" societies were those who had the biggest and more powerful machines, therefore more industrial development.

However, in the last years industrial noise changed into a silence need, considering that quiet occupational environments were not a luxury but an increasing need, both in workplaces, and outside these.

Although out of the scope of this paper, it is important to refer the magnitude of problems originated by noise exposure of populations, also designated as environmental noise.

3. NOISE OCCUPATIONAL EXPOSURE AND HEARING CONSERVATION PROGRAMS

There are obvious advantages, beyond hearing preservation, in reducing occupational noise exposure. To name an example, the benefits to the absenteeism and accidents reduction (Berger, 1985). This type of interventions could not be seen as casuistic, or short-term actions, but inserted in company general politic, with medium/long term effects. Only long-term strategies will allow the achievement of lasting results. Interventions in order to reduce occupational noise exposure will have to be delineated in the scope of company politics and not as a set of separated interventions.

Hearing Conservation Programs (HCP) usually designates the set of measures carried out in order to reduce or prevent occupational noise exposure. HCP are essentially recommendable where workers are exposed to daily exposure levels, without protection (i.e., with no use of HPD), equal or higher than 85 dB(A). In other words, the HCP are desirable when there are exposed workers, i.e., workers whose daily exposure level, or $L_{Ep,d}$, exceed the action level.

The way to develop a HCP could be very diversified. However there are some guidelines on which this development is based. The only common point to the several approaches will be the main goal of HCP, namely, the elimination and/or prevention of professional deafness. To attain this goal, HCP could have a specific emphasis in aspects, such as hearing protection, collective protection and organizational measures, workers training, health monitoring, among others.

NIOSH (1998), as well as other references in literature (Berger et al., 2000), considers recommendable that the structure of a HCP contains, at least, the following components:

1. Initial and annual auditory;
2. Occupational noise assessment;
3. Technical and organizational measures in order to prevent noise exposure;
4. Workers' hearing evaluation and monitoring;
5. Hearing protection;
6. Workers training and motivation;
7. Records archive;

In Portuguese industrial environments, only in a few cases we found a HCP (Barroso *et al.*, 1996; Arezes et al., 2000), at least in a structured way, like described here. Despite this fact, there are many entities and companies with concerns in this particular domain. Additionally, by legal appointment, many of the companies have to fulfil some of the HCP requirements, namely, workers' audiometric screening and occupational noise exposure assessment.

5. LEGISLATIVE EVOLUTION

Legislation related to workers' protection against noise exposure is closely linked to the legislation on the work conditions in general. Thus, the first reference appears in Portaria nº 53/71, of 3rd February, that approves the General Regulation of Safety and Hygiene in the industrial establishments, later modified by Portaria nº 702/80, of 22nd September. Noise exposure, like others physical agents, is also referred in the Decreto Regulamentar nº 347/93, of 1st October and Portaria nº 987/93, of 6th October, both related to the minimum requirements of health and safety at work.

Although the importance of the previous mentioned legislation, noise exposure appears for the first time, as central element, in Decreto Regulamentar 251/87, of 24th June, known as General Regulation on Noise. This legislation, although with widened objectives, constitutes the first step in legislation concerning noise exposure. In 1989 some disposals of the General Regulation on the Noise are modified, through the Decreto-Lei nº 292/89, of 2nd September. Although these legislations mentioned occupational noise exposure, all detailed specifications are endorsed to specific legislation, as is the case of occupational noise exposure.

Important landmark in what concerns to occupational noise exposure is the European Directive no.86/188/CEE, of 12th May, which establishes the general framework of workers' protection against noise exposure during work, transposed for internal law by Decreto-Lei no. 72/92, and regulated by Decreto Regulamentar 9/92, both of 28th April.

More recently, was published the Decreto-Lei 292/2000, of 14th November, which approves the new general regulation on noise, or as it is now called, Legal Regimen on Noise Pollution. This last one, like its predecessor, is not related to any particular aspects of occupational noise exposure, which are addressed to specific legislation.

6. ESTIMATION OF OCCUPATIONAL NOISE EXPOSED WORKERS

The precise calculation of the number of exposed workers in Portugal is very difficult, or not possible, due to the inexistence of a structuralized noise exposure data survey. Some data related to environmental noise exposure are available (Valadas *et al.*, 1996). However, without any mention to occupational noise exposure. Despite the inexistence of studies or national compilations on occupational noise exposure, it is possible, however, to estimate this number based on some indicators.

In Portugal it was also possible to verify that noise is a very important occupational risk. For this purpose, one must look to data about professional diseases (EASHW, 1999). By the analysis of this data, hearing loss represents, in 1997, circa 25% of workers with incapacity, with more than 4.500 workers, being only exceed by pneumatosis, which contribute with 57% of all workers with some kind of incapacity.

NIOSH, in the United States, carried out, between 1981 and 1983, a survey of occupational exposure, including noise exposure, which was called National Occupational Exposure Survey (NIOSH, 1998). In this survey, data were gathered in some companies in all the States of U.S. As results of this survey were presented, among others, the values of occupational noise exposure for some types of activities and industries (NIOSH, 1998). Through this data, it was possible to considered, based on the principle that the percentage of exposed individuals would be the same, the number of noise exposed workers in Portugal.

In order to do such an estimate, it was considered the total number of workers, i.e., the working population, and how this population was distributed by the different economics sectors. This information was obtained through statistical data from National Institute of Statistics (INE, 1998; 2000; 2001). Data obtained were referred to 1998 and 2000, once in these years it was described the distribution of the workers by specific branch of activity, and not only for sector of activity. This allowed doing a better comparison with American data. It was also possible to do a more general estimate for 2001, considering the data of the first trimester of this year.

Table 1 shows the obtained data and results. The column referring the percentage of exposed workers is estimated on the basis of the American study previously mentioned (NIOSH, 1998). For this purpose, it was considered that noise exposed workers were workers with a daily exposure level in an eight hours shift equal or greater than 85 dB(A), which is the level used in Portuguese legislation.

Activity Sector	Number of Workers (10^3)[1]			Estimated % of Exposed Workers[2]	Number of Exposed Workers (10^3)[3]		
	1998	2000	2nd Trim. 2001		1998	2000	2nd Trim. 2001
Working population	**4 738,8**	**4 908,5**	**4 983,8**				
Agriculture, forestry, and fishing	**639,5**	**616,3**	**645,2**	19,8	126,621	122,027	127,750
Industry, Construction, Energy, and Water	**1 694,7**	**1 719,6**	**1.696,7**	25,0 (a)			423,821
Mining, Production and Distribution of Electricity, Gas, and Water Industries	47,9	44,9		17,9	8,574	8,037	
Food Industries	119,0	117,4		34,0	40,509	39,964	
Textile, Apparel Industries	403,5	370,8		36,1	145,835	134,016	
Paper, Printing, and Publishing Industries	135,5	132,0		33,5	45,354	44,183	
Chemicals, Petroleum and coal products, Rubber and plastic products, and other non-metal Products	138,7	128,8		20,7	28,718	26,668	
Primary Metal Industries and other metal products	116,7	108,1		24,9	29,090	26,946	
Electronic and other electric equipment	81,2	100,1		8,1	6,577	8,108	
Transportation equipment	55,8	47,8		14,3	7,987	6,842	
Furniture Industries and Recycling	79,7	76,1		28,3	22,555	21,536	
Construction	516,7	593,5		19,1	98,586	113,240	
Services	**2 404,6**	**2 572,5**	**2.641,9**	8,8 (b)			232,082
Retail trade of automotive dealers and service stations	121,1	137,0		1,4	1,695	1,918	
Wholesale traders	100,7	133,3		5,3	5,337	7,065	
Retail traders, Repair services	432,7	452,7		20,9	90,434	94,614	
Hotels and restaurants	245,0	253,6		9,1	22,295	23,078	
Transportation and Public Utilities	177,6	180,4		7,8	13,853	14,071	
Financial services and Insurance	104,2	104,6		1,5	1,563	1,569	
Computers activities, Research and Development	158,8	188,9		1,5	2,382	2,834	
Public Adm., Defense e Social Security	287,4	306,7		9,1	26,153	27,910	
Education	275,4	271,2		9,1	25,061	24,679	
Health and Social Services	200,5	243,1		0,6	1,203	1,459	
Other activities and services	301,1	301,0		8,9	26,798	26,789	
				TOTAL	777,182	777,553	783,652
				% Total of Exposed Workers	16,4	15,8	15,7

(1) Values obtained from 1998 and 2000 statistical data, and from general 2001 statistics.

(2) Estimated values by analogy with United States values. In some cases estimation is based in each sub-sector representativity (expressed in the number of workers) in the general sector.

(3) Values obtained by affecting the percentage value to the number of total workers.

a, b See text, point 5.

Table 1 - Estimated number of noise exposed workers in Portugal.

Analysing table 1, it is possible to see that the evolution of the number of workers in each economic activity is not uniform, i.e., the number of workers could increase in the global sector of the Industry, decreasing, however, in a specific type of Industry.

To illustrate the former example it is possible to see, in table 1, the case of Industry, Construction, Energy and Water Sector, which suffered an increase from 1998 to 2000. However, in some activities, as it is the case of the Textile and Apparel Industries, this number has decreased in the same period. Thus, for the estimate in the 2nd trimester of 2001 (table 1), were used data from the aggregate sector of activity. In order to do so, the corresponding percentages of exposed workers have been used (values marked with letter (a) and (b) in table 1) on the basis of the weighed mean of the several percentages associated to each separated activities.

It is possible to see that the percentage of exposed workers in Industry decreases from 1998 to 200. However, it is necessary to consider the fact that this analysis doesn't represent an evolutionary analysis. Therefore, it is based on the same percentage of exposed workers, only modifying the number of workers in each activity. Thus, in reality, this reduction in the Industry represents a reduction of workers in this sector of activity, but does not represent the real reduction of the number of workers exposed to noise.

The small increase of the total number of exposed workers verified between 1998 and 2nd trimester of 2001 (of 777.182 for 783.652 workers) is due, essentially, to the reduction of the number of workers in the Industry, where the percentage of exposed workers is higher. The increasing number of workers, along the studied years, is justified, in a large extent, by the increasing number of workers in services, where the percentage of exposed workers is lower.

Finally, it is necessary to highlight the Textile and Apparel Industries and the Construction cases, which represent, together, almost a third of the total of exposed workers. Although in the first case the problem is recognized, even without any practical consequences, in the Construction Industry this problem is still underestimated.

7. CONCLUSIONS

Occupational noise exposure is, with no doubt, a transversal problem, as it encloses a large number of occupational environments, from Industry and Agriculture to Construction and Services.

Although this risk is usually considered in occupational environments, the truth is that minor importance has been given to this aspect. Often, the solution adopted is the most obvious, the adoption of hearing protection devices.

Although the estimate has been done with reference to the North American values, whose sectors of activity can differ to the Portuguese reality, one can assume that estimation does not have a significant error, and considering the inexistence of this survey, it seems to be an useful indicator. The percentage values presented in this study are alarming, showing that more than 25% of occupational population in industry is exposed to high sound pressure levels.

One of the conclusions that can be drawn by this analysis is the fact that the great importance of occupational noise has no consequences in the measures, carried out to reduce and prevent it. In fact, as it can be seen for the presented numbers, noise is an occupational risk with increasing trend, which will be aggravated if no measures and programs are established.

It is, therefore, necessary to adopt different preventive and corrective solutions against occupational noise, and not restricting them to the use of HPD, solution often adopted for its relative easiness implementation and low cost. Although seeming a practical solution to the problem, it could be contradicted by the discrepancy between real and catalogued attenuation (Arezes and Miguel, 2001).

Although great part of problems resolution can be associated to an adjusted prevention, there are many things to do in this domain, namely, in the development of prevention instruments. Thus, the current and future research should be based on the need for development of more efficient instruments of prevention, as for example, new methods of hearing evaluation, training methods or biological indicators of hearing loss susceptibility.

Independently of HCP further orientations, the future of Prevention, in what it concerns noise exposure, will consider the development of more efficient assessment tools, in order to decrease, or even eliminate, the impact of occupational noise exposure in workers' quality of life.

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