The Impact of Occupational Hazard Information on Employee Health and Safety: An Analysis by Professional Sectors in Spain

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Abstract

All workers have the right to perform their job duties under the best possible conditions, safeguarded from the harm which the execution of their duties may entail. In addition, employers have the obligation to guarantee this right to health, implementing a preventive system which assures the safety and health of the workers under their charge. Information for workers is a fundamental part of any occupational health and safety management system in companies. The aim of this study was to analyze the influence in which preventive information has on certain variables relating to workers' occupational health and safety and by sector of activity. This study was conducted with data collected through the 6th National Survey on Working Conditions in 2007 in Spain. The data included a random sample of 11,054 people from a working population of 20,476,900. To conduct the study a probabilistic model was created using Bayesian networks including the following variables: preventive information, sector, psychological symptoms, physical symptoms and accidents at work. The results indicated the importance of information in companies' preventive activity and the difference existing in its application across the various sectors, with Industry being the sector in which information for workers has the most positive impact.

Keywords: *Hazard prevention, occupational accidents, musculoskeletal ailments, stress, activity sector.*

Introduction

Technological development, economic growth, social evolution and technical progress in recent times have led to improvements in occupational conditions, making possible safer and healthier environments at companies. The occupational accident figures, however, continue to be alarming. The International Labor Organization (ILO) estimated that 6,000 workers around the world die every day from work-related diseases and accidents.[1] In Spain, according to the National Institute for Occupational Safety and Hygiene (INSHT) there were a total of 627,876 occupational accidents resulting in medical leaves, and 556 fatal incidents) in 2010.[2] The prevention of work hazards in companies, thus, takes on special importance.

Occupational hazards are understood to encompass the series of activities and measures aimed at protecting workers' health and safety, encouraging them to adopt behaviors and attitudes favoring prevention in their daily actions at work. Hazard prevention is a very broad concept which includes different spheres in the occupational setting, Herrero et al.[3] highlight four fundamental pillars upon which occupational hazard prevention rests in companies: management commitment, hazard control and management, training and communication, and, finally, worker participation.

As information is a fundamental cornerstone of hazard prevention, European directives with regards to safety and health in occupational settings established this as a right held by workers. European Directive 89/391/EEC contains the general legal framework upon which Community-based prevention policy is based, standing as the instrument for active compliance by European Union member states. The transposition into Spanish law of the EU Directive is Law 31/1995 on the Prevention of Occupational Hazards. According to Article 18, on information, it indicates that employers must take appropriate measures so that workers receive all necessary information regarding: hazards threatening workers' safety and health, protection and prevention measures, and activities applicable to such hazards and the emergency measures adopted.

Numerous studies conveyed in their analyses the importance of information and communication with regards to those hazards to which workers are exposed as a determining factor in organizations' safety levels.[4-7] Thomas[8] stated that the best way employers have to protect their workers is to be very active in their communications with regards to hazards, as information makes their employees conscious of those to which they are exposed, and the need to protect themselves. Along the same line, Cecaro et al. [9] pointed out the crucial role of communication with regards to employees' safety-related behaviors and improving the effectiveness of companies' prevention services.

In terms of sectors, companies dedicated to Construction are the most studied in this regard, as Construction is one of the sectors most susceptible to employee accidents.[10] Workers in this sector have an informal and oral culture with regards to communicating about hazards. Various studies underscore the impact of preventive information on increases in safety levels in the Construction sector.[11, 12] In the Agricultural sector, meanwhile, Farquhar et al.[13] pointed to the difficulties workers have accessing information due to the temporary nature of these activities and the diverse languages of the laborers participating in the different agricultural campaigns.

Other studies stated that, in addition to having information on prevention, its transmission must be effective.[14, 15] For Farid[14] effective communication is the key term and issue here. The right information must be given to the right people, in the right way. For information to be useful to workers, they need to internalize it, making it part of their actions. The information workers receive should influence their attitudes, knowledge, beliefs and, hence, their behavior. This internalization of information through conduct, among other factors, leads to a more safety-conscious culture in the workplace.[16] Companies enjoying improved company cultures in terms of safety awareness see rises in active participation among workers and, hence, improvements in prevention-related aspects, such as the reporting of occupational incidents [17] and the identification of areas for improvement with regards to safety in the workplace.[18]

Schulte[19] proposed that a pro-prevention culture be fomented in the training of young people. In his study he mentioned the need to concentrate efforts in educating the workforce of tomorrow to ensure that schools include issues related to safety and health at work, raising awareness among young people regarding this problem and changing the attitudes of future generations. This coincides with the idea of the authors, Herrero et al.[3], of strengthening the culture of safety through its components; management

commitment, hazard control and management, training and communication, and, finally, worker participation, not only in the professional sphere, but also applied to people's other daily activities.

Finally we must emphasize the need to allocate resources to the process of providing prevention information. We need to invest in the disclosure, dissemination and application of information on safety and health at work and on the usefulness of such information, just as it is necessary to conduct research on the factors that either encourage or hinder the development, transfer and use of prevention-related information.[20]

Purpose of the Study

The purpose of this study was to analyze the influence which preventive information has on certain variables relating to workers' occupational health and safety, by sector of activity. This information was evaluated based on the perception that workers have of it and the results were measured based on the physical and psychological ailments and problems they suffered, and the accidents in which workers were involved in the last two years.

Methods

Participants

In order to carry out this study, data were used from the 6th National Survey on Working Conditions (VI ENCT), offered by the National Institute for Occupational Safety and Health [21], a body attached to the Spanish Ministry of Labor and Immigration. The goals of this survey were:

- To identify exposure to diverse occupational risks and to determine the most frequent occupational risk exposures.
- To determine those factors within the work environment that impact worker health.
- To determine preventive activities carried out by companies.

Data collection was carried out by the Sigma Dos company between the 12th of December, 2006 and the 11th of April, 2007. The sampling procedure was conducted over several phases, stratifying by conglomerates and randomly selecting the primary and secondary sampling units (municipalities and sections) and workers through random routes and determined quotas.

Survey results were obtained through personal interviews in which the workers were directly questioned at their residences, with the responses noted on the questionnaire. The questionnaire consisted of 76 questions. We will subsequently discuss those selected for use in the study.

The population consisted of workers from all economic activities across the country. The sample consisted of a total of 11,054 worker interviews, of which 58.5% were men and 41.5% were women. For a confidence interval of 95.5% (2 sigma) the error for the sample set was ±0.95%. The distribution based on activity sector and workforce size is shown in Table 1.

One of the limitations of previous surveys was resolved by the conducting of a pilot survey, carried out by INSHT in 2005, in order to ascertain the advantages and disadvantages of the methodology employed to date in the successive ENCTs. This study applied the same methodology and questionnaire but differed from the previous 5th National Survey on Working Conditions (5th ENCT) with regards to the site at which worker interviews were conducted; rather than at their workplace, they were carried out at workers' homes. This initiative was justified by the results of a comparative study done by the INSHT itself of surveys conducted in other countries with the same characteristics as the Spanish ENCT, as well as opinions gathered from a range of different and relevant scientific/social spheres which indicated possibly skewed results arising mainly from the location in which the employee interview was carried out. The comparative analysis of the results of this pilot survey (the 2005 Work Conditions Survey) looking at those obtained from the 5th ENCT, clearly yielded two key aspects.

Firstly, interviewing workers at their homes makes it possible to access groups of workers which are difficult or impossible to find when seeking them out at their workplaces (workers on leave, temporary workers, workers without contracts, etc.) In addition, it increases the probability of getting access to certain groups of workers: temps, women, workers under 25, non-Spanish workers, etc. Secondly, it was shown that there are statistically significant differences in the responses give by workers interviewed at their workplaces and those interviewed at home. Said differences generally consisted of more positive evaluations of most factors related to work conditions by those employees interviewed at work, as

compared to those interviewed at home. However, the way of obtaining the data is a personal interview, with the employee to fill out a closed questionnaire, which means that the limitations of said questionnaires in the acquisition of open opinions are applicable to the study, which cannot benefit from said opinions.

Variables

The current study formed part of a larger project on the influence of work organization on health and safety-related results. In this particular case, five variables were analyzed in order to study the relationship between hazard-related communications and occupational accident rates. The variables used in this study are indicated below.

Activity sector

This variable refers to question 6 BIS of the VI ENCT. It indicates the main activity performed by the company where the surveyed worker was employed, i.e., if the firm belongs to the Agriculture, Industry, Construction or Service sector. Of the total sample, 6.2% were devoted to Agriculture, 16.0% were employed in Industry, 12.8% were in Construction, and 65.0% were in the Service sector. These percentages are similar to the actual distribution of all Spanish workers by activity sector.

Hazard-related communications

This variable refers to the perception which workers had of the level of information they possessed regarding occupational risks to their health and safety. Specifically, Question 55 of the questionnaire read: "In relation to occupational risks to your health and safety, how knowledgeable would you say you are?" The answer is given on a Likert Scale with 4 options, ranging from "Very well informed" to "Poorly informed." To carry out the study the variable was transformed to a Boolean one, grouping options 1 and 2 under "Well informed" and options 3 and 4 under "Poorly informed."

About 80% of workers considered themselves to be well or very well informed regarding the work-related hazards to their health and safety. 16.8% believed that they lacked information or were not informed.

Psychological Symptoms

The psychological symptoms variable refers to perceived levels of stress, demoralization, pain, and anxiety. This item provided information on how workers perceived their own thoughts, feelings, and behaviors, and how these could significantly damage their health and safety.

The psychological symptoms were measured through the use of Question 66 of the VI ENCT: "Do you frequently suffer any of the following symptoms?" Those surveyed could choose from among 8 options: "a hard time sleeping or poor sleep," "a constant feeling of fatigue," "headaches," "dizziness," "difficulty paying attention," "forgetfulness/difficulty remembering things," "tension/irritableness," "emotionally exhausted/a lack of energy," "unable to forget about problems at work," "changes in appetite and digestion," "eye problems," "low spirits," etc. For the normalization of the response a Boolean variable was constructed considering workers with three or more symptoms, and those who reported fewer than three.

In general the most frequently cited symptoms were the feeling of constant fatigue (12.3%), sleep alterations (12%), and headaches (10.4%).

Physical Symptoms

Using a multiple response question, the study sought to determine the areas of the body in which workers suffered from musculoskeletal symptoms.

The physical symptoms were measured by Question 31 of the questionnaire, asking participants to indicate the main body parts (e.g. nape of the neck, back, legs) where they felt discomfort arising from job-related postures and efforts. As with the previous variable, the response was normalized considering that workers suffered musculoskeletal symptoms when they felt discomfort in three or more areas of the body.

The analysis of the survey of musculoskeletal symptoms found that 32.3% of the workers stated that they felt symptoms in three or more parts of the body which they attributed to body positions and exertions associated with their work. The most frequent ailments were those located in the lower part of the back (40%), the nape/neck (27%), and the upper part of the back (26.6%).

Occupational Accidents

Finally, the outcome variable of this study (occupational accidents) quantified all the injuries sustained by workers as a result of work performed under an employment contract.

The occupational accident rate was measured by asking the participants whether they had suffered any occupational accidents in the last two years causing them to require medical assistance, treatment, or first aid.

Over 10.6% of the sample stated that they had suffered an accident in the last two years causing them to require medical assistance, treatment, or first aid.

Data Analysis

Descriptive analysis

The first part of the results features a descriptive analysis of the data The aim of all descriptive techniques is to generate quantitative data which describes the similarities and differences between a set of members. In our case the descriptive analysis will be used for the percentage of each one of the answers in the five factors studied. This analysis will also help us to gauge the initial situation in terms of psychological and musculoskeletal symptoms.

One of the objectives of the study was to verify the differences existing in the study factors across the different activity sectors, and by work position, in order to see in which of these it is necessary to make a greater effort to improve OCCUPATIONAL HAZARD INFORMATION. Thus, contingency tables by activity sector and work position covering the four remaining study factors were created (Poor hazard prevention communication, musculoskeletal symptoms, psychological symptoms and occupational accidents).

Bayesian networks

Probabilistic network models [22] are popular multivariate modeling and data mining techniques for extracting knowledge from databases containing information for a given problem (e.g., transactions of a company or surveys of a population). These techniques are based on sound statistical learning algorithms from the raw data, thus allowing for probabilistic inferences.

The Bayesian network (BN) method has become increasingly popular. They have been used in several knowledge areas, such as medicine [23], ecology and natural resources management [24], geology [25], organizational research [26], lifecycle engineering [27] and software engineering [28].

Bayesian networks (BNs) are also being applied to additional research related to occupational safety. For instance, the paper by Ren [29] aimed to contribute to offshore safety assessments by proposing a methodology to model causal relationships with a BN capable of providing graphical inter-relationships and of calculating numerical values for the likelihood of each failure event occurring. Zhou et al. [30] proposed a BN model to establish a probabilistic relational network among causal factors, including safety climate factors and personal experience factors which exert influences on human safety behavior. Martín et al. [31] used BNs to analyze workplace accidents using auxiliary equipment (ladders, scaffolding, etc). De Oña et al. [32] showed the possibility of using BNs to classify traffic accidents according to their injury severity. Finally, McCabe et al. [33] demonstrated using BNs that high work pressure, high interpersonal conflict, and low-quality leadership were strongly associated with work-related health outcomes and accidents.

The BN model is a multivariate probabilistic model which represents a set of variables and the dependencies that exist between them. The model allows us to make Bayesian inference, this means that it is possible to estimate the subsequent probability of the unknown variables, based on the known variables. The model provides interesting information on the relationships between the variables in the network and permits us to interpret the cause-effect relationships. In the model each variable is independent of the variables that are not descendents in the graph. The inclusion of relationships of independence in the graph structure makes the Bayesian network a good tool to represent understanding in a compact manner. The BN model offers flexible method of reasoning based on the propagation of probabilities throughout the network in accordance with the laws of probability theory.

In our particular example, BN models were applied directly to the results of the VI ENCT so as to discern the relationships existing among the different variables involved in the study. These relationships were represented by means of a directed graph, which encodes the marginal and conditional dependencies present in the data. This allows for the complex

relationships that may be present in the data set to be explored visually.

Then a sensitivity analysis in the BN models was made. The simplest form of sensitivity analysis is to simply vary one value in the model by a given amount, and examines the impact that the change has on the model's results. For example, it might be shown that by changing the preventive information to 100%, the occupational accident ratio falls by, say, from 10.45% to 9.89%. This is known as one-way sensitivity analysis, since only one parameter is changed at one time. The analysis could be repeated on different parameters at different times. While one-way sensitivity analysis is useful in demonstrating the impact of one parameter varying in the model, it may be necessary to examine the relationship of two or more different parameters changing simultaneously. This approach involves the changing of, say, two key parameters (for example, preventive information and activity sector), showing the results for each potential combination of values within a given range.

To learn and determine the model based on the data, various algorithms were developed that rely on statistical dependency tests and on automated optimal model searches that represent the given data set. These algorithms yield a Bayesian network from the available data set with a minimum degree of human supervision. There are a number of software packages available to efficiently build BNs. Currently, numerous tools are available that allow this process to be carried out comfortably and efficiently, for example: Hugin, Netica, Analytica, Bayes Net Toolbox, and many others. In this study we used Hugin Researcher (http://www.hugin.com) and Netica Bayesian Network Software (http://www.norsys.com) to build the model, analyzed the data and displayed the results.

Model

In order to study the influence of hazard-related communications on occupational safety and health, the following Bayesian network was used, considering the previously mentioned factors (see Figure 1).

Main factor of the study:

- Hazard-related communications

Grouping factor:

- Activity sector

Outcome variables on occupational safety and health:

- Psychological Symptoms
- Musculoskeletal symptoms
- Occupational accidents

Results

Figure 2 shows the input data of the study factors extracted from the results of the VI National Survey on Working Conditions. In these data one can see the marginal probabilities of the variables making up the study, for example, the marginal probability of experiencing work stress is 10.1%, that is, 10.1 % of workers had at least three stress-related symptoms. Worthy of note was that 32.3% of the sample had musculoskeletal ailments, that one in eight workers felt well informed, and that 10.4% had suffered an accident in the preceding two years.

Analyzing the variables studied by the core business to which the company is dedicated (see Table 2), we see that in Agriculture and Services over 17% of employees reported feeling poorly informed with regards to prevention. As for musculoskeletal complaints, 43.1% of workers in the Agricultural sector reported this type of symptom in different parts of their bodies, followed by 35.8% among workers in the Construction sector. According to the results, the sector featuring the greatest number of workers suffering from stress was in Services (10.8%), while Construction and Manufacturing companies were those with the highest rates of work-related accidents, with over 13% of workers injured.

Table 3 shows these same results broken down by position. The group of workers who stands out for suffering a lack of information on workplace hazards, which may affect the performance of their duties, were staff dedicated to domestic services, cleaning, cooks, waiters and street sweepers, as 22.5 % reported being not very well or poorly informed. On the opposite side were business executives, public administration personnel and other professions characterized by having intermediate and advanced studies, who reporting having more prevention information. Occupations related to primary occupations, in activities such as Agriculture, Livestock and Fisheries were those suffering the most musculoskeletal complaints, reported by 42.6% of these workers, while medical staff was the group with the most job stress, with 15.4% claiming to suffer more than three of the psychological symptoms

listed. As for work-related injuries, 20.4% of professionals dedicated to Mechanics, Repairs and Welding had suffered a workplace accident in the preceding two years. Also standing out were workers in Construction, Mining, Transport and Industry, whose occupational accident rate was greater than 15%.

After this descriptive analysis, data were analyzed using the Bayesian network model. This model analyzes the interrelationships and influences which information on prevention has, broken down by sector of activity, on safety and health results in companies.

A sensitivity analysis was carried out for each of the factors under study. These sensitivity analyses show the influence which preventive information has on accident rates and physical and psychological problems. First, a global sensitivity analysis was carried out, shown in Table 4. Subsequently, Table 5 shows the sensitivity analysis by activity sector. These tables compare the initial probabilities with the conditional probabilities derived from the sensitivity analysis. This technique allows us to graphically explore the results of the final variables, with the critical factors of information on hazards serving as evidence.

Table 4 shows how the results vary with regards to accidents and physical and psychological symptoms, distinguishing between workers who claimed to have good information on occupational hazards and those who did not. It was observed that where workers were well informed the percentage of the outcome variable dropped, but even more noteworthy was the proportionately greater increase in physical and psychological problems and accident rates when workers were not knowledgeable in the field of occupational safety and health. For example, the accident rate decreased to 9.9% when there was good information, while when employees were poorly informed about hazards it rose to 13.8%, starting from an initial value of 10.4%.

In the analysis of the results by sector of employment, Table 5 shows, on one hand, the influence of information on musculoskeletal problems, stress and accidents, and on the other hand, the table indicates the differences between these results depending upon the possession of sufficient or insufficient information.

The first part of Table 5 was obtained via Bayesian inference. A graphic example is shown in Figure 3, where insufficient information on prevention in the Industrial sector appeared as evidence. The results showed the conditional probabilities of the study's outcome variables; 32.3% of the workers would present musculoskeletal symptoms, 17.3% would suffer psychological symptoms, and the probability of having a work-related accident would be 18.0%, as compared to 30.4%, 10.2% and 13.1%, respectively, in their initial states.

The increases in the differences on the same table indicate that in Industry information for workers is more effective than in the other sectors, as there were major differences in the conditional probabilities; 2.3% in physical problems, 8.4% in psychological problems, and 5.7% in occupational accidents. In this analysis also worthy of note was the data obtained on the Agricultural sector, due to the particularities intrinsic to this type of activity. In the Service sector, results indicated that good information on ergonomics reduced by more than 3% the physical problems suffered by workers in this sector. The variable presenting the greatest differences among workers who have good preventive information, and those without, was stress-related problems, with differences greater than 5% across all the sectors.

Discussion

Through the results of the analyses conducted, this study has sought to assess and reflect the importance of prevention-related information in organizations, and to defend the utility of the right to the information appearing in the Work Hazard Prevention Law.

The initial global results showed strong relationships between all the variables studied. In general it was observed that prevention-related information decreases the likelihood of employees suffering musculoskeletal problems, job stress and accidents in the workplace. It is particularly evident that workers who were not well informed significantly boosted those same results.

The analysis by sector presented clear differences between them with regards to access to and the usefulness of information. In the primary sector workers considered themselves to be more poorly informed, and reported more physical ailments. Compared to the other sectors, they also suffered less stress and fewer accidents – which was surprising, because these activities feature a great number of hazards. It is possible that the deviation of these results was due to the fact that many of these

accidents are not reported, as this is a sector consisting mainly of self-employed workers and small businesses. In the sensitivity analysis the results reflected the controversial role played by preventive information in the Agricultural sector. The difficulty these workers have accessing information is a result of the size and dispersion of the companies involved, the seasonality and temporal nature of their tasks, the workers' cultural levels, difficulties in communications between workers and employers due to the different languages they speak and the high turnover rate in the Agriculture sector, as workers use it as a springboard to access other work in the job market. These shortcomings need to be addressed in order to improve the safety and health of workers in the primary sector.[34]

The Industry and Construction sectors presented similar data in terms of the level of information workers had and health and safety-related results. Workers in these sectors were those with the most prevention-related information, although they were also those with the highest accident rates, mainly due to the number of hazards to which their jobs expose them. When reviewing the results offered by this information, the differences are evident in both sectors. The assimilation of information reduced rates of physical and psychological symptoms and, above all, the accident rate, significantly more in Industry than in Construction. In other words, workers in Industrial settings better apply this information, are more aware of the hazards to which they are exposed, and better use resources to protect themselves. As a result, they generate a more preventive culture than that existing in the Construction sector.

Finally, in the Service sector staff reported being less informed than in the other sectors. The comparatively high rate of job stress in their results is worthy of note. The influence of prevention-related information in this sector makes it possible to reduce musculoskeletal ailments more significantly than in other sectors, demonstrating the effectiveness of the provision of information on ergonomics for workers in this sector. Secondly, there was also a clear decrease in the effects of job stress, with high the stress rates which can appear among workers lacking prevention information being considerably reduced.

Conclusion

The complexity of the preventive information communication process in businesses requires a thorough analysis of all the factors involved in it; the content of this information, the form of communication, the people who must provide the information, the methodology to use, etc. This study focused on quantitatively analyzing the usefulness of the preventive information provided by companies to their employees in order to improve their health and safety, comparing the results by activity sector.

By professional sectors, in the primary sector workers considered themselves to be more poorly informed, and reported more physical ailments. Compared to the other sectors, they also suffer less stress and fewer accidents. The Industry and Construction sectors presented similar data in terms of the level of information workers had and health and safety-related results. Workers in these sectors were those with the most prevention-related information, although they were also those with the highest accident rates, mainly due to the number of hazards to which their jobs expose them. In the Service sector staff reported being less informed than in the other sectors.

Having described and quantified the accident rates and the physical maladies and psychological problems owing to a lack of prevention information, as indicated in this study, we believe that one of the most dangerous situations generating the most hazards involves ignorance and misinformation, as they aggravate the risk factors which may exist in the workplace. Not knowing means being more vulnerable to hazards than a worker who is informed, properly trained, and has mastered all the different aspects of his position.

In order to minimize hazards companies ought to, in any case, make available the materials necessary to carry out sound preventive planning, which should include appropriate information and training as an integral and fundamental part of the planning itself and the work health and safety management system.

Current legislation indicates that companies are obligated to provide all workers with information on: risks to safety and health at the workplace, both those which are applicable to the company in general and those specific to each work position or function; and the protective and preventive measures and activities applicable to said hazards and the measures adopted with reference to first aid, fire fighting and evacuation. This information is provided in order to make workers aware of their work surroundings and all the circumstances involved, indicating all possible hazards, their severity and the protective and prevent measures adopted. This information, however, needs to be bidirectional: workers also must inform their

superiors and the designated employees in order to take preventive action, wherever necessary, reporting any situations which in their view pose a threat to workers' health or safety.

But companies should not provide this information just to comply with the laws in force. Rather, companies should be capable, through preventive information and training, to create enhanced awareness amongst their workers, generating a change in favorable attitudes so that both supervisors and workers get involved and accept that prevention is an essential part of a job well done, establishing a genuine corporate culture of safety.

In order to achieve these objectives it is necessary to establish and promote work health education. Health at work is a priority due to the consequences of work-related accidents. Thus, educational measures and techniques tending to reduce hazard factors and protect workers should be adopted, especially with regards to those occupations and sectors which are particularly vulnerable, as analyzed in this article. In addition, health-related education should be aimed at promoting a greater awareness of the problem of hazards among political leaders, corporate executives, and the workers themselves, above all to encourage actions not just to evaluate working conditions and hazard factors, but also to establish changes when necessary, adapting to address industrial shifts and workers' safety and health needs.

Finally we can say that the results obtained in this study show that by improving just one of the basic prevention elements, worker safety can be significantly enhanced. Keeping employees well informed of the hazards involved in their jobs and how to protect themselves allows for the development of a culture of prevention which makes it possible to reduce work-related accidents and the physical and psychological symptoms workers suffer. To this end, information on occupational risks must play a prominent role in companies' prevention planning and in their handling of occupational health and safety issues. So, we must emphasize the need to allocate resources to the process of providing prevention information.

For future research it would be advisable to include other variables related to prevention training, the resources devoted to safety, worker participation, and commitment and leadership with regards to occupational safety and health. In addition, the INSHT periodically carries out National Work Conditions Surveys, so that the study now completed with the data from the 6th ENCT should be run again looking at the data from the next survey in order to examine the changes in the information, specifically with regards to the aspects related to OCCUPATIONAL HAZARD INFORMATION. Future research may also feature the use of other sources and complementary data such as administrative records, case studies and situation reports.

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Table 1 Distribution of Worker Sample by Activity Sector and Size of Workforce

	Size of workforce						
	Freelancers	1-9	10-49	50-249	250-500	>500	Total
Farming	224	273	114	55	9	11	686
Industry	139	337	463	362	132	340	1,773
Construction	185	458	449	228	42	50	1,412
Services	1,008	1,960	1,097	875	332	1,911	7,183
Total	1,556	3,028	2,123	1,520	515	2,312	11,054

Source: Technical report prepared by the Sigma Dos Company. 2007.

Table 2 Occupational Safety and Health by Activity Sector

	Poor Hazard Prevention Communication	Musculoskeletal Symptoms	Psychological Symptoms	Occupational accidents
Global	16.8%	32.3%	10.1%	10.4%
Farming	17.5%	43.1%	8.6%	9.9%
Industry	14.6%	30.4%	10.2%	13.1%
Construction	14.5%	35.8%	7.1%	13.8%
Services	17.5%	31.0%	10.8%	9.2%

Table 3 Occupational Safety and Health, by Work Position

	Poor Hazard Prevention Communication	Musculoskeletal Symptoms	Psychological Symptoms	Occupational accidents
Global	16.8%	32.3%	10.1%	10.4%
Workers in Construction and Mining	16.2%	36.7%	6.4%	15.3%
Truckers, delivery drivers, taxi drivers and other drivers.	17.9%	36.4%	9.9%	16.8%
Health care personnel	11.2%	37.5%	15.4%	10.5%
Teachers	19.0%	23.0%	11.3%	6.6%
Domestic service, cleaning, cooks, waiters, street sweepers	22.5%	36.9%	10.9%	12.1%
Salespeople, sales representatives and clerks	17.2%	27.2%	9.1%	7.0%
Administrative staff	15.3%	29.2%	12.0%	4.5%
Farmers, ranchers, fishermen and sailors	17.5%	42.6%	8.2%	9.9%
Defense and security	13.7%	25.1%	12.5%	14.9%
Mechanics, repairmen, welders	13.0%	31.8%	10.4%	20.4%
Workers in mechanized industrial production; assemblers	17.4%	33.9%	10.0%	16.0%
Workers in traditional industries; artisans	18.2%	32.9%	8.8%	10.0%
Professionals in Law, the Social Sciences and the Arts	11.9%	22.9%	9.2%	5.3%
Professionals in the Sciences and IT personnel	14.4%	22.8%	11.2%	7.0%
Business executives and Public Administration officials	8.1%	24.5%	11.0%	5.8%
Other occupations requiring intermediate or advanced studies	5.6%	31.0%	11.3%	4.2%

Table 4 Analysis of Global Sensitivity on Preventive Information

		Musculoskeletal symptoms	Psychological Symptoms	Occupational accidents
Hazard-related communication	Initial status	32.3%	10.1%	10.4%
	Good	31.9%	8.9%	9.9%
	Poor	34.2%	15.8%	13.8%

Table 5 Sensitivity Analysis on the Sector of Activity and the Perception of Preventive Information Supplied

		Employee health and safety results			Increases in the differences in results		
Activity sector	Hazard-related communication	Musculoskeletal symptoms	Psychological Symptoms	Occupational accidents	Musculoskeletal symptoms	Psychological Symptoms	Occupational accidents
Farming	Initial	43.1%	8.6%	9.9%	-4.0%	8.1%	-0.7%*
	Good	43.5%	7.4%	10.2%			
	Poor	39.5%	15.4%	9.5%			
Industry	Initial	30.4%	10.2%	13.1%	2.3%	8.4%	5.7%
	Good	30.0%	8.9%	12.3%			
	Poor	32.3%	17.3%	18.0%			
Construction	Initial	35.8%	7.1%	13.8%	2.1%	5.0%	2.8%
	Good	35.6%	6.4%	13.5%			
	Poor	37.7%	11.4%	16.3%			
Services	Initial	31.0%	10.8%	9.2%	3.1%	6.6%	4.4%
	Good	30.5%	9.6%	8.5%			
	Poor	33.6%	16.2%	12.9%			

* Insignificant difference, with 95% confidence level via test-Z.

Figure 1 Bayesian Network Model

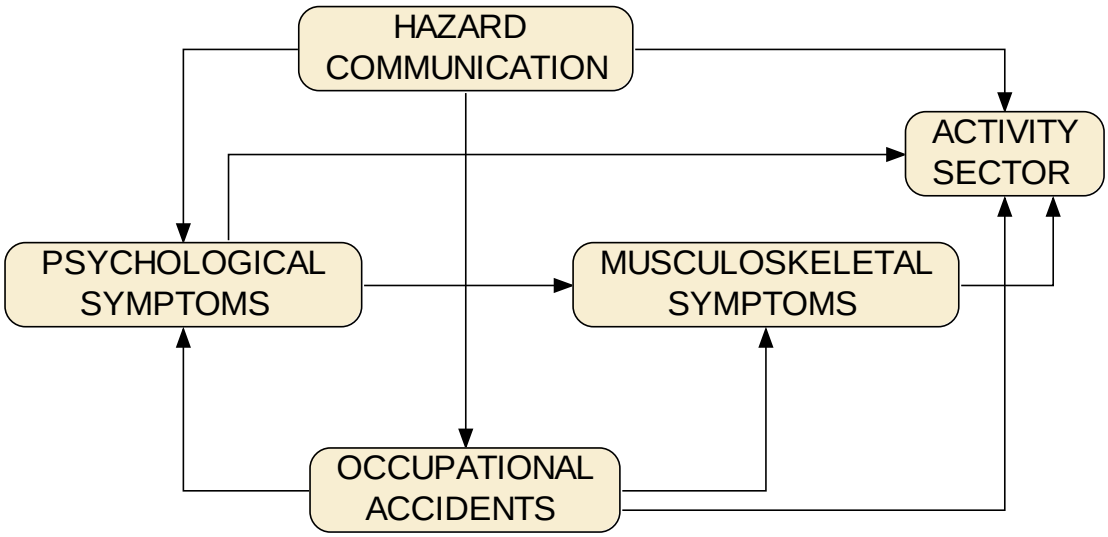

Figure 2 Bayesian Network Model- Marginal Probabilities

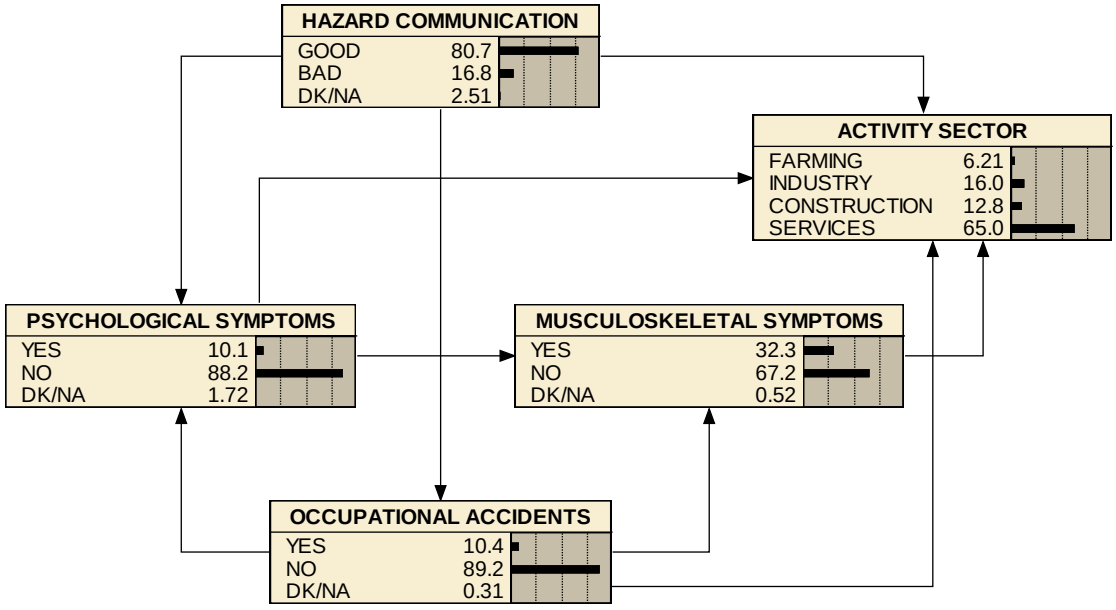

Figure 3 Sensitivity Analysis on the Hazard Communication Factor in the Industrial Sector