

## Is there an estimation bias in occupational health and safety surveys? The mode of administration and informants as a source of error

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### Abstract

Information quality deficiencies have been detected in occupational safety and health surveys in Europe, which typically gather self-reported data responded by employers or their representatives. For instance, their low response rates and informant profiles make estimations on establishments with safety representatives (SRs) unreliable. We tested the administration mode and informants as sources of error regarding establishments with SRs in Catalonia, Spain. Two sources of information were compared: the Second Catalan Survey of Working Conditions 2011 (IICSWC) – with a methodology similar to surveys conducted at state and European level – and the Programme on Prevention of Risks Management in Companies (PPRMC) – in which the labour authority collected data using a documentary verification in another sample of establishments. Percentage of establishments with SRs was estimated using the data from the PPRMC and also the differences in percentage between sources and informant profiles (with 95%CI). Results show that the IICSWC overestimates the percentage of establishments with SRs.

### Key words

Estimation bias; Data quality; Employee participation; Information systems; Occupational health; Survey research

## Introduction

In order to assess the state of occupational safety and health in companies, surveys on occupational safety and health management (Departament d'Empresa i Ocupació (DEMO) 2012a; European Agency for Safety and Health at Work 2009a; European Foundation for the Improvement of Living and Working Conditions (EUROFOUND) 2009; INSHT 2009) and those on working conditions (Departament d'Empresa i Ocupació (DEMO) 2012b; European Foundation for the Improvement of Living and Working Conditions (EUROFOUND) 2010; INSHT 2012) are the most valuable sources of information. These surveys allow us to obtain indicators to guide and define not only public policies but also actions carried out by the agents involved in this issue (García and Gil 1996). Additionally, in social sciences such as sociology, industrial relations and public health these survey data have been used extensively for research purposes. A number of studies relying upon these surveys can be found, for instance, with the goal to analyze the situation, distribution and evolution of working and employment conditions, the extent of worker participation, or health-related impacts (Van Aerden et al. 2015; Jones et al. 2013; Author E et al. 2015; Smith et al. 2008).

However, occupational safety and health management surveys have certain deficiencies concerning information quality, owing to biases in the data gathered (GREDS-EMCONET 2013; Lucy and Sinclair 2012; Petrakos, Kleideri, and Ieromnimon 2011; Walters et al. 2012). The origin of these biases may be related to the profile of the informant (Peersman et al. 2014; Violán et al. 2013), the manner in which the information is collected (European Agency for Safety and Health at Work 2010; GREDS-EMCONET 2013; Lucy and Sinclair 2012;

Martínez-Sánchez et al. 2013; Petrakos et al. 2011; Walters et al. 2012) and, connected to this, the response rate (Marta-Pedroso, Freitas, and Domingos 2007).

The estimate of establishments with safety representatives stands as a prime example of the need to examine data quality in occupational safety and health management surveys.

Worker participation in occupational health, especially that of the safety representative, has been associated with an improvement in health at work (Author F et al. 2008; Walters 2006).

This improvement has been shown in terms of direct impacts, such as the reduction in injuries due to accidents at work (Reilly, Paci, and Holl 1995) and in the prevalence of work-related illnesses (Mygind et al. 2005), but above all in terms of indirect impacts, such as the improvement in prevention policies in companies (Coutrot 2009). In the European Union, Framework Directive 89/391/CEE (European Council Directive No. 89/391/EEC 1989) recognizes the right of workers to be consulted and participate in matters of health and safety at work. This Directive was transposed into the Spanish Law 31/1995 on Prevention of Risks at Work (LPRL 31.1995) which regulates the number of safety representatives to be designated according to the number of workers in the company or workplace. Specifically, the designation of safety representatives is stipulated in companies or establishments with more than 5 employees (RDL 1.1995); establishments with fewer than 6 employees which belong to companies with more employees may have safety representatives. Also the constitution of a Health and Safety Committee is stipulated in establishments with more than 49 employees.

Despite the relevance of worker representative participation in preserving health and safety at work, this is a relatively disregarded topic; moreover, existing data are suspect. For

instance, data on establishments with safety representatives show a high degree of variability even though similar data collection methods are used. According to European sources (European Agency for Safety and Health at Work 2009b), 70% of establishments in Spain with more than 9 employees were estimated to have safety representatives, whereas the Spanish survey for the same year (INSHT 2009) estimated that 43.4% of establishments of more than 5 employees had safety representatives, ranging from 27.9% in establishments of 6 to 9 employees to 100% in establishments with over 500 employees. In Catalonia, the 2011 Catalan survey showed that there were safety representatives in 47.8% of the companies with more than 5 employees based at a single workplace (GREDS-EMCONET 2013).

Reliability concerns arise regarding different aspects. On one hand, the aforementioned surveys present very low response rates: 8.7% in the case of Europe (Petraikos et al. 2011) and 21.2% in the case of Catalonia. On the other, a possible bias was detected in one recent European survey related to the fact that access to the workers' representatives, as informants, was conditioned by the consent of the business owner (65% of the cases) (Riedmann and European Foundation for the Improvement of Living and Working Conditions 2010). These biases may lead to an overestimation of the companies with safety representatives (Lucy and Sinclair 2012; Walters et al. 2012).

Both at international and at national levels, few studies have evaluated the quality of the surveys on occupational safety and health management and those available are of a qualitative nature (Lucy and Sinclair 2012; Petraikos et al. 2011). Driven by the importance of gathering good quality, reliable data (García and Gil 1996; Peruga et al. 2000), the Catalan

administration via the Sub-directorate General of Health and Safety at Work carried out, in 2011, the Programme on Prevention of Risks Management in Companies (PPRMC) in parallel with the development of the Second Catalan Survey of Working Conditions (IICSWC) (Departament d'Empresa i Ocupació (DEMO) 2012a). In both cases, data were gathered via the same questionnaire (Departament d'Empresa i Ocupació (DEMO) 2012a) but using two different methods of data collection: whereas in the Second Catalan Survey of Working Conditions the data were gathered in the manner typical of this type of surveys –self-reported by employers or their representatives-, the Programme on Prevention of Risks Management In Companies was oriented to minimizing biases, placing special emphasis on the response rate, the method of data collection and the profile of the informant. For this reason the data from the Programme on Prevention of Risks Management In Companies may be considered to be the best available.

Given the importance of safety representatives for the health of workers, the variability in the estimates available on safety representatives and the scarcity of studies that give a quantitative evaluation of the quality of the information collected in occupational safety and health management surveys, this study aims to estimate, from the data of the Programme on Prevention of Risks Management in Companies, the percentage of establishments in Catalonia with safety representatives as well as to evaluate the possible differences in estimates according to the source of the information (Programme on Prevention of Risks Management in Companies and Second Catalan Survey of Working Conditions) and the profile of the informant.

## **Data and Methods**

### *Design and reference population*

Cross-sectional study. The reference population consisted of those establishments in Catalonia with one or more workers affiliated to Social Security on 30<sup>th</sup> March 2011 (N= 226,355) (Tesorería General de la Seguridad Social and Ministerio de Empleo 2011).

### *Sources of information*

The data were obtained from the Programme on Prevention of Risks Management in Companies (PPRMC) and the Second Catalan Survey of Working Conditions (IICSWC), each source with its own sample of establishments (421 and 1,675, respectively), which made up the units of the study. Both samples were obtained through a design stratified according to provinces, economic activity and size of the Social Security contribution account. The sampling error of each sample was calculated in order to estimate prevalence in finite universes with a confidence level of 95% and under the assumption of maximum indetermination ( $p=q=0.5$ ). With an infinite population and an assumption of simple random sampling, the sampling errors are: for proportions estimations, 4.78% in the Programme on Prevention of Risks Management in Companies and 2.39% in the Second Catalan Survey of Working Conditions. As a result of its larger sample size, IICSWC has narrower confidence intervals than the ones from PPRMC.

The period of data collection was from 1<sup>st</sup> October to 15<sup>th</sup> December 2011, for the Programme on Prevention of Risks Management in Companies, and from 14<sup>th</sup> June to 2<sup>nd</sup> August, for the Second Catalan Survey of Working Conditions, with a response rate (American Association for Public Opinion Research. 2011) of 81.2% in the Programme on

Prevention of Risks Management in Companies and 21.2% in the Second Catalan Survey of Working Conditions. In previous publications detailed information can be found about the methodology used in the sampling design and the fieldwork of the Second Catalan Survey of Working Conditions (Departament d'Empresa i Ocupació (DEMO) 2012a).

#### *Instruments and methods of data collection*

The same questionnaire was applied in the Programme on Prevention of Risks Management in Companies and the Second Catalan Survey of Working Conditions (Departament d'Empresa i Ocupació (DEMO) 2012a). However, while in the case of the Second Catalan Survey of Working Conditions the questionnaire was self-completed by the employers or their representatives who transmitted the information either online, by telephone or on paper (86.7%, 9.5% and 3.7% of the establishments, respectively); for the Programme on Prevention of Risks Management in Companies data were collected by the labour authority. That is to say, technicians of the Sub-directorate General of Health and Safety at Work carried out a documentary verification of the information in the establishments, in the framework of interviews with the persons responsible for occupational safety and health in the companies and in the presence of the safety representatives where these existed. This verification involved asking for certificates or documents proving the information on management of risk prevention provided by the companies.

#### *Study variables*

The dependent variable was "establishment with safety representative/s" (Yes; No), considering "Yes" to mean having at least one safety representative. Independent variables were: "source of information" (PPRMC; IICSWC), "profile of the informant" (Sub-directorate General of Health and Safety at Work technician; general manager; person responsible for

human resources; person responsible for occupational safety and health; person responsible for other matters; administrative staff; others, without special responsibility) and “size of establishment” (1 to 5 employees; 6 to 9 employees; 10 to 49 employees; 50 to 249 employees; 250 to 499 employees; >499 employees). The size of the establishment was considered as a stratification variable in the estimate of the percentage according to information source.

For all of the variables, the response categories “Does not know” and “Does not answer” were considered as lost values, except in the case of establishment size, for which a deterministic imputation was made based on the size associated with the social security contribution account code (64 companies from the Second Catalan Survey of Working Conditions). The PPRMC had no missing values in reference to the variables included in the analysis. As for the IICSW, missing values regarding the variable “establishment with safety representatives” were 78 (4.66%), 184 (11%) with regard to the variable “profile of the informant”.

### *Statistical analysis*

A descriptive analysis was made of the independent variables for both samples (Programme on Prevention of Risks Management in Companies and Second Catalan Survey of Working Conditions). Then, an estimate was made of the percentage of establishments with safety representatives and the differences in the percentages between the two sources of information – taking the Programme on Prevention of Risks Management in Companies as a reference – with the respective 95% confidence intervals (95%CI), globally (for all establishments and for those of more than 5 employees) and by establishment size. Finally



the percentage of establishments with safety representatives was estimated and the differences in the percentages, according to the different profiles of informants – taking as reference the technicians of the Sub-directorate General of Health and Safety at Work (Programme on Prevention of Risks Management in Companies). These estimates were obtained from the samples and standard errors accounted for the sample design in each case.

## **Results**

In table 1 the samples from the two sources of information are described in terms of the study variables. When compared to the distribution of establishments in Catalonia, the sample of the Programme on Prevention of Risks Management in Companies is more similar to the reference population than the Second Catalan Survey of Working Conditions. The distribution of the study units by establishment size presents differences between the sources: the stratum of the Programme on Prevention of Risks Management in Companies with most units is that which corresponds to establishments with 1 to 5 employees, while in the case of the Second Catalan Survey of Working Conditions the stratum of 10 to 49 employees stands out. As regards the profile of the informant of the Second Catalan Survey of Working Conditions, the highest percentage corresponds to persons responsible for occupational safety and health.

INSERT TABLE 1

According to the Programme on Prevention of Risks Management in Companies, there are safety representatives in 6.6% (with a 95%CI: 4.6-9.4) of the totality of establishments in Catalonia, and 21.6% ((15.1-29.7) if only the establishments with 5 or more employees are considered. This percentage tends to increase as establishment size increases: from 0.4% (0.1-2.5) in establishments with 1 to 5 employees to 79.3% (30-97.2) in establishments with more than 499 employees (Table 2).

Comparing the data from the Second Catalan Survey of Working Conditions with those from the Programme on Prevention of Risks Management in Companies, the differences in percentages of establishments with safety representatives are: 20.9% overall (17.7-24.2), 28.3% (20.1-36.4) for establishments with more than 5 employees, and rising to 46.8% (21.7-71.9) for those with 50 to 249 employees (Table 2).

INSERT TABLE 2

When data gathered from the different informant profiles of the Second Catalan Survey of Working Conditions is compared to that collected by Sub-directorate General of Health and Safety at Work technicians, greater differences in percentages are observed when informants are persons responsible for occupational safety and health, 44% (36.9-51.3), and persons responsible for human resources, 33.2% (25.2-41.1) (Table 3).

INSERT TABLE 3

## **Discussion**

Taking the case of establishments with safety representatives, we provide a quantitative evaluation of the information quality of occupational safety and health management in companies, specifically of the biases in the estimates. We compared the percentage of establishments with safety representatives in Catalonia, collected according to the Programme on Prevention of Risks Management in Companies, to figures obtained from the Second Catalan Survey of Working Conditions (Departament d'Empresa i Ocupació (DEMO) 2012a); where the former collected data using a method focused on minimizing biases (GREDS-EMCONET 2013; Lucy and Sinclair 2012; Petrakos et al. 2011; Walters et al. 2012), and the latter used a different method, one commonly used at state (INSHT 2009) and European levels (European Agency for Safety and Health at Work 2009a; European Foundation for the Improvement of Living and Working Conditions (EUROFOUND) 2009).

According to the Programme on Prevention of Risks Management in Companies, there are safety representatives in 21.6% of establishments with more than 5 employees in Catalonia (establishments in which regulations stipulate the designation of one or more safety representatives). The Second Catalan Survey of Working Conditions yields much higher estimates of establishments with representatives, for the whole set of establishments in Catalonia and for those with more than 5 employees.

In this study we did not only focus on the mode of administration as a source of measurement error, but also on the respondent (Alwin 1991). We observed that the percentage of establishments reported to have one or more safety representative varies not only according to the method of data collection (Programme on Prevention of Risks

Management in Companies or Second Catalan Survey of Working Conditions), but also according to who the informant is. With respect to the information collected from Sub-directorate General of Health and Safety at Work technicians, overestimations are higher when informants are the persons responsible for occupational safety and health. This is highly significant bearing in mind that they are the recommended informants in some surveys (Lucy and Sinclair 2012), given their training and duties (RD 39.1997).

The results of the Programme on Prevention of Risks Management in Companies differ from other surveys on occupational safety and health management using as informants employers or their representatives. For example, the percentages of establishments with more than 5 employees which have safety representatives gathered in the Second Catalan Survey of Working Conditions and in the Spanish survey (INSHT 2009) are both roughly double the estimate of the Programme on Prevention of Risks Management in Companies (49.8% and 43.4% versus 21.6%). Moreover, the European survey (European Agency for Safety and Health at Work 2009b) estimates that 70% of establishments with more than 9 employees have safety representatives in Spain, well above figures obtained by both the Second Catalan Survey of Working Conditions and the Programme on Prevention of Risks Management in Companies (56.6% and 30.4%, respectively). It would appear, then, that the overestimate observed in the Second Catalan Survey of Working Conditions would also occur in the different occupational safety and health management surveys conducted at state and at European levels.

This generalized overestimating of establishments with safety representatives might be partly related to the low rates of response of the surveys. Estimates increase because

companies participating in the surveys tend to be those which are most committed to occupational safety and health (Lucy and Sinclair 2012; Walters et al. 2012), or those which are least reticent in replying. In the Second Catalan Survey of Working Conditions, 4.7% of the companies did not respond to the question on the existence of safety representatives, and for this reason the percentage of establishments without safety representatives may be even higher. At European level, several studies point out the need to improve response rates and to obtain information on the companies that do not respond, in order to correct biases associated with the low rates (Lucy and Sinclair 2012; Marta-Pedroso et al. 2007; Petrakos et al. 2011).

In line with other studies (European Agency for Safety and Health at Work 2010; Lucy and Sinclair 2012; Peersman et al. 2014), the results obtained point to the fact that the method of data collection and the profile of the informant are potential sources of bias. However, some considerations must be taken into account in order to interpret the results obtained and, specifically, to evaluate possible explanations for the differences observed between the two sources.

Firstly, the collection of data in the two samples (Second Catalan Survey of Working Conditions and Programme on Prevention of Risks Management in Companies) was not carried out simultaneously (3<sup>rd</sup> and 4<sup>th</sup> quarter of 2011). This fact might have led to a change in the number of establishments with one or more safety representatives, mainly related to the calling of union elections. However, owing to their proximity in time, it cannot be imagined that so high a number of union elections would have been called as to be a possible explanation of the differences observed between the estimates of each source of

information. In the case of the Second Catalan Survey of Working Conditions, despite the data being gathered in the 3<sup>rd</sup> quarter, the month of August was avoided in order to facilitate access to the companies.

Secondly, a bias may also occur as a result of using the establishment as a unit of data collection and analysis (Petrakos et al. 2011) – since the regulation stipulates the designation of safety representatives according to the number of employees in the establishment or company – as well as the fact that the units of the sample (Social Security contribution account code) and of analysis (establishment) and the categories of the variable “size of establishment” in the sampling and analysis phases were not the same. For this reason, we explored the distribution of the samples according to the different categories of stratification and of analysis. It was detected that the Second Catalan Survey of Working Conditions under-represented small establishments and over-represented medium and large establishments with respect to the population, whereas the distribution of the Programme on Prevention of Risks Management in Companies corresponded to that of the population, which lends more external validity to the results obtained by the Programme on Prevention of Risks Management in Companies. Even so, these differences in distribution do not affect the results reported for each stratum of size of the establishment

As regards the methodology of the data comparison, it has not been possible to carry out a specific analysis of the validity of the information from the Second Catalan Survey of Working Conditions (Riegelman and Hirsch 1992; Viladrich and Doval 2007), because the establishments participating in the two samples were different. For this reason it was decided to use the difference in the percentages and confidence intervals between the two

sources of information (Gardner and Altman 1988; International Committee of Medical Journal Editors. 2014).

Information provided by the Second Catalan Survey of Working Conditions leads to a generalized overestimation of the percentage of establishments in Catalonia with safety representatives, something which might be explained by the informant profiles and the method of data collection employed in the survey. It is necessary to carry out more specific studies to determine the most appropriate profile of informant, as well as to make changes in the way data are collected in an attempt to improve, for example, the response rates (Lucy and Sinclair 2012; Marta-Pedroso et al. 2007; Peruga et al. 2000; Petrakos et al. 2011; Walters et al. 2012). It would also be advisable to explore the existence of biases in the rest of the information on occupational safety and health management compiled via surveys of this type. Hence, the study suggests there is a need for the labour authority and the institutions which are responsible, not only in Catalonia but also at state and European level, to focus their efforts on creating more complete and better quality information systems (Walters et al. 2012) – specifically in surveys – upon which to base more efficient actions and policies in the area of occupational health. Also, the results show the low level of representative participation in occupational safety and health in establishments in Catalonia, highlighting the need to establish interventions to encourage worker participation in the companies, given its proven relationship with the improvement of prevention of risks management and, indirectly, that of workers' occupational health.

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## Tables

**Table 1.** Description of the samples from the two information sources (PPRMC and IICSWC) in terms of the study variables

Variable name	Categories	PPRMC	IICSWC	Reference population
		n (%)	n (%)	N (%)
Establishment size				
	1 to 5 employees	284 (67.46)	253 (15.1)	178,345 (78.79)
	6 to 9 employees	45 (10.69)	105 (6.27)	18,267 (8.07)
	10 to 49 employees	59 (14.01)	626 (37.37)	24,469 (10.81)
	50 to 249 employees	19 (4.51)	513 (30.63)	4,504 (1.99)
	250 to 499 employees	9 (2.14)	103 (6.15)	453 (0.20)
	>499 employees	5 (1.19)	75 (4.48)	317 (0.14)
Source of information				
	PPRMC	421	category not applicable	category not applicable

IICSWC	category not applicable	1,675	category not applicable
Profile of the informant			
SGHSW <sup>a</sup> technician	421	category not applicable	category not applicable
General manager	category not applicable	341 (20.36)	category not applicable
Person responsible for human sources	category not applicable	288 (17.19)	category not applicable
Person responsible for OSH <sup>b</sup>	category not applicable	508 (30.33)	category not applicable
Person responsible for other matters	category not applicable	24 (1.43)	category not applicable
Administrative staff	category not applicable	128 (7.64)	category not applicable
Others, without special responsibility	category not applicable	202 (12.06)	category not applicable

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Sources: Programme on prevention of risks management in companies (PPRMC) and Second Catalan Survey of Working Conditions (IICSWC).

Sub-Directorate General for Health and Safety at Work. 2011.

<sup>a</sup> SGHSW: Sub-Directorate General for Health and Safety at Work

<sup>b</sup> OSH: Occupational Safety and Health



**Table 2.** Estimates of the percentages and difference in the percentages of establishments with safety representatives – global and stratified by size of establishment – by information source. Catalonia, 2011

Establishment size	PPRMC (a)	IICSWC (b)	Comparison (b-a)
	% (95%CI)	% (95%CI)	Percentage Diff. % (95%CI)
1 to 5 employees	0.36 (0.05-2.54)	10.04 (6.52-15.17)	9.68 (7.55-11.81)
6 to 9 employees	6.80 (2.21-19.1)	42.04 (25.08-61.11)	35.23 (26.14-44.32)
10 to 49 employees	26.34 (16.57-39.15)	47.77 (35.7-60.12)	21.44 (8.83-34.04)
50 to 249 employees	40.65 (19.96-65.29)	87.47 (81.2-91.86)	46.82 (21.75-71.89)
250 to 499 employees	100.00 <sup>a</sup>	92.71 (80.03-97.58)	-7.29 (-33.61-19.03)

>499 employees	79.33 (29.97-97.18)	93.26 (81.47-97.76)	13.94 (-122.81-150.68)
Total >5 employees <sup>b</sup>	21.56 (15.15-29.73)	49.82 (39.4-60.2)	28.30 (20.08-36.44)
Total	6.60 (4.58-9.42)	27.53 (21.9-33.96)	20.93 (17.66-24.19)

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Sources: Programme on prevention of risks management in companies (PPRMC) and Second Catalan Survey of Working Conditions (IICSWC).  
Sub-Directorate General for Health and Safety at Work. 2011.

<sup>a</sup> No variability in responses

<sup>b</sup> The total has also been calculated for establishments with more than 5 employees, as they are the ones for which the regulations stipulate the designation of safety representatives.

**Table 3.** Estimates of the percentages and differences in the percentages of establishments with safety representatives, according to the profile of the informant. Catalonia, 2011

Source and profile of the informant	% (95%CI)	Percentage Difference <sup>a</sup> % (95%CI)
Programme on prevention of risks management in companies (PPRMC)		
SGHSW <sup>b</sup> technician	6.60 (4.58-9.42)	Reference category
Second Catalan Survey of Working Conditions (IICSWC)		
General manager	16.05 (10.18-24.38)	9.45 (5.63-13.28)
Person responsible for human resources	39.75 (22.04-60.62)	33.15 (25.24-41.06)
Person responsible for OSH <sup>c</sup>	50.70 (32.37-68.84)	44.10 (36.90-51.29)
Person responsible for other matters	25.49 (5.41-67.16)	18.89 (3.90-33.87)
Administrative staff	27.09 (13.29-47.39)	20.49 (13.9-27.08)

Others, without special responsibility

21.21 (10.15-39.06)

14.61 (6.73-22.49)

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<sup>a</sup> Difference in the percentage of the estimate corresponding to each informant profile of the IICSWC with respect to the estimate corresponding to the SGHSW technicians in the PPRMC.

<sup>a</sup> SGHSW: Sub-Directorate General for Health and Safety at Work

<sup>b</sup> OSH: Occupational Safety and Health