Workplace accidents in mining of Catalonia in 2012

RESUMEN / ABSTRACT

Objective: To compare in Catalonia , the incidence of fatal occupational injuries and non-fatal accidents for workers in the mining sector Subterrania workers with open-pit mining in 2012 . Methods : Data from accident injuries came from the Ministry of Labour and Immigration and the Department of Industry , Mines i Energia de la Generalitat de Catalunya. The incidence of fatal and non-fatal injuries was calculated by accident and the Odds Ratio (OR) in the confidence interval of 95% (95 % CI) for mineworkers in Subterrania compared to workers in the mining opencast Results and discussion: the OR of workers mining Subterrania compared to open pit is 2.6 (95% CI 1.8 to 3.8) among themselves and hired workers in underground mines is 2.47 (95% CI 2.4 to 5.8)

PALABRAS CLAVE / KEYWORDS

Workplace Accidents; Mining; Odds Ratio; ORP Conference

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Introdution

In the global economy, the mining sector plays a fundamental role as it provides vital raw materials and energy for a large number of industries, including ceramics, building, electronics, metal, paper, plastics and others. Spain has traditionally been an outstanding European producer of nonferrous and precious metals. According to data from 2009, it was the sixth European producer of sand and gravel for industrial applications and the third producer of gypsum in Europe. Nevertheless, the global economic and financial crisis initiated in 2007 affected the major markets for construction and ceramics and consequently, the consumption of all types of minerals declined [1]. In Spain, the value of mineral output (not including mineral processing) decreased by 50%, from € 4,465 million of market able production in 2007 to € 2,250 million in 2011 [2].

If the indexes of work accidents in the Spanish mining are compared with those of other countries, we can see that the values are much higher [3].

Mining activities have important economic, environmental, labor and social repercussions on local and global scales [4]. In this sense, the first decade of the 21st century in particular has seen a renewed debate about mining and its sustainability [5] This is owing to public concern about its environmental and social impacts (severe land disturbance, off-site impacts, community displacement, and health and safety problems; [6,7].

Catalonia, Fig. 1, one of the most industrial communities in Spain, is also one of the regions with a highest production of minerals (considering all types of minerals as a whole). Between 2000 and 2007 the production output increased and in 2007 it started to decline as a consequence of the international economic crisis (in spite of the economic situation, Catalonia became the first producer of minerals in Spain in 2009). According to the latest statistics published by the General Directorate of Mining of the Spanish Government, the Catalan sector accounted for almost 18,4% of the national mineral production with around € 514 million in 2011, and it employed about 2,570 direct workers and 1,615 indirect workers [8]

Fig. 1. Location of study area

Despite safety strategies have been implemented in workplace, occupational accidents and incidents have increased in parallel of growth and expansion of industries and their consequences are unacceptable [9]. The most controversial outcomes related to occupational accidents could include injury and loss of life, disability [10,11], social impacts and deacrese in productivity [12]. It seems that this challenge could have a huge impact on some developing countries [13-14]. Accident causes have been widely investigated and documented in the literature and articles reporting this topic include to the age and long length of work shifts as variables[15], occupational safety management [16], job factors and organization related factors [10]. Thus, the implementation of preventive measures requires detailed analysis of accidents [17]. The level of safety culture is a result of the value of human life and health in a given society [18].

Historically, mining has been one of the most hazardous work environments in many countries around the world [19] . In addition, due to their severity and frequency, mining injuries, illnesses, and fatalities are among the costliest [20]. Despite

the record of progress that has been achieved in reducing mining injuries and fatalities, both the number and severity of mining accidents occurring are still unacceptable [21].

The incidence of work accidents in energetic mining Spanish decreases, whereas the age of the injured workers increases. However, the seriousness of the injuries caused by the accidents increases with age. [22]. Over 60% of patients believed that their injury was preventable, either by wearing appropriate clothing or by following correct safety procedures. [23].

The most common type of accident recorded in subsurface and surface mining in Spain throughout the period of 2003–2008 was physical over-exertion on the muscular-skeletal system with 21.7% and 28.3%, respectively. [24].

So, the major goal of this study is to analyze data on occupational accidents in the mining of Catalonia (Spain), in the period 2011-2012 in order to use clues that would support political definition of priorities and strategies for prevention.

Methods

Study Population

The study population comprised accidents that took place in the Spanish and Catalan energetic mining sector in 2011–2012, within the work schedule (we did not consider accidents which happened on one's way to or from work) which caused the injured worker to lose at least one workday. Data were obtained from the annual digital data base of the Ministry of Employment and Social Security of Spain and those provided by the Division of Energy Mines of Catalonia. In itinere accidents traveling to or from the mining company are not included.

Description of the Methodology

The study was divided into underground and surface mining, A risk index is defined as the ratio of the percentage of injuries attributed to a given subpopulation (age group or size of work centre) to the percentage of the total workforce represented by that subpopulation [25]. A risk index of 1 corresponds to an average risk, while a value greater than 1 indicates a higher risk for

that group. Thus, to calculate the risk index, we needed to know the percentage of accidents that happened in each work centre, and the percentage of workers. We also calculated the average duration index (ADI) which indicates the seriousness of accidents. We analysed the relationship between the risk index (as an indicator of the incidence of accidents in a population) and the ADI, this was done with the nonparametric statistical Spearman rank correlation coefficient. The mean was calculated for the total population in 2011 and 2012. Throughout this paper, analyses were conducted at a .05 significance level.

Corporate differentiation.

Because corporate differentiation refers to the different market or production niches occuppied bya firm, corporate differentiation was operationalized with three separate variables: (a) the number of different types of mines owned by the parent organization, which can range from 1-13 (see Table 1); (b) the number of different mining methods used in all of the parents underground mines, which can also range from 1-13 (see Table 2); and (c) whether mining comprises more than 50% of the activities (measured in terms of employees) of the parent organization.

Table 1: Underground mining methods

1	longwall/ripper
2	longwall/shear
3	continuous/auger
4	continuous/bore
5	continuous/ripper
6	continuous/shortwall

7	conv./shoot office solid-loading machine
8	hand load/shoot off solid
9	scoop/shoot off solids
10	conventional with cutting machine
11	hand load/anthracite
12	hand load/cutting machine
13	scoop with cutting machine

Source: MSHA 2001a.

Table 2 Types of mines.

1	Underground-Metal
2	Underground-Nonmetal
3	Underground-Stone
4	Surface – Metal
5	Surface – Nonmetal
6	Surface – Stone
7	Mills – Metal
8	Mills – Nonmetal
9	Mills – Stone
10	Sand and Gravel
11	Underground – Coal
12	Surface – Coal
13	Mills – Coal

Source: MSHA 2001a.

Table 2 Types of mines.

Results and discussion

Comparing accidents between USA, Spain and Catalonia, we obtain Table 3 for accidents in USA, Table 4 for Spain and Table 5 for Catalonia.

		2011		2012	
Type of mine		Injuries	%	Injuries	%
Stone	Fatal	5	0,07	6	0,09
	No Fatal	1653	23,59	1665	25,44
Sand and gravel	Fatal	3	0,04	4	0.06
	No Fatal	597	8.52	584	8.92
No metalic mineral	Fatal	0	0,00	2	0.03
	No Fatal	481	6,86	484	7.39
Metal	Fatal	4	0.06	1	0.02

	No Fatal	341	4.87	341	5.21
Coal	Fatal	14	0.20	18	0.27
	No Fatal	3,909	55.79	3,441	52.57
Total		6,526	100	6,546	100

Table 3.- Injury and workers in the mining of USA in 2011 and 2012 (not including office workers)

In USA mining accidents decreased in 2012 compared to 2011, increasing the working population of 231,060 people in 2001 to 233,551 in 2012. However fatalities were 26 (0.37%) in 2011 and 31 (0.47%) in 2012. Half of the fatalities and injuries belong to workers in coal mines both in 2011 and in 2012

		2011		2012	
Type of mines		Injuries	%	Injuries	%
Extraction of coal and lignite	Fatal	5	0,14	1	0.03
	No Fatal	2122	57.68	1,808	54,20
Extraction of crude petroleum and natural gas	Fatal	0	0.00	0	0.00
	No Fatal	19	0.52	10	0,30
Mining of metal ores	Fatal	2	0.05	0	0.00
	No Fatal	119	3.23	103	3.09
Other mining and quarrying	Fatal	6	0.16	8	0.24
	No Fatal	1,406	38.22	1,406	42.15
Total		3,679	100	3,336	100

Table 4. Injuries and division activity sector in Spain

In Spain the number of lesions was reduced in 2012 to the amount of 3336, still in 2011, 3,679 accidents and the workforce in mining varied from 39,400 people in 2011 to 35,200 in 2012. Fatal injuries also decreased from 13 (0.35%) in 2001 to 9 (0.27%) in the 20012. Fatal accidents (most of them occurred in other extractive industries) in 2011 were 6 (46% of all moral) and 8 (89%) in 2012. In mines of lignite extraction nonfatal injuries were higher than those occurring in other types of mining in both 2011 (with 58% of the total) and 2012 (with 52% of all accidents).

		2011		2012	
Type of mines		Injury	%	Injury	%
Extraction of coal and lignite	Fatal	0	0,00	0	0.00
	No Fatal	3	1.35	5	2.67
Extraction of crude petroleum and natural gas	Fatal	0	0.00	0	0.00
	No Fatal	4	1.80	3	1.60
Mining of metal ores	Fatal	0	0.00		0.00
	No Fatal	63	28.38	40	21.39
Other mining and quarrying	Fatal	0	0.00	1	0.53
	No Fatal	152	68.47	138	73.80
Total		222	100	187	100

Table 5. Injuries and division activity sector Catalonia

In Catalonia, the number of accidents decreased from 222 in 2011 to 187 in 2012, declining mining workers, with about 4,356 in 2011 and 2012 jobs were lost up to 4,185. and lesions were also reduced. However, fatalities increased in 2012 because there was an accident, while in 2011 it remained without any fatal injury. Most accidents have occurred in other extractive industries (stone) concentrating 152 non-fatal injuries (68%) in 2011 and 138 (74%) in 2012. Also, the only mortal injury that occurred in mining in two years was in such quarries.

	2011		2012	
	No fatal	Fatal	No fatal	Fatal
USA	28,13	11,25	28	9
Spain	93	33	94,5	25,6
Catalonia	51	0	44,4	24

(*) Fatal IR = (number of fatalities / Mining Workers) * 100,000

(**) Non Fatal IR = (number of non-fatal accidents / Mining Workers) * 1000

Table 6. Comparison of the risks of incidence (IR) of fatal accidents (*) and non-fatal (**)

According to Table 6, for both IR fatalities and IR non fatalities, the values in Spain have been 3 times higher than those in USA, and for Catalonia they have been nearly 2 times higher . Therefore, workers in the Spanish and Catalan mining are more exposed to occupational accidents than in USA .

In Catalonia, permanent workers are more than twice , exactly 2.6 times more likely to have an accident than the contracted external staff (Table 7) , with an index of 95% confidence , and a Mantel - Haenszel Xi^2 28.2 . The hired staff who belongs to an auxiliary company is authorized to enter the mine , although usually only a small proportion of workers from these enterprises visit the mining facilities .

Also own and contracted workers in underground mines are more likely to suffer an injury than fixed operators and contractors working in opencast mines , Table 8.

	Unadjusted ODs	IC 95%	Xi^2	p
Underground personal	2,60	1,8 – 3,8	23	< 0,01
Opencast personal	1			
Own underground personal	2,47	2,4 -5,8	41,87	0
Hired underground personal	1			
Own underground personal	10	6,7 – 16,2	169	0
Own opencast personal	1			
Own opencast personal	1,93	0,85 – 4,9	2,7	0,04
Hired opencast personal	1			
Hired underground personal	5,3	2,35 – 13,5	21	< 0,01
Hired opencast personal	1			

Table 7 Risk factors of occupational injuries among mining workers, 2012: Results of multiple logistic regression analysis

	Underground mines			Opencast mines		
	Injury no death	Population risk	Incidence rate	Injury no death	Population risk	Incidence rate
Own personal	120	834	143,88	28	1736	16,13
Hired personal	29	668	43,41	8	947	8,45
Total	149	1502	99,20	36	2683	13,42
	Fatal			Fatal		
Own personal	1	834	119,90	0	1736	0,00
Hired personal	0	668	0,00	0	947	0,00
Total	1	1502	66,58		2683	0,00

Table 8 Comparison of the risk of injury for nonfatal occupational injury among workers in underground mining regarding opencast mining workers in Catalonia

Conclusions

Incidence rates (IR) of accidents in Spain in 2012 were 94.5 for nonfatal injuries and 25.6 for fatal injuries. These values are much higher than the ones from U.S. . These indice rates were 44.4 and 24 for non -fatal and fatal respectively in Catalonia , which are also higher than in the values from U.S. that were 28 and 9.

The staff of underground mines has 2.6 times more chance of having an accident than staff working in opencast mines .

The staff itself is 2.47 times more likely to have injured personnel hired in mineral companies in Catalonia .

The own personnel from underground mines has a probability of 10 with respect to own workers from opencast mines .

The staff itself from opencast mines has more 1,93 times more probability of having an accident than hired staff.

Workers engaged in underground mining have 5.3 times greater chance of suffering ab injury than contracted workers working in opencast mines .

In general, the incidence rates of workers in underground mines , 99.2 IR, is much higher than the one for workers from opencast (13.42).

This study shows that workers in underground mines are more likely to have an accident at work than those working in the opencast mining and among these workers from underground mines, which are part of the company as fixed workers, are more likely to have lesions than hired workers .

We recommend using protective equipment in accordance with the work , and giving priority to collective protection to the individual protection. The personal protective equipment must be used throughout the workday.

All mining companies are required to assess the risks of job security, but often these assessments are not accurate. Consequently , the causes of accidents are commonly different than those considered in other productive sectors. It is imperative to analyze the real causes and get all the information that permits a good risk assessment

The complexity of the industrial accident rate makes it necessary to conduct a thorough analysis of working conditions in order to improve safety at work [26] .

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