

1 **GENDER DIFFERENCES IN LOST WORK DAYS DUE TO OCCUPATIONAL ACCIDENTS**

2 **by**

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## 32 **Gender differences in lost work days due to occupational accidents**

### 33 **Abstract**

34 **Objective:** We report the relationship between duration of sick leave due to occupational injury  
35 and worker gender. We also examine the relationship between certain independent variables  
36 and duration of sick leave, including age, type of work, place of work, company size, day of the  
37 week and time of day.

38 **Data and method:** We analyzed accident records (N = 4,188,714) that resulted in lost time from  
39 work in Spain during 2008 through 2014. Statistical differences were determined using  
40 Student's t-test for independent samples.

41 **Results:** Women were involved in accidents more often than men and had a longer duration of  
42 lost work time. The magnitude of this difference increased with age, and the duration of sick  
43 leave was higher among older workers. Regarding company size, the highest average length of  
44 injury-related time off from work occurred in firms with fewer than 5 workers. The duration of  
45 sick leave gradually increased throughout the week from Monday to Sunday among men and  
46 from Monday to Friday among women. The duration of injury-related sick leave was higher  
47 when traveling and while at venues other than the usual place of work. Moreover, the duration  
48 of injury-related sick leave was higher when workers were performing non-routine tasks.

49 **Conclusion:** Emerging factors related to the duration of injury-related sick leave included  
50 gender, age, firm size, the day of the week, and the type and place of work. Knowledge of these  
51 factors may help to reduce lost time from work and its associated costs.

### 52 **Keywords**

53 Job safety; Lost work days; Gender; Injury; Occupational accident; Sick leave duration

### 54 **1. Introduction**

55 Occupational accidents result in significant costs for companies, the worker, and society overall.  
56 These costs vary by accident type and are higher as the duration of sick leave resulting from the  
57 accident increases. Lost working days due to job-related injuries have been proposed as an  
58 alternative metric for evaluating safety in the workplace (Coleman & Kerkerling, 2007).

59 A longer duration of sick leave, i.e., lost work days, increases costs to the company inasmuch  
60 as the worker is not productive during those days. The firm usually pays the worker during sick  
61 leave (a cost that increases in proportion to lost work days), and the worker may be replaced by

62 a temporary employee, assuming one is available, who also must be paid (Butler, Baldwin, &  
63 Johnson, 2006). Asfaw, Mark, and Pana-Cyan (2013) found an increase in profits of 10% was  
64 related to a reduction of 1.1% in accidents with reported time off work in the United States  
65 mining industry.

66 Sick leave as a consequence of occupational injury usually has an influence on the income of  
67 the worker, which decreases with the time spent absent from work (Boden & Galizzi, 1999).

68 Usually this income is affected by what is covered in accident-related sick leave, the possible  
69 insurance coverage of the worker, and any remuneration received from the national social  
70 security system.

71 Occupational sick leave also brings about a cost both for society and for the national social  
72 security system. The magnitude of compensation is normally in direct proportion to the duration  
73 of the time off from work, as well as the costs of medical assistance and rehabilitation, when  
74 they, too, are necessary. In Spain, the country of study, sick leave payments for temporary  
75 incapacity are intended to cover loss of income due to illness or injury when the worker is  
76 additionally claiming health assistance from the social security system (Art. 128.1 LGSS) (López  
77 González et al., 2012).

78 One of the most studied variables having an influence on accident rates has been gender  
79 (Garcia Herrero, Mariscal Saldana, Garcia Rodriguez, & Ritzel, 2012). Whereas men have  
80 higher accident rates (Salminen, 2004), the duration of post-accident sick leave among women  
81 is generally longer (Cheadle et al., 1994; Johnson & Ondrich, 1990). In one study, researchers  
82 reported that of persons employed in positions of lower responsibility, women experienced more  
83 days off work for recuperation than men (Moral de Blas, Corrales-Herrero, & Martín Roman,  
84 2012). A higher percentage of women also were involved in serious accidents while traveling to  
85 and from work, and in accidents on external assignments (Moral de Blas et al., 2012). In  
86 contrast, longer sick leaves occurred among men in Sudan who were involved in accidents,

87 when sick leave was less than 30 days in duration (El Tayeb, Abdalla, Heuch, & Van den Bergh,  
88 2015).

89 Variables other than gender influence the length of sick leave. For example, the seriousness of  
90 the accident (In Spain, the seriousness of the accident is diagnosed by a doctor the day of  
91 occurrence of the event) and the duration of sick leave tend to be higher among older people,  
92 as demonstrated in the industrial sector in Spain, where sick leave is longer for older workers  
93 (Blanch, Torrelles, Aluja, & Salinas, 2009). Likewise, among public health hospital service  
94 workers in Mallorca, workers older than age 45 experienced longer sick leaves (Monroy  
95 Fuenmayor, Vicente-Herrero, Moreno Morcillo, Nuñez Fernández, & Tejedó Benedicto, 2010).  
96 The same phenomenon is noted for falls in the construction sector in Washington (Lipscomb et  
97 al., 2014) and for accidents in the Swedish mining industry (Laflamme, Menckel, & Lundholm,  
98 1996). These results are supported by other studies showing that older workers experience  
99 more days absent from work, e.g., the transversal study completed in Washington with a sample  
100 of 28,473 work-related compensation claims for disability (Cheadle et al., 1994). Such  
101 differences are not apparent in other sectors, which suggests that they may depend on the  
102 sector and the category of the work (Laflamme & Menckel, 1995). For instance, a Quebec study  
103 of lost work days due to accidents among nurses and domestic workers presented no age-  
104 related differences in duration of sick leave (Cloutier, David, & Duguay, 1998).

105 In Spain, there is widespread use of the temporary contract worker (a worker who is hired for a  
106 time-limited period). This practice affects the duration of sick leave, with a shorter duration of  
107 sick leave in the case of work contracts through temporary employment agencies and a  
108 lengthier duration for open-ended contracts (Garcia-Serrano, Hernanz, & Toharia, 2010; Moral  
109 de Blas et al., 2012).

110 In general, companies with more workers have fewer lost working days after an accident  
111 (Cheadle et al., 1994). In Italy, an inverse relationship was noted between the size of the firm

112 and the duration of sick leave in all industrial sectors (Fabiano, Curro, & Pastorino, 2004). In  
113 contrast, in South Korea, a large company had a lengthier duration of sick leave for employees  
114 experiencing back pain or lumbago (Kim, June, Yang, Park, & Park, 2006).

115 Temporal factors such as the day of the week, the hour of the working day (number of working  
116 hours completed by the worker when the accident took place), and the time of day (between 0  
117 and 24) have been related with the seriousness of accidents in the construction sector in Spain,  
118 the percentage of serious accidents increases as the week goes by (Camino Lopez, Ritzel,  
119 Fontaneda, & Gonzalez Alcantara, 2008). Moreover, a higher duration of sick leave following  
120 accidents occurs on weekends (Moral de Blas et al., 2012). The seriousness of the accident is  
121 greater at certain times of day, especially after lunch (Camino Lopez, Fontaneda, Gonzalez  
122 Alcantara, & Ritzel, 2011) and after the sixth hour of the work day (Moral de Blas et al., 2012).

123 According to data from the National Institute of Statistics in Spain, 13,837,688 work days were  
124 lost due to occupational accidents in 2012 (11,490,107 in the work day and 2,347,581 when  
125 traveling) (Ministerio de Empleo y Seguridad Social, 2013b), as opposed to 1,290,114 work  
126 days lost due to strikes (Ministerio de Empleo y Seguridad Social, 2013a). The high number of  
127 lost work days due to occupational accidents highlights the importance of analyzing sick leave  
128 data and accident etiology.

129 In our study we examined gender-specific data highlighting the length of sick leave resulting  
130 from injuries to workers in the occupational setting. The aim was to explore the hypothesis that  
131 sick leave duration is different for men and women following occupational injury. We also  
132 determined how selected independent variables influence the relationship between sick leave  
133 duration and gender. Specifically, we examined age, setting, company size, work type, and  
134 temporal variables such as the day of the week, for how they relate to accident occurrence and  
135 resulting sick leave.

136 **2. Methods**

137 All injuries occurring to workers as a consequence of the work they undertake are defined as  
138 occupational accidents. In Spain, all occupational accidents that involve sick leave must be  
139 submitted via an accident report form to the National Institute of Safety and Hygiene at the Work  
140 Place (INSHT; Instituto Nacional de Seguridad e Higiene en el Trabajo).

141 Company information (size, sector) and injured worker data (gender, age, type of contract,  
142 length of service, social security data) are entered in the accident report form. In addition, other  
143 data are reported as they relate to injured body part, date (mm/dd/year), day of the week and  
144 time of day. Moreover, lost work days are included when returning to work.

145 **2.1 Data**

146 We selected all accidents resulting in sick leave of more than one day that occurred in Spain  
147 over the period 2008 through 2014. The data originated from notifications recorded in the  
148 archives of the Ministry of Employment and Social Security.

149 As the aim was to conduct analyses with average values and to avoid distortions due to  
150 accidents with more lost work days, we reduced the highest values by 1%, the percentile of  
151 99%, amounting to 216 lost working days. Therefore, in our study, we consider accidents with  
152 lost work days numbering between 1 and 215.

153 Table 1 shows the number of accidents by year, and that the total number of accidents under  
154 analysis was 4,188,714. The large number of accidents under analysis empowers our ability to  
155 detect small but statistically significant differences.

156 Table 1. Number of accidents with sick leave (lost work days) by year Spain, 2008-  
157 2014

2008	2009	2010	2011	2012	2013	2014
878,962	696,366	636,181	572,624	465,806	460,647	478,128

158

## 159 2.2. Statistical analysis

160 We conducted all analyses using SPSS v22 software. We calculated the average number of lost  
161 work days by gender, age, whether engaged in routine or non-routine work, company size,  
162 accident location, day of the week and time of day. We calculated these measures analyzing  
163 gender differences and the duration of sick leave stemming from an accident. Statistical  
164 inferences were completed using Student's t-test for independent samples and analysis of  
165 variance (ANOVA) in cases where the factor presented more than two values.

## 166 3. Results

167 In the tables below, we report the number of accidents (N), the mean and standard deviation for  
168 the duration of sick leave, and the 2-tailed statistical significance level for Student's t-test in  
169 comparing means of independent samples (assuming unequal variances), as well as the 95%  
170 confidence intervals for difference in means (tables 2, 3, 4, 5, 6, 7, 8, 9).

171 Table 2 shows that the average number of lost work days due to occupational accidents was  
172 significantly higher for women by 1.197 days than for men ( $p < 0.005$ ).

173 Table 2. Average duration of sick leave due to accidents by gender in Spain, 2008-  
174 2014

Number of accidents		Average number of lost work days		Standard deviation		Statistical significance (p-value)	95% confidence intervals for the difference in means	
Men	Women	Men	Women	Men	Women		Lower	Upper
2,894,237	1,294,477	24.81	26.00	30.753	29.732	< 0.005	-1.259	-1.134
4,188,714		25.18						

175 Women in Spain presented a higher average duration of sick leave for all the years of our study,  
176 as Table 3 shows.

177 Table 3. Average duration of sick leave due to accidents by gender and year in Spain,  
 178 2008-2014

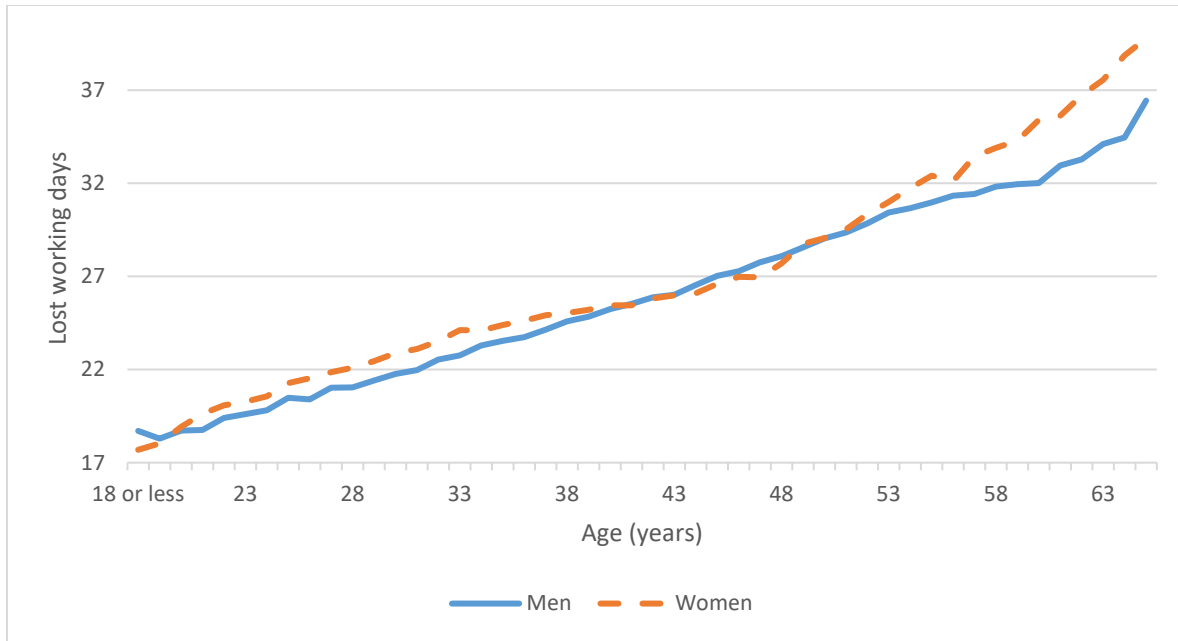
	Number of accidents		Average number of lost work days		Standard deviation		Statistical significance (p-value)	95% confidence intervals for the difference in means	
	Men	Women	Men	Women	Men	Women		Lower	Upper
2008	644,367	234,595	21.33	22.70	25.658	24.647	0.001	-1.492	-1.256
2009	490,759	205,607	24.50	25.88	30.685	29.339	0.001	-1.531	-1.225
2010	441,777	194,404	25.24	26.27	31.206	29.819	0.001	-1.192	-.869
2011	393,365	179,259	25.77	26.36	31.478	29.583	0.001	-.763	-.426
2012	312,354	153,452	26.43	26.80	31.918	30.173	0.001	-.557	-.181
2013	300,285	160,362	27.16	27.76	34.008	32.854	0.001	-.799	-.396
2014	311,330	166,798	26.78	27.70	33.695	32.719	0.001	-1.116	-.723

179 Table 4 shows the average number of lost days due to occupational accidents by gender and  
 180 age. A continuous increase in the duration of sick leave can be noted for both men and women  
 181 alike as they age. A further increase in this duration after age 50 may be observed for women.  
 182 And as for men, after age 60, as the slope of figure 1 increases after such age.

183 Table 4. Average of lost working days due to occupational accidents by gender and  
 184 age (grouped) in Spain 2008-2014.

Age	Number of accidents		Average number of lost work days		Standard deviation		Statistical significance (p-value)	95% confidence intervals for the difference in means	
	Men	Women	Men	Women	Men	Women		Men	Women
24 or less	295,285	115,369	19.19	19.73	24.088	21.451	< 0.001	-.694	-.391
25 to 34	865,033	353,347	21.78	22.76	27.038	25.127	< 0.001	-1.089	-.888
35 to 44	876,411	353,735	24.93	25.28	30.660	28.507	< 0.001	-.464	-.237
45 to 54	593,100	322,006	28.63	28.75	34.420	32.679	.091	-.266	.020
55 or more	264,408	150,020	32.01	34.26	37.273	37.915	< 0.001	-2.488	-2.010





186

187 Figure 1. Average of lost working days due to occupational accidents by gender and  
 188 age in Spain 2008-2014

189 With respect to company size, in all cases, the mean lost work days due to accidents among  
 190 women were significantly higher than those for men ( $p < 0.001$ ). The higher mean lost work  
 191 days due to accidents occurs in firms with fewer than 5 workers, is lower in firms of 50 – 249  
 192 workers, and increases in those with more than 250 workers (Table 5).

193 Table 5. Average of lost working days due to occupational accidents by gender and  
 194 size of firm in Spain 2008-2014

Number of workers in the firm	Number of accidents		Average number of lost work days		Standard deviation		Statistical significance (p-value)	95% confidence intervals for means differences	
	Men	Women	Men	Women	Men	Women		Men	Women
1 to 4	404,579	113,292	28.45	30.43	33.194	32.815	< 0.001	-2.199	-1.766
5 to 9	318,735	78,000	25.22	26.44	31.661	30.077	< 0.001	-1.452	-.976
10 to 24	546,121	135,919	24.19	25.19	30.642	29.088	< 0.001	-1.182	-.832
25 to 49	418,396	131,958	23.58	24.61	29.774	28.347	< 0.001	-1.208	-.853
50 to 99	341,101	150,067	23.44	24.83	29.644	28.720	< 0.001	-1.562	-1.210
100 to 249	353,032	200,222	23.70	24.70	29.439	28.523	< 0.001	-1.157	-.841
Over 250	512,273	485,019	25.01	26.41	30.457	30.147	< 0.001	-1.521	-1.283

195 Table 6 presents data on the average number of lost work days by gender by days of the week.  
 196 One can see that the average duration of sick leave increases as the week progresses from  
 197 Monday through Friday for men and for women. We also found statistically significant  
 198 differences for both genders when comparing successive days of the week ( $p < 0.05$ ).  
 199 During the typical work week of Monday through Friday, the average number of lost work days  
 200 was higher for women, with statistically significant differences for all days of the week ( $p < 0.05$ ).  
 201 The shorter duration of sick leave for women on weekend days attracted our attention, as it  
 202 deviated from our findings for weekdays. The mean number of lost work days decreased among  
 203 women on weekends but increased among men.  
 204 Table 6. Average of lost working days due to occupational accidents by gender and day of the  
 205 week in Spain 2008-2014

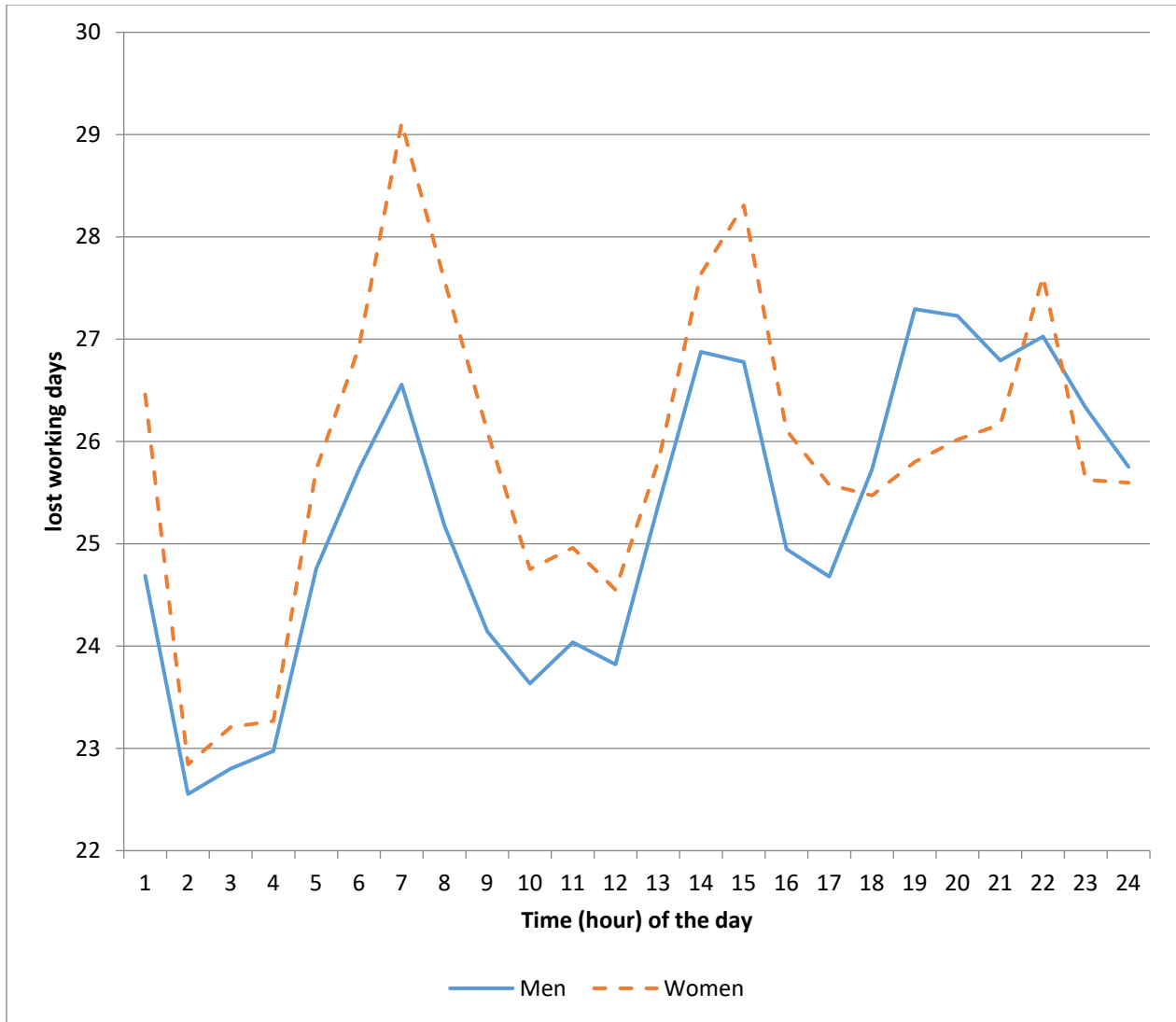
	Number of accidents		Average number of lost work days		Standard deviation		Statistical significance (p-value)	95% confidence intervals for the difference in means	
	Men	Women	Men	Women	Men	Women		Men	Women
Monday	600,367	239,831	23.41	25.19	29.654	29.058	0.001	-1.917	-1.641
Tuesday	568,419	235,636	23.78	25.65	29.984	29.551	0.001	-2.020	-1.735
Wednesday	530,731	225,738	24.22	25.98	30.415	29.871	0.001	-1.914	-1.618
Thursday	483,492	213,743	25.34	26.50	31.125	30.115	0.001	-1.317	-1.007
Friday	451,831	206,538	26.57	27.06	31.888	30.419	0.001	-.651	-.330
Saturday	172,088	109,814	27.40	25.95	32.510	29.593	0.001	1.221	1.687
Sunday	87,309	63,177	27.50	25.42	32.516	28.954	0.001	1.768	2.392

206 Table 7 reports the duration of sick leave due to accidents by the time of day of accident  
 207 occurrence. The differences between men and women were statistically significant except for  
 208 accidents occurring between 2am and 4am, at 6pm, and at midnight. For accidents occurring  
 209 between 7pm and 9pm and at 11pm the average number of lost work days for women was  
 210 lower than it was for men; in all remaining cases, the average duration of sick leave for women  
 211 was higher.

212 Table 7. Average of lost working days by gender and by time of day of the accident in  
 213 Spain 2008-2014

Hour	Number of accidents		Average number of lost work days		Standard deviation		Statistical significance (p-value)	95% confidence intervals for the difference in means	
	Men	Women	Men	Women	Men	Men		Lower	Upper
1	68,951	36,166	24.69	26.46	30.282	29.805	0.001	-2.154	-1.391
2	56,495	21,101	22.55	22.84	27.901	26.148	0.177	-.711	.131
3	50,606	17,519	22.80	23.21	28.242	26.215	0.083	-.866	.053
4	46,603	15,147	22.97	23.27	28.442	26.636	0.245	-.791	.202
5	39,832	13,684	24.76	25.73	30.376	29.459	0.001	-1.547	-.393
6	52,617	20,824	25.73	26.92	31.474	30.494	0.001	-1.688	-.700
7	88,856	53,166	26.56	29.12	32.235	32.614	0.001	-2.909	-2.211
8	178,219	100,690	25.18	27.57	31.301	31.126	0.001	-2.634	-2.152
9	236,419	110,614	24.15	26.10	30.485	29.907	0.001	-2.171	-1.741
10	341,526	129,597	23.63	24.75	29.670	28.808	0.001	-1.304	-.932
11	310,194	114,126	24.04	24.96	30.092	29.171	0.001	-1.125	-.725
12	333,308	123,406	23.82	24.55	29.800	28.700	0.001	-.920	-.541
13	176,841	82,041	25.37	25.80	31.351	29.779	0.001	-.679	-.177
14	111,722	78,364	26.88	27.64	32.384	30.660	0.001	-1.049	-.476
15	109,511	69,665	26.78	28.31	32.425	31.376	0.001	-1.833	-1.229
16	154,387	57,908	24.95	26.11	31.134	29.624	0.001	-1.449	-.875
17	168,028	53,218	24.68	25.58	30.756	28.981	0.001	-1.183	-.610
18	129,694	49,436	25.73	25.47	31.641	28.959	0.102	-.051	.565
19	74,402	40,170	27.29	25.80	32.479	29.357	0.001	1.123	1.863
20	50,539	36,854	27.23	26.02	32.550	29.599	0.001	.795	1.624
21	37,325	29,768	26.79	26.17	32.343	29.432	0.009	.156	1.093
22	32,702	20,821	27.03	27.61	32.268	31.141	0.036	-1.135	-.038
23	29,179	12,688	26.33	25.63	31.610	28.959	0.026	.082	1.324
24	16,281	7,504	25.75	25.60	31.153	29.083	0.710	-.659	.968

214 The same data from Table 7 may be seen in graphic form (Figure 2) where three peaks are  
 215 observed in the average days lost, the first and most important between 6am and 8am; the  
 216 second between 2pm and 4pm (lunchtime in Spain); and the last, less pronounced, from 7pm to  
 217 10pm for men and at 10pm for women, which may be related to travel from work to home when  
 218 the workday ends.



219

220 Figure 2. Average of lost working days by gender and time of day of the accident in  
 221 Spain 2008-2014

222 In relation to these peaks and travel patterns, Table 8 shows that the duration of sick leave due  
 223 to occupational accidents by place of work are higher in accidents that occur when traveling,  
 224 both during the work day and when traveling between home and work ( $p < 0.05$ ). The duration  
 225 of sick leave is lower for men than for women, both at the usual place of work and when  
 226 traveling, but higher if the accident occurs at another work venue or traveling to and from work.

227 Table 8. Average of lost working days by gender and place of accident in Spain 2008-  
 228 2014

	Number of accidents		Average number of lost work days		Standard deviation		Statistical significance (p-value)	95% confidence intervals for the difference in means	
	Men	Women	Men	Women	Men	Women		Lower	Upper
At the usual place of work	2,301,528	936,728	23.26	23.68	29.255	27.967	0.001	-.487	-.351
Traveling	213,187	63,563	30.11	31.14	34.739	33.393	0.001	-1.329	-.732
To and from work	229,302	270,297	34.43	32.91	36.573	33.303	0.001	1.319	1.710
At another place of work	150,220	23,889	26.24	25.18	33.682	29.870	0.001	.647	1.477

229

230 Lost work days due to occupational accidents increased significantly when the worker was  
 231 engaged in non-routine tasks ( $p < 0.05$ ), which highlights the lengthier duration of sick leave in  
 232 these cases. In Table 9, one can see that these differences apply both to men and women. The  
 233 duration of sick leave was only significantly higher for women for accidents occurring when  
 234 engaged in routine work ( $p < 0.05$ ); there was no statistically significant gender difference in the  
 235 duration of sick leave due to accidents when engaged in non-routine work ( $p > 0.05$ ).

236 Table 9. Average of lost working days by gender and if engaged in routine work in  
 237 Spain 2008-2014

	Number of accidents		Average number of lost work days		Standard deviation		Statistical significance (p-value)	95% confidence intervals for the difference in means	
	Men	Women	Men	Women	Men	Women		Lower	Upper
No	323,622	310,929	31.68	31.81	35.418	32.902	0.118	-.302	.034
Yes	2,570,615	983,548	23.94	24.17	30.003	28.410	0.001	-.292	-.158

#### 238 4. Discussion of results

239 The average number of work days lost due to injury is statistically greater for women than for  
 240 men (Tables 2, 3, 5, and 9), which is consistent with conclusions drawn in other previous

241 studies (Cheadle et al., 1994; Johnson & Ondrich, 1990). In an analysis of injury-producing  
242 accidents that occurred in Spain between 1997 and 2001 (N = 1,385,301), and where the  
243 injuries were difficult to diagnose, researchers concluded that women presented longer sick  
244 leave durations from these injuries (Moral de Blas et al., 2012). These researchers also stated  
245 that more women also were injured when traveling.

246 The results regarding lost work days by the age of the injured worker (Figure 1) align with those  
247 of other studies, thereby highlighting a longer duration of sick leave among older workers.

248 Blanch et al. (2009) reported on a study conducted in an industrial plant in Spain with 156  
249 workers on the duration of notified sick leave due to accidents. The authors found indications of  
250 a relationship between worker age and duration of sick leave, although the relationship was not  
251 statistically significant, possibly due to the modest sample size.

252 In another study of 446 workers completed in the public health and social services sector of  
253 Mallorca between 1991 and 2008 (Monroy Fuenmayor et al., 2010), workers were grouped by  
254 age ranges, comparing those under 30 years in age, with those of 30 to 45, and those over 45  
255 years in age. The average duration of sick leave due to accidents was 22.52 days, 33.19 days,  
256 and, 24.92 days respectively; however, these differences were not statistically significant when  
257 95% confidence intervals were examined.

258 In the Swedish mining sector (Laflamme et al., 1996), the descriptive data referring to the  
259 average number of days lost by age appears to indicate a tendency towards more accidents as  
260 age increases, especially for men older than 55. In the current study, a change can be seen for  
261 women after age 50 (figure 1) and men after age 60. In this Swedish study (Laflamme et al.,  
262 1996), statistical significance was not reported by days or by age.

263 In the previous studies in the Spanish working environment (Blanch et al., 2009; Monroy  
264 Fuenmayor et al., 2010), as well as the study on mining in Sweden (Laflamme et al., 1996), no

265 age-related sick leave duration pattern could be discerned. In our results a growing pattern of  
266 the length of sick leave periods that increases with age is shown (figure 1). In table 4, as  
267 individuals by age are grouped, the differences on the length of sick leave between each age  
268 group is significant, and this duration increases with age, both for men and women.

269 The conclusion that women, on average, lose more work days due to accidents, is supported by  
270 the data from our study: In all the years of the study (table 3), for all sizes of company (table 5),  
271 for weekdays from Monday to Friday (table 6) and at the usual place of work (table 8) engaged  
272 in routine work (table 9).

273 With regard to temporal factors and the day of the week, the percentage of serious accidents in  
274 Spain increased in the construction sector as the week progressed (Camino Lopez et al., 2008)  
275 and the duration of sick leave was higher on weekends for accidents involving injuries of difficult  
276 diagnosis (Moral de Blas et al., 2012). In our study, we confirmed a progressive increase in lost  
277 workdays as the week advanced – for men throughout the week, including weekends, and for  
278 women on weekdays, but not at weekends. We see this pattern not only for the construction  
279 sector (Camino Lopez et al., 2008), but others as well. These data lead us to propose that a  
280 relevant metric for accident seriousness must include the number of lost working days due to an  
281 accident (Table 6), and not be limited to the seriousness of the diagnosis reported by medical  
282 staff members (Camino Lopez et al., 2008). The duration of sick leave linked to weekend  
283 accidents among men supports the results of the study on accidents with injuries difficult to  
284 diagnose (Moral de Blas et al., 2012); our study could not confirm the same relationship for  
285 women – i.e., longer sick leave due to weekend accidents. In other studies, women present  
286 more lost days after an accident on the weekends (Brogmus, 2007). The difference on the  
287 increase of duration of sick leave on weekends by gender need further research.

288 With regard to time of the day, the result of the average duration of sick leave shows three peak  
289 times that may be related to longer sick leave following travel-related accidents (Table 8); the

290 first, between 6am and 8am, a time when many trips to work take place; the second, between  
291 2pm and 4pm, when lunch-related trips occur, especially after lunch, a result that is consistent  
292 with the greater seriousness of accidents after eating (Camino Lopez et al., 2011); and at 7pm,  
293 with a less prominent peak, when the journey back home takes place. In Spain, where travel  
294 back home is usually staggered more among workers, the third peak may be less pronounced  
295 than in other countries. Camino Lopez et al. (2017) show that men have more traffic-related  
296 accidents between 6pm and 8pm whereas women do not show the same pattern.

297 The consequences of the accident are also increased when carrying out tasks other than  
298 routine ones (Table 9). This greater seriousness, already highlighted in a study completed in  
299 Spain on the construction sector (Camino Lopez et al., 2008), was supported in our analysis of  
300 a more diverse classification of workers. The increase in the duration of sick leave was  
301 statistically significant and special preventive measures may be advisable when workers are  
302 assigned to non-routine work.

303 Likewise, the accident was more serious when carrying out work at venues other than the usual  
304 place of work (Camino Lopez et al., 2008), an aspect that was also confirmed in this case by  
305 longer sick leaves (Table 8). Again, this relationship should be considered when workers are  
306 engaged outside of their usual place of work (Sanmiquel, Rossell, & Vintró, 2015). Travel-  
307 related accidents deserve additional mention, as in many cases they are related to road traffic  
308 accidents, one possible consequence of traveling to less familiar, non-routine work areas.

309 In conclusion, having analyzed more than 4 million instances of sick leaves situations in Spain  
310 between 2008 and 2014 we can state that:

- 311 • The average length of the sick leave periods increases as the week goes by from Monday  
312 to Friday (table 6);



- 313 • This sick leave duration increases with age and more drastically for older workers (table 4;  
314 figure 1);
- 315 • The highest length of sick leave periods due to work accidents are linked to enterprises with  
316 less than 5 staff members. Regardless of the size of the company, the length of sick leave  
317 is longer for women (table 5).
- 318 • The average length of sick leave periods increases from Monday to Friday (table 6).
- 319 • This average length is higher between 6am to 8 am; from 2pm to 4pm and from 6pm to  
320 8pm (table 7 and figure 2).
- 321 • The average of working days lost is higher when travelling, during working-hours or  
322 commuting (table 8). And it is also higher if engaged in a non-routine activity (table 9).

323 Limitations: The severity of the accident and the length of the sick leave after an accident may  
324 vary in different work activities and are related to the injured body part (Tsioras, Rottensteiner, &  
325 Stampfer, 2014). It should also be borne in mind that the type of accident changes with age  
326 (Altunkaynak, 2018; Chau et al., 2014) and the variations at different ages may have been  
327 influenced. In this study these variables have not been analyzed and deserve further research.

## 328 **5. Practical implications of the major findings**

329 Better knowledge of the duration of accident-related sick leave, a variable that is closely related  
330 to both economic and other costs accidents, can assist with measures to shorten their duration.  
331 In any company, programs need to be developed that establish preventive measures. Insurance  
332 firms may find the data of use in relation to the costs associated with insuring certain  
333 companies, in accordance with the company's characteristics and those of the workers that are  
334 employed in the company.

335 The increase in the duration of sick leave with age might be due to a reduction in  
336 musculoskeletal, sensory, and motor capabilities among older people, perhaps affecting women

337 disproportionately (Laflamme et al., 1996). The recuperation of older people is generally slower  
338 (Margolis, 2010). Companies should consider establishing or encouraging simple but regular  
339 exercise routines for their employees that will help reduce the length of sick leave and  
340 accidents, especially with advancing age. Further research is needed to determine the reasons  
341 for the increase in the length of sick leave for older women.

342 Fatigue has been related to increased accident rates and seems to be related to increased  
343 duration of accident-related sick leave. In this study, we saw that sick leave duration increased  
344 as the week progressed. Shortening the work day as the week progresses or establishing more  
345 adequate breaks may reduce accident rates and the concomitant length of sick leave.

346 The mean number of work days lost due to accidents is greater when employees are engaged  
347 in non-routine work or in a non-routine place of work. Companies should consider special  
348 preventive measures when their employees are performing non-routine tasks or conducting  
349 them in unusual places.

350 This study showed that there was an increase of the duration of sick leave due to accidents by  
351 year. In 2007, an economic crisis began in Spain and worsened during the years of the study.  
352 The crisis affected working condition and salaries. Salary can affect the duration of sick leave,  
353 as a higher salary can permit access to treatments for workers that are not covered by  
354 insurance, thereby reducing sick leave duration (Kim et al., 2006); moreover, higher salaries  
355 have been related to less absenteeism (Drago & Wooden, 1992). Helping employees with  
356 treatment for better recovery would reduce the duration and sick leave costs.

357 The salary gap (lower salary received by women) can influence women's longer duration of sick  
358 leave due to accidents. More research is needed to determine the influence of salary on the  
359 accident rate and the duration of sick leave. What salary would be appropriate from the point of  
360 view of safety and health?

361 The large sample size (N = 4,188,714 accidents) allows us to detect statistically significant  
362 differences, and note the possible influences of several independent variables, despite the high  
363 dispersion of values (standard deviation) of the dependent variable (days lost due to  
364 occupational accidents). The statistical significance of our results represents a relevant  
365 contribution in comparison with results of other studies where relationships are hypothesized,  
366 but not clearly demonstrable due to smaller samples.

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