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Research Article

The "Weekday Effect": A Decrease in Occupational Accidents from Monday to Friday—An Extension of the "Monday Effect"

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Objective. Study the variation in the number of accidents across days of the workweek, from Monday to Friday. *Data and Method*. All occupational accidents of full-time workers in Spain from 2011 to 2018 are analyzed. A total amount of 2,873,872 accidents are representative and not heavily affected by underreporting bias. Chi-squared test (χ^2) and z-value determine statistically significant differences in accident percentages from Monday to Friday, controlling personal (sex, age, nationality, and seniority), company (activity, size, and region), temporal (hour of the day and working hour) variables, and consequences (severity, injury type, and injured body part). *Results*. "Weekday effect" with a decrease in accidents of 29.4% from Monday to Friday, a decrease of 14.3% from Monday to Tuesday ("Monday effect"), 3.9% from Tuesday to Wednesday, 7.9% from Wednesday to Thursday, and 7% from Thursday to Friday. The "weekday effect" and the "Monday effect" occur across industries, for all company sizes, for all types of workers (both genders, different ages and seniority), for different types of injury, and across the day and the shift. "Monday effect" increases with age and seniority, for men, in small companies (10 to 49 workers), in the morning, at the beginning of the work shift hours, and for back injuries. "Weekday effect" decreases with age and increases with seniority, for men, in companies between 20 and 249 workers, in the morning and at the beginning of the work shift hours, and for back injuries.

1. Introduction

The "Monday effect" refers to patterns that are notably different on Mondays compared to other days of the week. In the case of work accidents, several publications have drawn attention to the fact that there are more accidents reported on Mondays than on other days of the week. This Monday effect is evidenced by the fact that there are more workers' compensation claims due to accidents that occurred on Monday [1–5].

Some authors propose that some of the accidents reported on Monday are injuries that occurred during the weekend and that are reported on Monday to be covered by occupational accident insurance [3]. Other explanations include ergonomic effects from weekend activities, as certain injury types, like back injuries and sprain and strains, are particularly common on Mondays [2] which stress the need for a warm-up at the beginning of the week; adverse psychological responses to start the workweek may also be explained [5, 6].

Several studies describe poorer performance and productivity on Monday, compared with other workdays: with worse performance of supply chain fulfillment [7], lower stock returns in finance related with a more pessimistic mood on Mondays [8], and less productivity related with the loss of practice-efficiency during weekends [9]. This phenomenon is known as "Monday effect."

However, what happens beyond Monday? Understanding when accidents are more likely to happen can guide targeted interventions, reducing overall risk and harm. This knowledge can inform regulations, workplace policies, and safety measures that can include adjusting work schedules and breaks, improving training programs, or enhancing safety protocols.

We can define the term "weekday effect" as the patterns that exhibit variations depending on the specific day of the week. In this article, we will refer to the "weekday effect" as the variation in the number of accidents throughout the week, from Monday to Friday.

Workers approach and react differently to the beginning (Mondays), middle (Wednesdays), and end (Fridays) of workweeks. They are less satisfied and more stressed at the beginning of the week [10]. There is increasing evidence that mood varies in a consistent weekly rhythm. Mood tends to be lowest on Monday ("blue Monday" hypothesis) and highest on Friday [8].

The seven-day week acts as a temporal map, providing structure, order, and routine. There are some variations in work results throughout the workweek [11]. Research shows that there is a significant "weekday" effect on human error. Tuesdays, Wednesdays, and Thursdays show a 2% lower probability of error than Mondays [12], and productivity grows along the week as workers get more practice and perceive the next weekend break approaching [9]. Absence from work is higher at the beginning of the week and lower at the end influencing the productivity of companies [9]. Incivility decreases from Monday to Friday [11].

Regarding the number of accidents, there is little research about the variations of accident rates by different days of the week, with conflicting results. Smith et al. [13] analyzed 4,645 accidents in a large engineering company, where the a priori accident risk appeared to be constant. They found a significant increase in accidents from the first to the last two days of the week for night shift workers. They did not find significant differences in the number of accidents on different days of the week for morning and afternoon shifts. On the contrary, Lopez et al. [14] reported, between 1995 and 2015 in the construction sector in Spain, a decrease in the number of accidents as the week progressed.

Various factors may play a role in the variations of accident rates along the week. It can be difficult to adapt again to work rhythms after disconnecting from work, during the weekend or after long breaks [15, 16]. Increased fatigue that accumulates over the week can lead to decreased attention and slower reaction times [12] while increasing the risk of an accident.

The aim of this article is to study accident variations between all days of the week (not only for Mondays), controlling the effect of other variables like personal (sex, age, nationality, and seniority), company (activity, size, and region), temporal (hour of the day and working hour) variables, and consequences (severity, injury type, and injured body part).

Knowing the variation in the number of accidents on different days of the week could lead to new regulation and practice of the distribution of working time by the government and companies. It may also suggest new routines to switch between rest and recovery time and work time, which can be promoted by companies, unions, or the government.

Hypothesis 1. On Mondays, the number of accidents is higher than on other weekdays. This would equal to the "Monday effect."

Hypothesis 2. The number of accidents is equal along the weekdays (from Tuesday to Friday). Rejecting this hypothesis, we would confirm the presence of the "weekday effect."

Hypothesis 3. The most prevalent type of accident is the same throughout the week.

2. Materials and Methods

2.1. Data Collection. This is a secondary data analysis study using official accident data from the Spanish official Workplace Incident Notification Forms, held on file at the Ministry of Labor, Migrations and Social Security. In Spain, any bodily injury sustained by a worker that arises out of or in connection with work is defined as an occupational accident [17].

In Spain, all occupational accidents that involve any lost working days must be submitted electronically, via an accident report form, to the National Institute of Safety and Hygiene. The financial compensation if the accident is work-related is greater than in the rest of the accidents, which means that the majority of work-related accidents are reported in Spain.

We included data on all occupational accidents that resulted in at least one calendar day of absence from work, including fatal accidents. Spain has an insurance-based accident reporting system which allows for a significant financial compensation for the victim of a work-related accident; thus, we can assume that the notification of accidents in Spain is close to 100%.

2.2. Variables Analyzed. The official Workplace Incident Notification Forms gather information about the following [18]:

(i) Worker: sex, age, nationality, seniority, employment status, and occupation

(ii) Company: size, economic activity (NACE code), and geographic location

(iii) Temporal and spatial information: date, day of the week, day-hour and work-shift-hour, and workplace

(iv) Sequence of events: specific physical activity and associated material agent, trigger ("cause of the accident"-deviation and associated material agent), and contact form (how has the injured person been injured)

(v) Consequences: severity of the accident, type of injury, and injured body part

(vi) End of the injury leave: the number of lost working days (LWD) and the cause of the discharge are incorporated to the report, at the end of the injury leave

2.3. Study Design. For our analysis, we selected occupational accidents in Spain, over the period 2011 through 2018. We excluded relapses (new medical discharge for the same reason—the same accident—within 180 calendar days following the effective date of the previous medical discharge) and

Table 1: Number of reported occupational accidents from Monday to Friday. Full-time workers (Spain), 2011-2018.

2011	2012	2013	2014	2015	2016	2017	2018	Total
405,214	317,701	310,142	322,912	349,340	372,635	392,343	403,585	2,873,872

commuting accidents (accidents during the journey between home and the workplace), which are not defined as occupational accidents in many countries [17].

In Spain, the labor legislation [19] establishes that the maximum duration of the ordinary workweek is forty hours of effective work on average in annual computation (art. 34.1) and the number of ordinary hours of effective work may not exceed nine hours daily, except if regulated differently by agreement (art. 34.3). The normal working timetable in Spain is eight working hours a day, from Monday to Friday for full-time workers.

To eliminate the variability, for part-time contracts, of days worked per week and hours worked, we analyzed only accidents for full-time workers. Part-time workers tend to work more at the end of the regular week in Spain, and we do not have reliable data on their working hours. The number of accidents on different days of the week can be affected by this pattern in hours worked on different days of the week for part-time workers.

Only accidents from Monday to Friday, the regular workweek, were included.

Table 1 shows the reported accidents by year. The total number of accidents under analysis was 2,873,872. The large number of accidents can allow detecting small but statistically significant differences.

2.4. Statistical Analysis. The study of independency or relationship between the days of the week and the other variables was performed with contingency tables and use of the chi-squared test (χ^2). We determine whether there is a statistically significant difference between the expected frequencies and the observed frequencies in the contingency table.

If the number of accidents is evenly distributed between Monday and Friday, there should be an equal expected number of accidents per day across all workdays. The result tables show the number of accidents each day of the week. They also show the percentage of accidents with respect to Monday for the rest of the days of the week; the percentage will be greater than 100% if the number of accidents is greater than that of Monday and less than 100% if it is below.

To estimate whether the difference between the percentages of accidents, on different days of the week, is statistically significant, the z-value is calculated for the difference in percentages:

$$z = \frac{\bar{p}_1 - \bar{p}_2}{\sqrt{((\bar{p}_1(1-\bar{p}_1)/n_1) + (\bar{p}_2(1-\bar{p}_2)/n_2))}}. \quad (1)$$

If the absolute value of z-value is greater than 1.96, we will reject the hypothesis of equality of percentages, so we can affirm that the difference is statistically significant at 95%.

If the difference is not statistically significant with the previous day of the week, the cell in the table was shadowed. The number was marked with an asterisk (*).

All the analyses were computed with the statistical analysis software package SPSS v.23.

3. Results

In the period 2011-2018 in Spain, the number of accidents decreased as the workweek progressed from Monday to Friday. It decreased from the 693,221 that occurred on Monday to 489,392 on Friday, representing a decrease of 29.4% (Table 2). The biggest decrease occurred between Monday and Tuesday, with a reduction of accidents by 14.3% on Tuesday. The reduction in the number of accidents continues throughout the week, being statistically significant every day of the week (Figure 1).

The decrease in the number of accidents throughout the week occurred, and it is statistically significant in all subgroups, such as sex, age, nationality, or seniority (Table 2).

The decrease of accidents during the workweek was more pronounced in men (a decrease of 31.6% from Monday to Friday) than in women (a decrease of 22.3% from Monday to Friday). Also, the "Monday effect" (the decrease in accidents between Monday and Tuesday) was greater for men (Table 2).

For all ages considered, the number of accidents decreased throughout the week. All the decreases were statistically significant, except the decrease from Thursday to Friday for those over 60 years of age. The "Monday effect" was greater for older workers, with a greater decline between Monday and Tuesday; on the contrary, the weekday effect was less evident in older workers (Table 2).

The decrease in the number of accidents, from Monday to Friday, was greater among national workers than for European Union (UE) and non-European Union (NoUE) workers (Table 2).

The "Monday and weekday effects" have been greater for more experienced workers, with greater decreases in the number of accidents between Monday and Tuesday and between Monday and Friday (Table 2).

Accommodation and food service activities are the only activities in which the number of accidents did not decrease throughout the week, most likely due to common workload increases in this sector as the weekend approaches. In the rest of the activities, where the workload is more balanced, both the "Monday effect" and the "weekday effect" occurred. Both effects occur for all company sizes (Table 3).

Accidents decreased throughout the week in all Spanish regions, with the exception of the Canary Islands, from Tuesday to Wednesday, although in this case the increase is not statistically significant (Table 3).

Regarding the hour of the accident (Table 4), many accidents occurred in the morning with a more pronounced drop in the percentage of accidents from Monday to

Table 2: Accidents by day of the week and personal variables. Full-time workers (Spain), 2011-2018.

		Number of accidents						Percentage compared to Monday				
		Mon	Tue	Wed	Thu	Fri	Total	Mon	Tue	Wed	Thu	Fri
Sex	Men	526,878	447,124	426,708	389,889	360,226	2,150,825	100%	84.9%	81.0%	74.0%	68.4%
$\chi^2 = 1{,}090$ p value < 0.001	Women	166,343	147,194	144,219	136,125	129,166	723,047	100%	88.5%	86.7%	81.8%	77.7%
Age $\chi^2 = 486.63$ p value < 0.001	Less 30	105,192	91,553	88,606	80,445	72,864	438,660	100%	87.0%	84.2%	76.5%	69.3%
	30-39	208,942	179,787	171,197	156,964	143,001	859,891	100%	86.0%	81.9%	75.1%	68.4%
	40-49	208,361	177,315	169,967	156,965	147,022	859,630	100%	85.1%	81.6%	75.3%	70.6%
	50-59	143,500	122,545	118,494	110,387	105,519	600,445	100%	85.4%	82.6%	76.9%	73.5%
	More 60	27,226	23,118	22,663	21,253	20,986	115,246	100%	84.9%	83.2%	78.1%	77.1%*
Nationality $\chi^2 = 260.4$ p value < 0.001	NoUE	44,724	38,873	37,936	35,837	34,517	191,887	100%	86.9%	84.8%	80.1%	77.2%
	UE	23,973	20,981	20,411	18,649	18,081	102,095	100%	87.5%	85.1%	77.8%	75.4%
	Spain	624,524	534,464	512,580	471,528	436,794	2,579,890	100%	85.6%	82.1%	75.5%	69.9%
Seniority $\chi^2 = 387.43$ p value < 0.001	Less 1 year	240,224	210,462	204,071	189,312	176,586	1,020,655	100%	87.6%	85.0%	78.8%	73.5%
	1 to 3 years	104,033	89,275	85,618	78,071	73,080	430,077	100%	85.8%	82.3%	75.0%	70.2%
	3 to 6 years	93,688	79,601	75,590	69,664	64,566	383,109	100%	85.0%	80.7%	74.4%	68.9%
	More 6 years	255,276	214,980	205,648	188,967	175,160	1,040,031	100%	84.2%	80.6%	74.0%	68.6%
Total		693,221	594,318	570,927	526,014	489,392	2,873,872	100%	85.7%	82.4%	75.9%	70.6%

*Statistically not significant difference, in number of accidents, with the previous day (between Thursday and Friday).

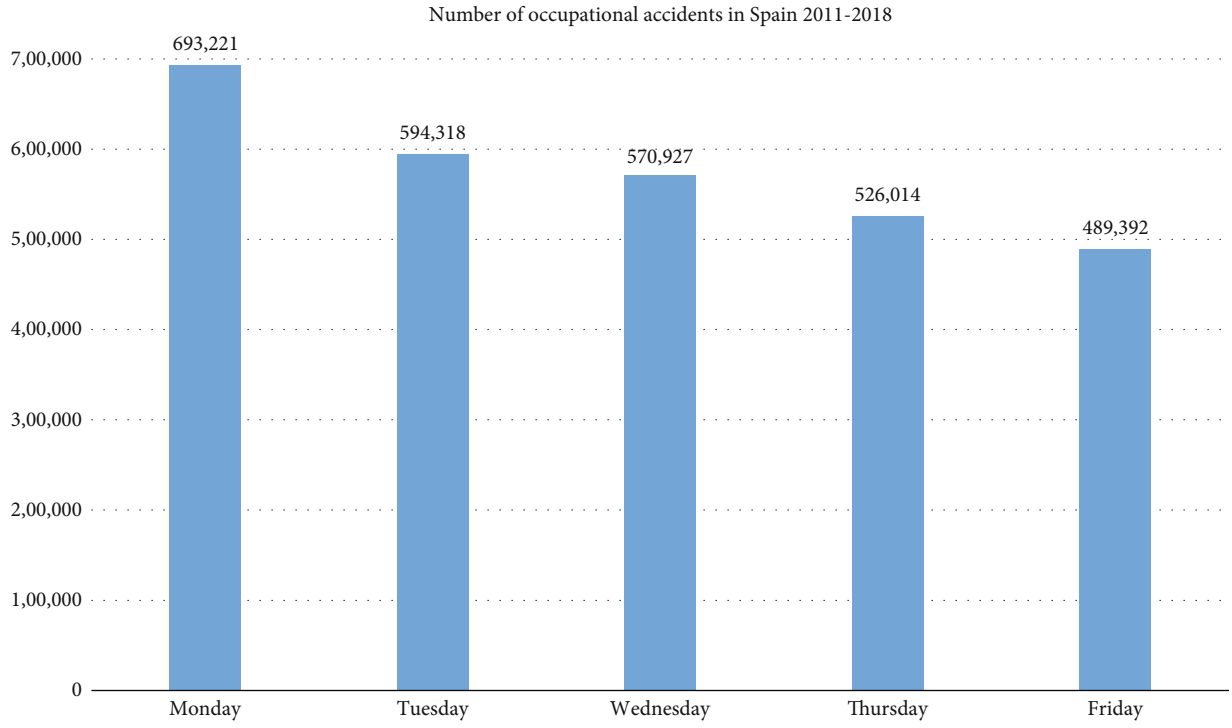

Figure 1: Number of occupational accidents in Spain by weekday (years 2011–2018; full-time workers).

Tuesday ("Monday effect") and throughout the week, from Monday to Friday ("workweek effect") when compared to the other periods (lunch, afternoon, and other).

A greater number of accidents occurred during the first four hours of work. Across all weekdays, the hour with the most accidents was the second. The number of accidents increased between the first and second hours and then decreased throughout the work shift (Table 4).

There were a decreased of the number of accidents between Monday and Tuesday for all work hours. This decrease was greater for the first hours of the work shift. Additionally, there was a decreased in the number of

Table 3: Accidents by day of the week and company variables. Full-time workers (Spain), 2011-2018.

		Number of accidents						Percentage compared to Monday				
		Mon	Tue	Wed	Thu	Fri	Total	Mon	Tue	Wed	Thu	Fri
NACE code activity $\chi^2 = 5{,}509.84$ p value < 0.001	Agriculture, forestry and fishing	42,227	36,500	35,285	33,148	32,075	179,235	100%	86.4%	83.6%	78.5%	76.0%
	Mining and quarrying	4,739	4,043	3,734	3,488	2,854	18,858	100%	85.3%	78.8%	73.6%	60.2%
	Manufacturing	142,576	124,260	118,195	106,939	92,510	584,480	100%	87.2%	82.9%	75.0%	64.9%
	Electricity, gas, steam, and air-conditioning supply	629	551	511	436	449	2,576	100%	87.6%	81.2%*	69.3%	71.4%*
	Water supply: sewerage, waste management, and remediation activ.	13,588	11,638	11,118	10,045	9,254	55,643	100%	85.6%	81.8%	73.9%	68.1%
	Construction	104,139	84,765	80,185	71,275	65,362	405,726	100%	81.4%	77.0%	68.4%	62.8%
	Wholesale and retail trade: repair of motor vehicles and motorcycles	96,998	81,076	77,450	72,608	69,314	397,446	100%	83.6%	79.8%	74.9%	71.5%
	Transportation and storage	48,834	41,603	39,678	36,743	35,126	201,984	100%	85.2%	81.3%	75.2%	71.9%
	Accommodation and food service activities	34,058	32,258	33,171	33,095	36,096	168,678	100%	94.7%	97.4%	97.2%*	106.0%
	Information and communication	4,199	3,518	3,403	3,089	2,658	16,867	100%	83.8%	81.0%*	73.6%	63.3%
	Financial and insurance activities	1,660	1,472	1,478	1,417	1,148	7,175	100%	88.7%	89.0%*	85.4%*	69.2%
	Real-estate activities	1,266	1,040	1,046	1,032	966	5,350	100%	82.1%	82.6%*	81.5%*	76.3%*
	Professional, scientific and technical activities	8,277	7,031	6,825	6,192	5,269	33,594	100%	84.9%	82.5%	74.8%	63.7%
	Administrative and support-service activities	60,043	52,263	49,790	45,707	40,888	248,691	100%	87.0%	82.9%	76.1%	68.1%
	Public administration and defence; compulsory social security	54,752	46,224	44,401	40,601	38,345	224,323	100%	84.4%	81.1%	74.2%	70.0%
	Education	9,263	7,996	7,608	7,049	6,528	38,444	100%	86.3%	82.1%	76.1%	70.5%
	Health and social work activities	48,980	43,414	42,354	39,583	37,249	211,580	100%	88.6%	86.5%	80.8%	76.0%
	Arts, entertainment, and recreation	6,788	6,107	6,415	5,870	5,661	30,841	100%	90.0%	94.5%	86.5%	83.4%
	Other service activities	7,978	6,650	6,421	5,957	5,838	32,844	100%	83.4%	80.5%	74.7%	73.2*
	Activities of households as employers	2,205	1,888	1,846	1,718	1,786	9,443	100%	85.6%	83.7%*	77.9%	81.0%*
	Activities of extraterritorial organisations and bodies	22	21	13	22	16	94	100%	95.5%*	59.1%*	100.0%*	72.7%*
Company size $\chi^2 = 485.47$ p value < 0.001	Micro enterprises (4-)	71,702	61,436	58,634	54,677	53,843	300,292	100%	85.7%	81.8%	76.3%	75.1%
	Micro enterprises (5-9)	67,609	57,565	54,797	50,494	48,621	279,086	100%	85.1%	81.0%	74.7%	71.9%
	Small enterprises (10-19)	87,009	73,574	70,424	64,607	61,963	357,577	100%	84.6%	80.9%	74.3%	71.2%
	Small enterprises (20-49)	126,528	106,930	103,197	94,147	86,716	517,518	100%	84.5%	81.6%	74.4%	68.5%
	Medium-sized enterprises (50-249)	179,103	153,913	147,987	135,799	122,857	739,659	100%	85.9%	82.6%	75.8%	68.6%
	Large enterprises (250+)	161,247	140,877	135,866	126,278	115,382	679,650	100%	87.4%	84.3%	78.3%	71.6%

Table 3: Continued.

		Number of accidents						Percentage compared to Monday				
		Mon	Tue	Wed	Thu	Fri	Total	Mon	Tue	Wed	Thu	Fri
Region $\chi^2 = 863.54$ p value < 0.001	Andalucia	110,191	93,869	90,016	82,940	79,133	456,149	100%	85.2%	81.7%	75.3%	71.8%
	Aragón	19,434	17,244	16,231	15,006	13,832	81,747	100%	88.7%	83.5%	77.2%	71.2%
	Asturias	16,072	14,133	13,473	12,309	11,318	67,305	100%	87.9%	83.8%	76.6%	70.4%
	Baleares	23,633	20,462	19,936	18,846	18,243	101,120	100%	86.6%	84.4%	79.7%	77.2%
	Canarias	30,935	26,158	26,533	23,790	22,926	130,342	100%	84.6%	85.8%*	76.9%	74.1%
	Cantabria	7,141	6,336	6,170	5,560	5,261	30,468	100%	88.7%	86.4%*	77.9%	73.7%
	Castilla la Mancha	32,322	26,631	25,161	22,714	21,363	128,191	100%	82.4%	77.8%	70.3%	66.1%
	Castilla y León	32,916	28,542	26,986	24,810	23,190	136,444	100%	86.7%	82.0%	75.4%	70.5%
	Cataluña	125,025	110,272	106,289	98,874	88,975	529,435	100%	88.2%	85.0%	79.1%	71.2%
	Ciudad Autónoma	1,506	1,319	1,274	1,178	1,054	6,331	100%	87.6%	84.6%*	78.2%	70.0%
	Comunidad Valenciana	59,012	50,712	47,922	45,223	43,049	245,918	100%	85.9%	81.2%	76.6%	72.9%
	Extremadura	13,954	11,669	11,218	10,089	9,760	56,690	100%	83.6%	80.4%	72.3%	69.9%
	Galicia	39,213	33,701	32,541	29,766	28,723	163,944	100%	85.9%	83.0%	75.9%	73.2%
	La Rioja	5,104	4,427	4,122	3,793	3,396	20,842	100%	86.7%	80.8%	74.3%	66.5%
	Madrid	101,144	84,646	81,488	74,984	68,381	410,643	100%	83.7%	80.6%	74.1%	67.6%
	Murcia	22,672	18,789	18,130	16,880	16,096	92,567	100%	82.9%	80.0%	74.5%	71.0%
	Navarra	11,182	9,889	9,525	8,527	7,778	46,901	100%	88.4%	85.2%	76.3%	69.6%
	Pais Vasco	41,765	35,519	33,912	30,725	26,914	168,835	100%	85.0%	81.2%	73.6%	64.4%

*Statistically not significant difference, in number (percentage) of accidents, with the previous day.

Table 4: Accidents by day of the week and temporal variables. Full-time workers (Spain), 2011-2018.

		Number of accidents						Percentage compared to Monday				
		Mon	Tue	Wed	Thu	Fri	Total	Mon	Tue	Wed	Thu	Fri
Day hour $\chi^2 = 2{,}380.59$ p value < 0.001	Morning (8 to 14)	421,036	344,945	330,022	303,384	279,164	1,678,551	100%	81.9%	78.4%	72.1%	66.3%
	Lunch (14 to 16)	55,544	50,584	49,286	45,350	43,824	244,588	100%	91.1%	88.7%	81.6%	78.9%
	Afternoon (16 to 19)	101,537	94,097	91,309	82,815	75,696	445,454	100%	92.7%	89.9%	81.6%	74.6%
	Other (19 to 8)	115,104	104,692	100,310	94,465	90,708	505,279	100%	91.0%	87.1%	82.1%	78.8%
Work hour $\chi^2 = 3{,}876.43$ p value < 0.001	First 4 hours of work	464,387	378,133	361,524	333,680	302,783	1,840,507	100%	81.4%	77.8%	71.9%	65.2%
	More than 4 hours	228,834	216,185	209,403	192,334	186,609	1,033,365	100%	94.5%	91.5%	84.0%	81.5%
Work hour $\chi^2 = 7{,}608.29$ p value < 0.001	1	117,679	84,035	80,116	74,482	65,407	421,719	100%	71.4%	68.1%	63.3%	55.6%
	2	139,024	111,643	105,050	96,582	86,109	538,408	100%	80.3%	75.6%	69.5%	61.9%
	3	111,633	95,841	91,869	84,131	77,226	460,700	100%	85.9%	82.3%	75.4%	69.2%
	4	96,051	86,614	84,489	78,485	74,041	419,680	100%	90.2%	88.0%	81.7%	77.1%
	5	67,051	62,671	60,910	56,935	54,914	302,481	100%	93.5%	90.8%	84.9%	81.9%
	6	61,896	59,429	57,457	52,715	50,433	281,930	100%	96.0%	92.8%	85.2%	81.5%
	7	51,577	49,659	48,684	43,399	42,621	235,940	100%	96.3%	94.4%	84.1%	82.6%
	8	30,816	29,241	27,717	25,527	25,666	138,967	100%	94.9%	89.9%	82.8%	83.3%*
	More than 8	17,494	15,185	14,635	13,758	12,975	74,047	100%	86.8%	83.7%	78.6%	74.2%

*Statistically not significant difference, in number (percentage) of accidents, with the previous day.

accidents from Monday to Friday ("weekday effect"), greater for the first hours of the work shift (Table 4).

There was a significant decrease in the number of accidents between Monday and Tuesday (Monday effect), regardless of the severity of the accident. Although there was a decrease in the percentage of accidents throughout the workweek, the decrease was not statistically significant, between Tuesday and Thursday, for serious and fatal accidents, nor for fatal accidents from Thursday to Friday. The high number of light accidents analyzed allows minor differences to be detected (Table 5).

In general, for all types of injuries, there was a decrease in the number of injuries between Monday and Tuesday ("Monday effect") and throughout the workweek ("weekday effect"). Only in the case of effects of extreme temperatures, light, and radiation, there was a statistically significant increase between Monday and Tuesday. In the rest of the cases, if there was an increase compared to the previous day, this increase is not statistically significant (Table 5).

In relation to the injured body part, the "Monday effect" did not apply to head injuries but to all other injuries. We can highlight the case of back injuries, with a significant decrease between Monday and Tuesday ("Monday effect") and throughout the workweek, with a decrease in the number of accidents close to 44% between Monday and Friday (Table 5).

To analyze the differences according to occupations, we selected four representative activities, including two sectors that represent the highest number of accidents (manufacturing and construction): the information and communication sector representing work with new technologies and the health and social work sector, with high proportion of skilled workers and a high representation of women. It is assumed that the workload in these sectors is relatively stable throughout the week, with a relatively stable number of workers during the workweek. Within these activities, we have selected three representative occupations (Table 6).

In all the occupations analyzed, there was a decrease in the number of accidents between Monday and Tuesday ("Monday effect"); this decrease is being less in the case of health and social work activities. The "weekday effect" was also smaller for health and social work activities, although the decrease is statistically significant between Monday and Friday for all the selected activities and occupations.

4. Discussion of Results

We confirm hypothesis 1, on Mondays, and the number of accidents is higher than on other weekdays. These results underpin the existence of a "Monday effect" with an accident reduction of 14.3% from Monday to Tuesday between 2011 and 2018. This result is consistent across sociodemographic variables, time of the accident, and work sectors.

We reject hypothesis 2; the number of accidents is not equal along the remaining weekdays (from Tuesday to Friday). In the years 2011 to 2018, statistically significant decreases in injuries were evident: a decrease of 3.9% from Tuesday to Wednesday, 7.9% from Wednesday to Thursday, and 7% from Thursday to Friday (Table 2). We confirm the "weekday effect," the decrease in the number of injuries along the week, a cumulative decrease between Monday and Friday of 29.4%.

We reject hypothesis 3, as there were differences in the type of accident throughout the workweek. There were statistically significant differences regarding personal (Table 2; older, not Spanish, and with less seniority workers tended to have more accidents at the end of the workweek), company, and temporal variables (Table 4; the weekday effect

Table 5: Accidents by day of the week and consequences. Full-time workers (Spain), 2011-2018.

		Number of accidents						Percentage compared to Monday				
		Mon	Tue	Wed	Thu	Fri	Total	Mon	Tue	Wed	Thu	Fri
Severity $\chi^2 = 134.44$ p value < 0.001	Light	687,633	589,082	565,695	520,917	484,629	2,847,956	100%	85.7%	82.3%	75.8%	70.5%
	Serious	4,831	4,583	4,575	4,471	4,147	22,607	100%	94.9%	94.7%*	92.5%*	85.8%
	Fatal	757	653	657	626	616	3,309	100%	86.3%	86.8%*	82.7%*	81.4%*
Injury type $\chi^2 = 3{,}841.14$ p value < 0.001	Other and unknown injuries	14,458	12,247	11,692	10,847	9,784	59,028	100%	84.7%	80.9%	75.0%	67.7%
	Superficial–wounds and injuries	219,053	200,062	194,678	179,522	160,510	953,825	100%	91.3%	88.9%	82.0%	73.3%
	Bone fractures	43,937	39,685	39,183	37,813	38,258	198,876	100%	90.3%	89.2%	86.1%	87.1%*
	Dislocations, sprains, and strains	353,371	287,726	272,557	248,302	234,424	1,396,380	100%	81.4%	77.1%	70.3%	66.3%
	Traumatic amputations, loss of body parts	1,510	1,491	1,550	1,503	1,383	7,437	100%	98.7%*	102.6%*	99.5%*	91.6%
	Shock and internal injuries	38,880	32,198	30,529	28,270	26,395	156,272	100%	82.8%	78.5%	72.7%	67.9%
	Burns, scalds, and frostbite	8,268	8,240	8,291	7,999	7,856	40,654	100%	99.7%*	100.3%*	96.7%	95.0%*
	Poisonings and infections	1,148	1,035	1,107	1,015	1,037	5,342	100%	90.2%	96.4%*	88.4%	90.3%*
	Drowning and suffocation	406	391	403	394	272	1,866	100%	96.3%*	99.3%*	97.0%*	67.0%
	Effects of noise, vibration, and pressure	836	717	694	623	552	3,422	100%	85.8%	83.0%*	74.5%	66.0%
	Effects of extreme temp., light, radiation	307	357	316	224	176	1,380	100%	116.3%	102.9%*	73.0%	57.3%
	Psychological damages, traumatic shocks	2,390	2,236	2,200	2,029	1,913	10,768	100%	93.6%	92.1%*	84.9%	80.0%
	Multiple injuries	6,880	6,448	6,331	5,997	5,415	31,071	100%	93.7%	92.0%*	87.2%	78.7%
	Heart attacks, strokes, and nontraumatic	1,777	1,485	1,396	1,476	1,417	7,551	100%	83.6%	78.6%*	83.1%*	79.7%*
Injured body part $\chi^2 = 7{,}437.08$ p value < 0.001	Not specified	1,157	1,044	1,033	982	898	5,114	100%	90.2%	89.3%*	84.9%*	77.6%
	Head	38,317	39,629	38,927	32,915	26,945	176,733	100%	103.4%	101.6%	85.9%	70.3%
	Neck	27,271	23,631	22,884	21,066	19,261	114,113	100%	86.7%	83.9%	77.2%	70.6%
	Back	146,764	108,171	98,931	88,354	82,628	524,848	100%	73.7%	67.4%	60.2%	56.3%
	Trunk	30,578	25,224	24,147	23,107	23,549	126,605	100%	82.5%	79.0%	75.6%	77.0%
	Upper limbs	238,145	211,406	205,680	192,932	178,934	1,027,097	100%	88.8%	86.4%	81.0%	75.1%
	Lower limbs	190,990	166,281	160,584	148,838	141,284	807,977	100%	87.1%	84.1%	77.9%	74.0%
	Multiple parts	18,195	17,331	17,216	16,273	14,534	83,549	100%	95.3%	94.6%*	89.4%	79.9%
	Others	1,804	1,601	1,525	1,547	1,359	7,836	100%	88.7%	84.5%*	85.8%*	75.3%

*Statistically not significant difference, in number (percentage) of accidents, with the previous day.

Table 6: Accidents by day of the week and occupations. Full-time workers (Spain), 2011-2018.

NACE code	Occupation	Number of accidents						Percentage compared to Monday				
		Mon	Tue	Wed	Thu	Fri	Total	Mon	Tue	Wed	Thu	Fri
Manufacturing	Molders, welders, platers, assemblers of metal structures, and related workers	18,162	16,124	15,239	13,195	11,713	74,433	100%	88.8%	83.9%	72.7%	64.5%
	Mechanics and machinery adjusters	8,401	7,257	6,952	6,388	5,492	34,490	100%	86.4%	82.8%	76.0%	65.4%
	Manufacturing industry laborers	25,030	22,015	20,887	18,776	16,064	102,772	100%	88.0%	83.4%	75.0%	64.2%
Construction	Bricklayers, stonemasons, cutters, tillers, and stone engravers	23,144	18,414	17,486	15,562	14,810	89,416	100%	79.6%	75.6%	67.2%	64.0%
	Workers in structural construction works	9,574	7,854	7,445	6,597	5,925	37,395	100%	82.0%	77.8%	68.9%	61.9%
	Construction and mining laborers	15,246	12,359	11,876	10,395	9,546	59,422	100%	81.1%	77.9%	68.2%	62.6%
Information and communication	Technicians in information technology operations and user assistance	326	264	247	207	210	1,254	100%	81.0%	75.8%*	63.5%	64.4%*
	Technicians in audiovisual recording, broadcasting, and telecommunications	570	414	460	418	359	2,221	100%	72.6%	80.7%*	73.3%*	63.0%
	Electronic and telecommunication equipment installers and repairers	612	432	448	390	319	2,201	100%	70.6%	73.2%*	63.7%	52.1%
Health and social work activities	Doctors	1,435	1,307	1,323	1,198	1,164	6,427	100%	91.1%	92.2%*	83.5%	81.1%*
	Nurses and midwifes	5,448	4,856	4,876	4,550	4,131	23,861	100%	89.1%	89.5%*	83.5%	75.8%
	Aides (nursing assistants)	13,205	12,076	11,608	11,140	10,688	58,717	100%	91.5%	87.9%	84.4%	80.9%

*Statistically not significant difference, in number (percentage) of accidents, with the previous day.

was higher in the morning, at the first 4 hours of work, and at the beginning of the shift), as well as in the consequences of the injury (Table 5; higher weekday effect for light accidents and for back injuries), in different days of the week. Analysis of these differences may have applications for injury prevention.

The results found are contrary to those of the study by Smith et al. [13] where the number of accidents increased on the last two days of the week (Thursday and Friday) for the night shift. However, the results are consistent with what was found by Lopez et al. [14] for the construction sector in Spain.

There may be several explanations for this effect, and combined effects most likely may influence the number of accidents throughout the week and explain the weekday effect as follows:

Disconnection from work during the weekend, which makes it more likely to have an accident on Monday, until getting used to work routines again [1]

Daily disconnection from work, with an effect at the beginning of the shift. There were more accidents at the beginning of the shift each day (Table 4)

Habituation to work routines throughout the week (day) [9], which would decrease the number of accidents throughout the week (weekday effect)

Fatigue effect, increasing fatigue throughout the week [12], which, on the contrary, would increase the number of accidents along the week (day) as fatigue accumulates (contrary to the weekday effect)

Disconnection during the weekend seems to affect older workers more since the Monday effect increases with age. The older workers have many more injuries on Monday compared to Tuesday. On the contrary, the decrease in accidents throughout the week (weekday effect) is less pronounced for older workers.

The decrease in accident numbers was evident for all NACE categories but for accommodation and food service. Notably, in the manufacturing and construction sectors, which represent two of the activities with the highest number of accidents, the reduction of accidents from Monday to Friday was substantial with 35.12% reduction in manufacturing and 37.24% reduction in construction (Table 3). The reduction in the number of accidents between Monday and Friday, without manufacturing and construction accidents, is 25.75%.

In the initial work hours, Monday and weekday effects were greater, showing the influence of the weekend and daily breaks and the highest probability of accident in the first two hours of work each day (Table 4). This may be explained by the loss of a daily work routine, lack of muscle heating, and lack of full attention to work (influenced by previous events to work).

In the first hour of work, from Monday to Tuesday (Monday effect), there were a reduction of 28.6% of accidents and a reduction of 44.4% from Monday to Friday (weekday effect). While for more than 4 hours of work, the reduction between Monday and Tuesday was 5.5% and from Monday to Friday 18.5% (Table 4). Monday and weekday effects were greater at the beginning of work hours. Fatigue may had influenced the reduction of Monday and weekday effects, as the hours of work progress. When fatigue increases, an accident is more likely to occur. It is necessary to design adequate breaks, which will help reduce injuries [20].

Monday's effect is greatest for back injuries, with a 26.3% reduction between Monday and Tuesday. The weekday effect is also greater for back injuries, with a reduction in back injuries of 43.7% between Monday and Friday (Table 5). According to Johnson et al. [21], the cumulative effects of repetitive activities contribute to back pain, especially when return to work. We recommend a warm-up in tasks where effort must be made with the back, before returning work, especially on Mondays.

We also found the effects "Monday" and "weekday" in difficult to hide injuries, as bone fractures, where we can rule out moral hazard (injuries outside of work that are reported as workplace accidents).

There was a Monday effect for heart attack and strokes (Table 5). Ghiani et al. [22] highlighted that stress factors may play a role in weekly stroke patterns and recommended a gradual transition into the working week.

Our results are somewhat surprising. One could assume that workers, after the weekend break, are rested and relaxed and have full of energy resulting in fewer accidents at the beginning of the week with increasing numbers throughout the week. As we have shown, just the opposite occurs. In general, this phenomenon occurs independently of personal (sex, age, nationality, and seniority), company (activity, size, and region), temporal (hour of the day and working hour) variables, and consequences (severity, injury type, and injured body part).

We could also expect the number of accidents to increase as the working day progresses. On the contrary, we have shown that the number of accidents decreases as the working day progresses. Similar effect to that found with the progress of the week.

4.1. Conclusion. The study reveals a consistent pattern of accident variations throughout the workweek, challenging the assumption that workers, after a weekend break, experience fewer accidents at the beginning of the week. Contrary to this expectation, the research confirms the existence of a "Monday effect," with a notable reduction in accidents from Monday to Tuesday, extending across various demographics, industries, and temporal factors.

The findings support the first hypothesis, indicating a higher number of accidents on Mondays compared to other weekdays. Additionally, the study identifies a significant "weekday effect," with a cumulative decrease in accidents from Tuesday to Friday. This reduction holds true across different personal variables, such as gender, age, and nationality, as well as company-related factors and temporal variables.

The results also suggest potential explanations for these variations, including the impact of disconnection from work during the weekend, daily disconnection effects, habituation to work routines, and the influence of fatigue. Notably, older workers seem to be more affected by the "Monday effect," emphasizing the importance of considering age-related factors in workplace safety measures.

Furthermore, the study underscores the significance of the time of day, with a higher probability of accidents in

the initial work hours, emphasizing the need for adequate breaks and attention to safety during these periods. The observed reductions in accidents for specific injury types, such as back injuries, highlight the importance of warm-up routines, especially at the beginning of the workweek.

Overall, the research contributes valuable insights into the dynamics of workplace accidents, urging policymakers, companies, and workers to consider tailored safety measures and routines to mitigate risks throughout the workweek. The study's comprehensive analysis of various variables provides a foundation for future regulations and practices aimed at enhancing occupational safety and preventing accidents in the workplace.

4.2. Strengths. There is a large dataset of over 2.8 million accidents from 2011 to 2018, allowing for robust statistical analysis of differences between weekdays and a granular analysis of weekday patterns.

Inclusion of many control variables is related to personal (age, sex, etc.), company (size, industry), and temporal (time of day, work hour) factors. This allows the analysis to isolate the effect of weekday from other potential confounding variables and enhances internal validity.

Findings are consistent across different subgroups; the Monday and weekday effects were seen in both genders, various age groups, and industries. This suggests that it is a real effect not influenced by one particular demographic and demonstrates reliability of findings.

There is an expansion of the well-known "Monday effect" by analyzing the differences between all days of the workweek (including Tuesday). Most prior studies focused only on Monday vs. other days.

Large decrease from Monday to Friday of 29.4% suggests a substantial weekday effect beyond just Mondays.

4.3. Limitations. The study is descriptive and looks at correlations. It does not determine causation or explanatory mechanisms for the effects found.

The study population is only full-time workers in Spain (administrative data from Spanish official Workplace Incident Notification Forms is analyzed). Results may differ in other cultures or for part-time/informal workers (as they have been excluded from the study).

The decrease on Fridays could partially reflect people leaving early before weekends, having shorter work hours. The study tried to control this by excluding part-time workers, but it could still play a role.

4.4. Avenues for Future Research. In our research, we have demonstrated the existence of the weekday effect but not its causation or explanation. There are potential directions of study that could be explored in the future

(i) Analyze how other variables could influence the "Monday" and "weekday" effects as sleep patterns, weekend and daily activities outside work (disconnection from work during the weekend and daily disconnection), fatigue, and habituation to work. Designing and testing interventions and implementing policy changes through partnerships could amplify the public health impact of the research

(ii) Supplement significant testing with effect sizes to quantify scale of differences. Additional measures could better quantify the scale of differences

(iii) Examine interactions of the weekday effects with worker demographics and job characteristics. This could identify higher risk groups to target

(iv) Expand the analysis to part-time and informal workers to see if similar effects occur

(v) Analyze, in greater depth, the Monday and weekday effects in specific high-risk industries like construction and manufacturing to make tailored recommendations

4.5. Practical Implications. The study on the "weekday effect" in occupational accidents has significant practical implications for shaping workplace policies, regulations, and safety measures:

(i) Work schedules and breaks: scheduling more demanding or safety critical tasks during times when the risk of accidents is lower and designing breaks strategically

(ii) Warm-up routines: implementing warm-up routines, at the beginning of the workweek and in the beginning of the day

(iii) Age-related considerations: given that older workers seem to be more affected by the "Monday effect," targeted interventions and safety measures may be necessary for this demographic group. This could include additional training or support during the transition from the weekend to the workweek and special government regulations

Data Availability

Official accident data from the Spanish official Workplace Incident Notification Forms, held on file at the Ministry of Labor, Migrations and Social Security, are available upon request.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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