



Immigration and occupational accidents: A comparative study of accident severity among foreign and Spanish citizens in the agricultural sector

✉ Xavier Baraza and ✉ Natàlia Cugueró-Escofet

Faculty of Economics and Business, Universitat Oberta de Catalunya, Rambla del Poblenou 156, 08018 Barcelona, Spain

Abstract

Aim of study: The objective of this paper was to understand the differences between immigrants and Spanish workers in terms of duration of sick leave, for work accidents in Spain's agricultural sector, to propose possible action plans and improve the sector's future accident rates, with equal conditions for immigrants and Spanish workers.

Area of study: The analysis was based in a total of 158,166 accidents in Spain from 2013 to 2018.

Material and methods: The average number of working days lost per group (Spanish and immigrants) has been calculated for the different variables. For each case, a mean comparison analysis was performed using Student's t-test to independently compare nationals and immigrants for each variable.

Main results: The agricultural sector produces a high level of severe accident rates compared to other sectors, as incident rates of death are 59.36% higher in agriculture compared to other sectors. It has the highest level of accidents for foreign workers, as immigrants presented 91.36% more accidents than Spaniards, even if accidents for immigrants are under reported, as regarding workdays lost due to injuries reported, these are statistically higher for Spanish workers. This meaning that this sector is more precarious, and this is worse for immigrants, therefore is a compelling matter of social justice that deserve the establishment of policies for government and companies to equate work conditions between immigrants and Spaniards.

Research highlights: A comparative analysis of the severity of occupational accidents between Spanish and foreign workers in Spain's agricultural sector.

Additional key words: occupational safety; agriculture; safety health; accident rate.

Citation: Baraza, X; Cugueró-Escofet, N (2022). Immigration and occupational accidents: A comparative study of accident severity among foreign and Spanish citizens in the agricultural sector. Spanish Journal of Agricultural Research, Volume 20, Issue 3, e0105. <https://doi.org/10.5424/sjar/2022203-18792>

Supplementary material (Tables S1-S4) accompanies the paper on SJAR's website.

Received: 30 Aug 2021. **Accepted:** 01 Aug 2022.

Copyright © 2022 CSIC. This is an open access article distributed under the terms of the Creative Commons Attribution 4.0 International (CC BY 4.0) License.

Funding: This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Competing interests: No potential conflicts of interest were reported by the authors.

Correspondence should be addressed to Xavier Baraza: jbaraza@uoc.edu

Introduction

One of the most important social phenomena in the global context is the flow of immigration from developing countries, motivated by economic and employment-related issues. In 2015, approximately 244 million people were transnational migrants, about half of whom were workers, often engaged in jobs that are dangerous to their health (Moyce & Schenker, 2018).

Many studies have shown that the risk of fatal and non-fatal work-related injuries is higher among immigrants and minority groups, compared to the non-minority population of the host country (Ronda-Pérez *et al.*, 2012; Salvatore *et al.*, 2013; García-Arroyo & Osca, 2020), and this gap increases for fatal injuries (Ahonen *et al.*, 2007). This situation is considered widespread in different developed countries, as shown by studies conducted in Canada (Gravel *et al.*, 2013), the United States (McCurdy *et al.*,

2013), Sweden (Döös *et al.*, 1994), Italy (Mastrangelo *et al.*, 2010; Salvatore *et al.*, 2013), Denmark, the United Kingdom, and the Netherlands (Guldenmund *et al.*, 2013). This phenomenon has also been extensively studied in Spain (Agudelo *et al.*, 2009; Rubiales-Gutiérrez *et al.*, 2010; Ronda-Pérez *et al.*, 2019).

One of the sectors with higher accident rates among immigrant workers is agriculture. The International Labor Organization (ILO) estimates that agriculture employs about 1.3 billion people worldwide, accounting for half of the world's workforce. Also, at least 170,000 agricultural workers die each year, which means that workers in the agricultural sector are twice as likely to die at work compared to workers in other production sectors (ILO, 2015). In the EU-28 European Union, according to data from 2017, 12.8% of fatal accidents correspond to the agricultural sector (EUROSTAT, 2018). Given the global nature of the agricultural industry, the bibliography for the study of accident rates includes research carried out in various countries, including Spain (Arana *et al.*, 2010; Baraza & Cugueró-Escofet, 2021), Italy (Zambon *et al.*, 2018), Norway (Svendsen *et al.*, 2014), Great Britain (Solomon, 2002), Finland (Karttunen & Rautiainen, 2013), India (Kumar & Dewangan, 2009), and the United States (Patel *et al.*, 2017), among others.

The specific characteristics of agricultural activity are diverse tasks, work with heavy machinery (Arana *et al.*, 2010; Rondelli *et al.*, 2018), the use of pesticides and other chemical products (Rezaei *et al.*, 2019), high physical demands, sometimes performed in extreme environmental conditions (Błażejczyk *et al.*, 2015), isolation in the workplace, low level of training (Holte & Follo, 2018), etc. These characteristics involve a wide variety of occupational hazards to which agricultural workers are exposed and which often lead to accidents at work (Valero & Abril, 2016) with a high mortality rate.

In Spain, the foreign population in 2018 was 4,734,691, representing 10.13% of Spain's total population of 46,722,980 (SPEE, 2019). The occupations with the greatest number of foreign contractors were agricultural labourers, at 1,237,701, followed by other occupations such as cleaning staff (256,216) and kitchen assistants (123,837). It is important to highlight that hidden work in this immigrant group may represent a significant percentage of the total (Mastrangelo *et al.*, 2010; Salami *et al.*, 2015). Turning to accidents, according to 2018 data from the *Ministerio de Trabajo, Migración y Seguridad Social*, Spain (INSST, 2019), the agricultural third sector has the third highest incidence rate (work accidents with sick leave per 100,000 workers) at 5,297.9, very close to the value for industry (5,536.5) and somewhat further away from the value of construction (7,982.7), which has the highest accident rate in Spain.

Based on this frame of reference, this paper aims to assess the incidence and severity of occupational accidents, comparing native and immigrant workers, in the Spanish

agricultural sector, for the period 2013-2018, measuring severity by the total number of days of work lost (or days of sick leave, which is the same). We hope that with this analysis we will obtain a detailed characterisation of accidents by groups, depending on several crucial variables, for both immigrant and Spanish workers. This characterisation would be useful for establishing strategies and action measures that can reduce accident rates in agriculture and determining the priority of such measures; both quantitatively (by number of accidents) and qualitatively (by the severity of the accident) and aiming to bring the rates for immigrants in line with those for Spanish workers. The assessment of the severity of accidents through the number of days of work lost due to work-related injuries has been proposed in different studies (Coleman & Kerkerling, 2007; Fontaneda *et al.*, 2019). Sick leave due to an accident at work entails a cost for the company, which pays the worker during this period and must replace him with a temporary worker. It influences the worker's income, which decreases as the total time of leave increases. It also entails an expense for society in terms of financial compensation to the worker, as well as in the cost of medical assistance and rehabilitation (Bestratén & Baraza, 2015).

The objective of this paper was to understand the differences between immigrants and Spanish workers in terms of duration of sick leave, for work accidents in Spain's agricultural sector. We compare the origin of the worker differentiating native Spaniards and immigrants. We proceed to compare the duration of sick leave regarding personal, business, material, temporal, and geographical variables. Finally, we take conclusions regarding all these variables to propose possible action plans and improve the sector's future accident rates, with equal conditions for immigrants and Spanish workers.

Material and methods

In Spain, occupational accidents are defined as all injuries that occur to workers because of the work they perform. Since 2003, the National Institute of Occupational Safety and Health of the MTMSS of Spain collects all accidents that result in an absence from work of one or more days, by mandatory completion of an accident report form. This accident report contains company information (size, sector) and data of the injured worker (gender, age and seniority). In addition, the form incorporates additional data on the injured body part, the date of the accident, the day of the week and the time of the day of the accident, among other aspects.

The design of the present study was based on previous work on accident analysis that compared the characteristics of occupational accidents between groups, with gender as the group variable (Fontaneda *et al.*, 2019). In our case we compared the characteristics of occupational accidents between immigrants and Spanish workers.

Table 1. Agriculture activities.

Activity	NACE Code
Non-perennial crops	011
Perennial crops	012
Plant propagation	013
Agricultural production combined with livestock production	015
Support activities for agriculture, livestock and post-harvest preparation	016

Data

We selected all accidents resulting in sick leave of more than one day that occurred in Spain over the period from 2013 to 2018. We took the data from the reports that companies sent to the Ministry of Labour. There was a total of 3,420,087 reported accidents in Spain during this period, 158,166 of which were in the agricultural industry (NACE codes included are 011, 012, 013, 015, and 016, as we also report below) (see Table 1) (EUROSTAT, 2008). The high number of occupational accidents allows us to detect small differences that are statistically significant, therefore relevant. Although completing occupational accident forms is mandatory in Spain, it may be possible that some accidents have not been properly reported (Arana *et al.*, 2010).

Additionally, Spain's health authorities are required to diagnose the severity of each occupational accident. For this purpose, the severity of an accident can be classified into three different levels: minor, serious, or fatal. Of the total accidents analysed for the agricultural sector between 2013-18 (158,166), 156,065 accidents (98.67%) are classified as minor, 1,828 (1.16%) as serious, and finally, 273 accidents (0.17%) as fatal (Baraza & Cugueró-Escofet, 2021).

At the level of frequency accident, it is important to show the information in the form of total (AR_{total}) and fa-

tal (AR_{fatal}) accident rates. The definition of these accident rates is as follows:

$$AR_{total} = \frac{\text{number of accidents with sick leave} \times 10^5}{\text{average number of exposed workers}}$$

$$AR_{fatal} = \frac{\text{number of fatal accidents} \times 10^5}{\text{average number of exposed workers}}$$

Variables analysed

The most relevant information for the comparative study between Spanish and immigrant groups are the working days lost as a cause of the accident. As the objective was to analyse average values and avoid distortions due to accidents with more lost working days, the fatal accidents that are reported with a day off work have been eliminated from the sample, as well as the 99th percentile (equivalent to more than 468, therefore the study considers accidents with one to 467 lost work days).

The group variable considered was the origin of the injured worker, differentiating between native Spaniards and immigrants. The comparison variables were categorised into five groups that are explained and detailed below: (a) personal, (b) business, (c) material, (d) temporal, and (e) geographical (Camino-López *et al.*, 2008). The variables chosen are presented grouped in the proposed categories in Table 2.

Personal variables (a) are the characteristics of the injured worker, including age and nationality. Business variables (b) include the type of contract and the seniority of the worker involved in the accident, the number of workers in the company employing him, and the agricultural activity he performs. Material variables (c) include aspects that are unique to the accident, such as how it happened, and the type of injury suffered. Temporal variables (d) refer to the moment when the accident took place (day of the week and hour of the day). The geographical variable (e) used in this study describes the severity of accidents according to the geographical area where they occurred, in this case the regions of Spain.

Table 2. Summary of variables.

(a) Personal	Gender
	Age
	Nationality
(b) Business	Company staff
	Length of service
(c) Material	Deviation
	Injury
(d) Temporal	Day of the week
	Days of absence
(e) Geographic	Region of Spain

Statistical analysis

The statistical package used for the analysis is Stata version 16/MP. The average number of working days lost per group (Spanish and immigrants) was calculated according to gender, age, size of the company, seniority of the worker, the cause of the accident, injuries resulting from the accident, the day of the week, hour of the day and the region of Spain in which the accident occurred. For each case, a mean comparison analysis is performed using Student's t-test for independent comparing nationals and immigrants for each variable. We based our analysis on the method used by Fontaneda *et al.* (2019), who used

Table 3. Accidents in agriculture comparing Spanish and foreigners, 2013-2018, Spain.

	2013	2014	2015	2016	2017	2018	Total
Spanish workers							
Total number of workers from Spain	769,500	783,600	751,575	773,225	783,800	761,825	4,623,525
Total number of accidents from Spain	16,166	18,089	19,183	19,542	21,345	21,061	115,386
Total number of fatal accidents from Spain	25	30	39	26	34	41	195
Total accident rate (TAR)	2,100.8	2,308.5	2,552.4	2,527.3	2,723.3	2,764.5	2,495.6
Fatal accident rate (FAR)	3.25	3.83	5.19	3.36	4.34	5.38	4.22
Foreign workers							
Total number of workers foreign countries	231,375	206,775	222,075	224,050	232,325	223,675	1,340,275
Total number of accidents foreign countries	5,573	6,190	7,091	7,533	8,267	8,126	42,780
Total number of fatal accidents foreign countries	11	11	9	23	9	15	78
Total accident rate (TAR)	2,408.6	2,993.6	3,193.1	3,362.2	3,558.4	3,633.0	3,191.9
Fatal accident rate (FAR)	4.75	5.32	4.05	10.27	3.87	6.71	5.82

the days lost as a proxy to determine the severity of the accident, so as the independent variable measuring this severity. We then compared the days lost (proxy for severity) between the two groups we were interested, immigrants vs nationals. And we compared these days lost between the two groups, by using several dependent variables (gender, age, size of the company, seniority of the worker, the cause of the accidents, injuries resulted, day of the week, hour of the day and the region of Spain the accident occurred) to examine significant differences of days lost/severity between the two groups. We examined which variables were determining when we studied the severity of the accidents comparing immigrants vs nationals.

Results and discussion

The agricultural sector in Spain has the third highest number of workplace accidents, representing 4.62% of all accidents during the period between 2013 and 2018, just after the construction and industrial sectors (Baraza & Cugueró-Escofet, 2021). However, we should be cautious about this information, as it is possible that the real accident rate in this sector was higher than reported to the official body; specifically, in the period 2004 to 2008, one in-depth study estimated that only 61.85% of all accidents in the agricultural sector in Spain were reported (Arana *et al.*, 2010). In the case of fatal accidents, the incidence rates of death are 59.36% higher in agriculture compared to the fatal accident rate of all sectors. This information determines the importance of and need for a detailed analysis of this sector in terms of its accident rates and the severity of accidents (Baraza & Cugueró-Escofet, 2020).

The present work analysed in detail the situation of the immigrant group in agriculture from the point of view of its accident rate compared to native workers with the aim of observing possible differences that have already been

highlighted in other studies (Sousa *et al.*, 2010; Martín-Román & Moral, 2014; Callejón-Ferre *et al.*, 2015).

Table 3 compares the total and fatal accident rate between Spanish workers and foreign workers, observing much higher incidence rates for migrant workers compared to natives.

A very high cumulative difference was observed for the period studied among immigrant workers, who presented 91.35% more accidents, a situation that worsens in the case of fatal accidents, which was 116.8% higher for immigrant workers. This situation can be associated with lower job security for immigrant workers (Gravel *et al.*, 2013; Guldenmund *et al.*, 2013; Salvatore *et al.*, 2013; Moyce & Schenker, 2018), their unfavourable contractual conditions (Mastrangelo *et al.*, 2010) and the greater occupation of immigrants in higher risk jobs (Mekkoathil *et al.*, 2016).

As observed in Table 4, the number of workdays lost due to injury was statistically higher for Spanish workers than for foreigners ($p < 0.005$).

The results of Table 4 are consistent with other previous studies that have determined a higher incidence of accidents for immigrant workers, but with lower rates of sick leave and a higher prevalence of workplace presenteeism (Mateo, 2017). This factor is related to poorer working conditions for immigrant workers and less favourable benefits during the recovery period (Solé & Rodríguez, 2010). Furthermore, foreign workers often do not have timely safety and health information and are not aware of their rights and protections available at work (Smith & Mustard, 2010).

This previous analysis shows the need to study the comparative accident rate for Spanish workers and foreigners in the agriculture sector in terms of severity, in order to establish action plans for workers, companies and the government. For this, it will be necessary to obtain information on the “how”, “who”, “when”, “where” and “why” of the accidents that occurred and the consequences for each of the stakeholders.

Table 4. Average duration of sick leave due to accidents by nationality and year in agriculture, Spain (2013-2018). SD: standard deviation.

Year	No. of accidents		No. of lost working days		SD		Statistical significance (<i>p</i> -value)	95% confidence intervals		t-Student	df
	Spain	Foreign	Spain	Foreign	Spain	Foreign		Lower	Upper		
2013	15,058	5,171	33.84	28.97	48.65	42.87	0.000	-6.361	-3.385	-6.419	20,677
2014	17,223	5,732	33.83	28.59	48.41	42.24	0.000	-6.642	-3.835	-7.318	22,953
2015	18,324	6,537	33.81	28.98	48.54	42.57	0.000	-6.154	-3.497	-7.119	24,859
2016	18,457	6,858	34.28	28.62	50.25	42.59	0.000	-6.997	-4.321	-8.286	25,313
2017	19,891	7,332	33.84	28.92	49.06	42.79	0.000	-6.196	-3.654	-7.597	27,221
2018	20,119	7,475	33.98	28.17	49.79	40.71	0.000	-7.067	-4.544	-9.023	27,592

Personal variables

Agriculture is a significantly male-dominated sector (Alamgir *et al.*, 2009): during the period 2013-2018, for every 100 accidents in the agricultural sector in Spain, 20 involved women and 80 involved men. Table 5 shows that the average number of days lost due to work accidents was significantly higher in the case of Spanish workers compared to foreigners for both men and women, although the difference was greater in the female group.

In gender, the difference comes mainly from the fact that immigrant women showed fewer days lost compared to their male counterparts showing a gender effect against immigrant women. This aspect is consistent with other studies that have analysed occupational accidents in relation to gender; if immigrants are exposed to worse conditions, for immigrant females this is even worse, and one conclusion may be that women come back to work without being completely recovered from the accident (Lin *et al.*, 2008; Fontaneda *et al.*, 2019).

A continuous increase in the duration of sick leave can be observed both for native and migrant workers as they age (see Table 6). A further increase in this duration can be observed for the groups aged over 55 in the case of Spanish workers. The results for the days of work lost by age of the injured worker were in line with those of other studies, highlighting a longer duration of sick leave among older workers (Blanch *et al.*, 2009; Fontaneda *et al.*, 2019) and,

specifically, in the agricultural sector (Pickett *et al.*, 2008). The increase in the duration of sick leave with age could be due to a reduction in musculoskeletal, sensory, and motor abilities among older people, which may affect women disproportionately (Laflamme *et al.*, 1996). In general, for older people recovery is usually slower (Margolis, 2010).

Comparison of Spanish workers with immigrants by age group shows that there was a significant difference ($p < 0.005$) in favour of Spanish workers who have more days of sick leave. This difference increased with age: 1.30 days for workers under 24, 1.08 days for ages 25 to 34; 3.23 days for ages 35 to 44; 7.57 for ages 45 to 54; and 8.69 for those 55 and older.

Table 7 presents Morocco as the country of origin with the highest number of accidents, with 14,850 (37.9%), followed by Romania (9,210 accidents, 23.5%) and Ecuador (4,221 accidents; 10.8%). These nationalities coincide with highest immigration to Spain, due to the scarcity of native workers in the agricultural sector (Gadea *et al.*, 2015).

There were no significant differences with the number of days lost due to an accident at work, exception for Ecuador that is well below the average (27.48 days), with 23.60. From the analysis of fatal accidents, looking at the difference between the fatal accident rate minus the total accident rate (%FAR-%TAR), there is a significant reduction for Morocco (-19.5%), which is offset by the case of Romania (+9.1%) and Bulgaria (+16.7%). This data indicates that Eastern Europe countries have more serious accidents,

Table 5. Average duration of sick leave due to accidents by nationality and gender in agriculture, Spain (2013-2018). SD: standard deviation.

Sex	No. of accidents (average exposed workers)		No. of lost working days		SD		<i>p</i> -value	95% confidence intervals		t-Student	df
	Spain	Foreign	Spain	Foreign	Spain	Foreign		Lower	Upper		
Men	87,678 (3,379,500)	31,740 (1,038,000)	33.71	29.16	48.96	43.20	0.000	-5.162	-3.938	-14.576	119,146
Women	21,844 (1,244,000)	7,635 (301,650)	34.80	26.74	49.88	38.07	0.000	-9.288	-6.833	-12.860	29,477

Table 6. Average duration of sick leave due to accidents by nationality and age in agriculture, Spain (2013-2018). SD: standard deviation.

Age	No. of accidents (average exposed workers)		No. of lost working days		SD		p-value	95% confidence intervals		t-Student	df
	Spain	Foreign	Spain	Foreign	Spain	Foreign		Lower	Upper		
24 or less	13,063 (284,532)	3,628 (121,892)	22.30	21.00	32.53	29.82	0.029	-2.483	-0.131	-2.179	16,689
25-34	25,823 (898,290)	10,960 (342,691)	26.81	25.73	39.37	37.80	0.014	-1.952	-0.214	-2.442	36,781
35-44	29,286 (1,309,349)	14,854 (470,273)	32.39	29.16	46.28	42.42	0.000	-4.121	-2.343	-7.128	44,138
45-54	27,163 (1,295,048)	7,586 (292,685)	40.19	32.62	55.93	47.80	0.000	-8.948	-6.186	-10.740	34,747
55 or more	14,187 (836,306)	2,077 (112,734)	48.82	40.13	62.68	54.60	0.000	-11.534	-5.850	-5.996	16,262

an aspect reflected when observing the number of days lost due to an accident (29.80 days for Romania and 30.80 days for Bulgaria). The special incidence of severity of accidents for immigrants from Eastern Europe has already been studied in other countries (Guldenmund *et al.*, 2013). The rest of the countries present a difference rate (%FAR-%TAR) around 0, which indicates a logical proportionality between the number of total accidents and fatalities.

Business variables

Table 8 shows the average number of days lost due to work accidents in agriculture by nationality and size of company. Lack of experience is frequently cited as one of the causes generating the highest frequency of accidents in different sectors (Cattledge *et al.*, 1996; Bande & López Mourelo, 2015).

Regarding the size of the company, in all cases, the average number of workdays lost due to accidents among Spanish workers was significantly higher than that of foreigners. The highest average number of workdays lost due to accidents occurs in companies with fewer than 5 workers. The number of days lost decreases as the size of the company increases, especially in companies with more than 100 workers and even more in the largest companies (more than 250 workers). This situation shows how workers in larger companies are less likely to suffer accidents, and that, if they occur, they are less serious (Salminen *et al.*, 1993; Fabiano *et al.*, 2004). These differences by company size reflect work risks, the efficiency of safety programmes, and many factors in the work environment that are clearly more favourable in larger companies (Jeong, 1999).

The comparison of the number of days lost due to an accident between Spanish workers and immigrants according to the size of the company shows in all cases a significant difference in most cases in favour of Spanish workers who have more lost days. This difference decreases as the size of

the companies increases, going from 8.16 days in companies with less than 5 workers and reaching an equilibrium situation (there is no difference) in companies with more than 250 workers. Larger companies have better formal justice and equality conditions as they are easily forced by authorities to comply with the law. This type of formal justice does not need to depend on managerial decisions, as legal requirements are clear, and therefore obliging larger companies to fulfil these legal requirements is usually easier as this aspect is usually watched closely by unions and workers' representatives. This means better working conditions both for Spanish workers and for immigrants, and similar efficiency of safety programmes for both groups. In general, managerial decision-making in terms of generating justice in decisions is greatly dependent on informal justice, but once this informal managerial justice combines with social pressure and translates into formal aspects of required enforcement, then these few, clear requirements are precisely the ones that guarantee equal conditions of justice for all (Cugueró-Escofet & Rosanas, 2013; Cugueró-Escofet & Rosanas, 2020). This is the case of legal enforcement of safe conditions at work. And as large companies are better-aligned with legal requirements such as workplace safety, this means that larger companies are better at providing equal condition for nationals and foreigners.

Table 9 shows the effect of the worker's experience on the severity of accidents, differentiating between Spanish and immigrant workers.

In reference to the effect of the worker's experience on the severity of accidents, in both groups, Spanish workers and immigrants, a greater number of accidents was observed in workers with less experience (up to three months). This aspect is related to the job insecurity of the sector and the short-term contracts associated with harvesting campaigns (Gadea *et al.*, 2015). The number of accidents fell substantially in workers with 1 to 4 years of experience, which may be related to the departure from the agricultural sector of a significant part of the workers who

Table 7. Total and fatal accidents in agriculture for foreign workers in Spain (2013-2018).

Country	Total accidents	%TAR ^[1]	Fatal accidents	%FAR ^[2]	No. days lost	
					Average	SE ^[3]
Morocco	14,850	37.9	9	18.4	28.27	0.18
Romania	9,210	23.5	16	32.7	29.80	0.19
Ecuador	4,221	10.8	5	10.2	23.60	0.23
Bulgaria	1,434	3.7	10	20.4	30.80	0.47
Bolivia	1,045	2.7	0	0.0	25.56	0.43
Pakistan	942	2.4	2	4.1	31.57	0.68
Senegal	940	2.4	1	2.0	26.50	0.54
Mali	747	1.9	1	2.0	24.44	0.79
Algeria	657	1.7	2	4.1	29.09	0.89
Colombia	597	1.5	0	0.0	25.99	0.34
Poland	509	1.3	1	2.0	30.14	0.70
Portugal	475	1.2	1	2.0	33.57	0.52
Ukraine	346	0.9	1	2.0	30.86	0.70
Gambia	334	0.9	0	0.0	25.92	1.10
Lithuania	290	0.7	0	0.0	31.95	1.51
India	230	0.6	0	0.0	24.74	0.82
Ghana	224	0.6	0	0.0	24.90	1.03
Peru	175	0.4	0	0.0	24.05	0.43
Guinea	156	0.4	0	0.0	27.20	1.68
Paraguay	146	0.4	0	0.0	24.32	0.66
Mauritania	113	0.3	0	0.0	24.52	1.59
Rest of countries	1,531	3.9				

^[1] %TAR = (Total accidents of the country / Total accidents) × 100. ^[2] %FAR = (Fatal accidents of the country / Total fatal accidents) × 100.

^[3] SE =standard error.

have been involved in the sector only in a circumstantial way. Finally, an increase in the number of accidents from 5 years and up to 30 years of experience is once again noted, a group that corresponds to those who have consolidated their employment in the agricultural sector.

The comparison of the number of days lost due to an accident between Spanish workers and immigrants based on the experience of the injured worker shows in all cases a significant difference ($p < 0.005$) in favour of Spanish workers, who have more days of sick leave. Due to the lack of significance, the case of workers with more than 30 years of experience is not considered in this case. More experience should imply more training and experience in the work being done and, consequently, a lower probability of accidents (Llacuna *et al.*, 2013).

Material variables

Table S1 [suppl] (ordered by the total number of accidents) shows the aggregate data of the deviations causing accidents in the agricultural sector. The classification of the

deviations follows the methodology of European Statistics on Accidents at Work, or ESAW (EUROSTAT, 2013).

The type of accident has been frequently discussed in the literature (Melchior & Ruviaro, 2019). In the case of agriculture, the main types of accident that have been analysed are those that occur due to overturning during the handling of heavy machinery (tractors), since these accidents are more serious (Arana *et al.*, 2010; Valero & Abril, 2016) and are related to older and more experienced workers, who are usually the workers who use tractors (Goldcamp *et al.*, 2004; Arana *et al.*, 2010).

Accidents caused by the “loss (total or partial) of control of the means of transport or cargo (with or without motor)” (code 042) are those that present the greatest severity in terms of fatal accidents (a total number of 107 fatal, which 50 were not *in itinere*) that are not included in this study. In the case of non-fatal accidents, the number of days lost due to an accident in the case of Spanish workers is 46.00 days on average and that of foreign workers 42.33 days. These results may be conditioned by the underreporting of accidents in the agriculture sector; according to the study by Arana *et al.* (2010), not all the fatal accidents as-

Table 8. Average duration of sick leave due to accidents by nationality and company staff in agriculture, Spain (2013-2018). SD: standard deviation.

No. of workers	No. of accidents		No. of lost working days		SD		<i>p</i> -value	95% confidence intervals		t-Student	df
	Spain	Foreign	Spain	Foreign	Spain	Foreign		Lower	Upper		
1-5	36,102	6,971	41.98	33.82	56.09	49.69	0.000	-9.565	-6.739	-11.308	43,072
6-10	11,609	3,257	33.66	29.67	49.08	43.81	0.000	-5.489	-2.120	-4.189	14,864
11-25	14,600	4,832	31.80	30.18	47.18	44.68	0.036	-3.140	-0.110	-2.102	19,430
26-50	9,835	4,281	31.29	28.12	47.48	42.07	0.000	-4.814	-1.518	-3.766	14,114
51-100	9,432	4,428	29.45	27.74	44.39	40.66	0.030	-3.250	-0.162	-2.166	13,858
101-250	11,778	6,184	28.68	25.64	42.34	36.39	0.000	-4.290	-1.803	-4.802	17,960
Over 250	16,166	9,152	26.15	26.45	39.13	38.19	0.562	-0.700	1.289	0.580	25,316

sociated with the use of the tractor have been reported, and it establishes that in the period 2004 -2008 only 61.88% of the total number of the accidents that occurred in Spain were officially registered.

Other deviations that should be highlighted in terms of the number of days lost due to accidents correspond to falls at different levels and at the same level. “Fall of a person from a height” (code 051) with 52.70 days lost on average by Spanish workers and 41.53 by immigrant workers; “Fall of a person at the same level” (code 052) with 43.28 days in Spanish workers and 35.44 in the case of immigrant workers. A significant difference ($p < 0.005$) could be observed in accidents due to falls at the same level or at a different level in favour of Spanish workers, who had more days of sick leave. In the case of accidents due to the “loss (total or partial) of control of the means of transport or cargo (with or without motor)” the conclusion is that there was no difference between the days lost by Spanish and foreign workers. For this last type of accident, there are several studies that work to improve the intrinsic safety conditions of this machinery (Di Nocera *et al.*, 2018; Rondelli *et al.*, 2018; Kim *et al.*, 2019).

Only the case of “Caught between objects” (code 063) shows a greater number of days lost due to accidents in favour of foreign workers (43.46 days lost) compared to Spanish counterpart (42.66 days lost), although the difference was not significant.

Table S2 [suppl] shows the aggregate data of injuries derived from the various accidents that occurred in the agriculture sector. Injuries are categorised according to ESAW (EUROSTAT, 2013).

In reference to the type of injuries, in accidents with major damages, the difference in days lost due to sick leave is lower than in less significant accidents. The situations of “bone crushing” (code 020) and “amputations” (code 040) of greater severity presented minor differences between Spanish and foreign workers, 81.77 days lost compared to 75.43 days respectively in the case of “bone crushing” and 87.42 days lost compared to 84.06 days lost in the case of “amputations”.

Conversely, accidents with less serious consequences (number of days lost due to accidents) show a greater difference between Spanish and foreign workers in favour of the former group. This is the case of “extreme temperatures effects” (code 100) with 42.00 days lost and 18.63 days lost and the case of “effects of noise, vibration and pressure” (code 090) with 28.81 days lost and 12.85 days lost, and the case of “drowning and asphyxiation” (code 080) with 17.36 days lost and 7.63 days lost, respectively.

These results indicate that, for the same injury derived from the accident, in general terms, Spanish workers take more days off work with less intrinsic severity compared to immigrant workers. This situation is related to a greater labour presenteeism (Mateo, 2017) associated with ignorance of their rights and protections at work (Smith & Mustard, 2010) and to more unfavourable benefits during the period of sick leave (Solé & Rodríguez, 2010) for the case of immigrants. This situation cannot occur in more severe accidents, associated with an inability to work, which places foreigners nearer to the same level as nationals.

In Spain, accidents classified as “Heart attacks, strokes, and other non-traumatic diseases” (code 130) are considered work accidents, except when there is evidence to consider otherwise. In this case, no difference was observed between the days lost due to an accident between the two groups under study, an aspect that is related to the less clear working nature of the accident. The average number of days lost by Spanish workers was 180.47 days and by foreigners 182.50.

Temporal variables

Table 10 presents data on the average number of days of work lost by nationality by the day of the week the accidents occur.

In reference to the day of accident occur (see Table S3 [suppl]), the average duration of sick leave steadily increased as the week progressed from Monday to Sunday, and this was the case for both groups (nationals and immi-

Table 9. Average duration of sick leave due to accidents by nationality and length of service in agriculture, Spain (2013-2018). SD: standard deviation.

Length of service	No. of accidents		No. of lost working days		SD		<i>p</i> -value	95% confidence intervals		t-Student	df
	Spain	Foreign	Spain	Foreign	Spain	Foreign		Lower	Upper		
< 1 month	33,349	10,919	31.48	29.69	46.90	43.54	0.000	-2.789	-0.796	-3.527	42,266
1-3 months	26,922	12,231	29.58	27.80	43.76	40.52	0.000	-2.604	-0.775	-3.623	39,151
4-12 months	16,591	8,470	30.37	27.57	45.50	41.18	0.000	-3.952	-1.644	-4.753	25,059
1-2 years	4,998	2,160	33.26	28.80	48.14	44.14	0.000	-6.835	-2.092	-3.690	7,156
3-4 years	5,628	1,926	35.76	28.85	49.23	42.21	0.000	-9.369	-4.449	-5.506	7,553
5-10 years	10,128	2,735	42.27	29.86	56.03	43.76	0.000	-14.670	-10.137	-10.727	12,861
11-30 years	10,278	662	46.81	35.60	59.75	51.39	0.000	-15.781	-6.553	-4.717	10,938
> 30 years	1,628	2	54.89	30.00	68.15	4.59	0.606	-110.433	69.656	-0.516	1,628

grants). We also found statistically significant differences for both groups when comparing successive days of the week ($p < 0.005$) and confirming an increase in the number of days lost in both cases. This situation of greater number of days of absence in accidents that occurred during the weekend can be considered in relation to injuries that are difficult to diagnose (Moral de Blas *et al.*, 2012; Fontaneda *et al.*, 2019).

Table 10 also shows the evolution of the number of accidents, highlighting the following aspects: first, the reduction of these during the weekend; second, the highest number of accidents registered on Mondays; and third, from Tuesday to Friday the number of accidents remains stable. This situation can be considered normal as established by various studies carried out in various industrial sectors such as construction (Camino-López *et al.*, 2008). The higher accident rate on Monday can be attributed to the so-called “Monday effect”, associated with the circumstance that some of the accidents that occur on weekends are not reported until Monday, the first working day of the week, due to the worker’s social benefits in relation to the insurance company (Campolieti & Hyatt, 2006; Butler *et al.*, 2013).

Table S3 [suppl] shows the duration of sick leave due to accidents comparing the time of the day the accident occurred. The differences between Spanish and foreign workers were statistically significant ($p < 0.005$), except in accidents that occurred between 2 a.m. and 7 a.m. and between 10 p.m. and midnight. In all time slots, the average number of lost workdays for foreign workers was less than for Spanish workers.

Geographical variable

Table S4 [suppl] shows that the distribution of accidents is not the same in all the regions of Spain. There was a

greater number of accidents concentrated in the southern (Andalusia) and eastern (Valencia and Murcia) areas of Spain, coinciding with the main agricultural areas. In most regions the number of days lost due to accidents was higher for Spanish workers, except in some regions, such as Madrid or Valencia, but without statistically significant results regarding the difference presented. Some regions stand out with greater differences between the number of days of sick leave between nationals and foreigners, such as Aragón (with a difference of 9.09 days), even if in this case more accidents have been reported for foreign workers than for Spanish ones. Another example is Castilla y León (with a difference of 16.29 days); however, in this case the total number of accidents for Spanish workers was greater compared to foreigners. The different behaviours observed depending on the region should be subjected to more detailed analysis.

Conclusions

Agricultural sector presents high levels of immigration, poor working conditions, and high potential risks due to the nature of the work: the use of heavy machinery, dangerous materials, and in general hard outdoor labour, where employment also tends to be precarious.

Governments should be aware that this sector is more precarious, and this is even worse for immigrant workers. This sector should improve to arrive to benchmark conditions of other sectors as a matter of social justice. This is so because, immigrants are a big percentage of total workforce in agriculture compared to other sectors, so precarious conditions are worse in this sector compared to other sectors due also to the fact of immigrants being higher in relative percentage. Then, implementing specific plans to make the whole sector aware of this may result in improv-

Table 10. Average duration of sick leave due to accidents by nationality and day of the week in agriculture, Spain (2013-2018). SD: standard deviation.

Day of the week	No. of accidents		No. of lost working days		SD		<i>p</i> -value	95% confidence intervals		t-Student	df
	Spain	Foreign	Spain	Foreign	Spain	Foreign		Lower	Upper		
Monday	22,345	7,899	32.31	28.04	46.83	42.29	0.000	-5.441	-3.097	-7.138	30,242
Tuesday	19,498	7,012	32.92	27.80	48.63	42.70	0.000	-6.409	-3.836	-7.805	26,508
Wednesday	18,917	6,964	33.23	28.29	49.10	41.42	0.000	-6.241	-3.650	-7.483	25,879
Thursday	17,649	6,563	34.42	28.08	49.61	41.57	0.000	-7.682	-4.986	-9.211	24,210
Friday	17,207	6,248	34.94	29.70	49.90	41.62	0.000	-6.630	-3.861	-7.424	23,453
Saturday	10,301	3,492	36.58	31.24	51.51	43.83	0.000	-7.246	-3.433	-5.488	13,791
Sunday	3,605	927	38.46	32.09	52.75	42.21	0.000	-10.103	-2.643	-3.350	4,530

ing conditions for immigrant workers and therefore improve the sector as whole. The role of government bodies must be especially sensitive in this sector, which has the third highest number of accidents in Spain but ranks first in terms of severity, including death due to an occupational accident. The establishment of specific action plans and an increase in ad-hoc inspection for this sector is a factor that would reduce accidents once specific measures are established.

Findings expose those workers tend to be over-confident in their ability to perform their jobs as they are get older. Consequently, they underestimate the nature of the dangers involved and take more risks that lead to more severe accidents. It is imperative to increase ways of making workers aware of the dangers, which may involve the government requiring companies to train the workers at risk of over-confidence.

Then, our conclusions, may offer some guidance for designing training plans and improving the information that should be available about the risks to which agricultural workers are exposed. Specifically, companies (and governments as to reinforcing this) should understand that workers as get older tend to be over-confident and therefore should continuously being trained over the years to understand the dangers of their jobs.

Finally, an important element is the analysis of the possible underreporting of accidents, which according to some studies is high, and could even be hiding a situation of precarious workers, especially foreigners. If 27.02% of workers in the sector are non-nationals and accidents are under-reported, this figure can be expected to increase, creating a vicious circle of precarity that is unjust and should be denounced.

Limitations

This study analyses accidents in the agriculture sector in Spain in the period 2013-2018, but its conclusions

may be different in other countries of the European Union or the rest of the world. The MTMSS Workplace Accident Registry system collects the total number of reported accidents, but it may be that some have not been reported, and therefore have not been considered in this study.

Only accidents that have led to at least one day's absence from work have been considered, which means that accidents without a personal injury are not analysed in this paper. Likewise, we analysed the severity of accidents once they have occurred, but not the probability of their occurrence. The nature of the data used allowed us to study and compare groups of accidents in agriculture sector that have already occurred, hence, to show the probability that once the accident occurs in that specific category, it may be minor, serious, very serious or fatal.

Acknowledgments

The authors would like to thank the Subdirección General de Estadísticas [Sub-Directorate General for Statistics] of the Ministerio de Empleo y Seguridad Social [Labour Ministry], Spain, for providing access to the anonymous data on occupational accidents.

Authors' contributions

Conceptualization: X. Baraza, N. Cugueró-Escofet.

Data curation: X. Baraza, N. Cugueró-Escofet.

Formal analysis: X. Baraza, N. Cugueró-Escofet.

Investigation: X. Baraza, N. Cugueró-Escofet.

Methodology: X. Baraza, N. Cugueró-Escofet.

Software: X. Baraza, N. Cugueró-Escofet.

Supervision: X. Baraza, N. Cugueró-Escofet.

Validation: X. Baraza, N. Cugueró-Escofet.

Writing – original draft: X. Baraza, N. Cugueró-Escofet.

Writing – review & editing: X. Baraza, N. Cugueró-Escofet.

References

- Agudelo-Suárez A, Gil-González D, Ronda-Pérez E, Porthe V, Paramio-Pérez G, García AM, Garí A, 2009. Discrimination, work and health in immigrant populations in Spain. *Soc Sci Med* 68(10): 149-152. <https://doi.org/10.1016/j.socscimed.2009.02.046>
- Ahonen EQ, Benavides FG, Benach J, 2007. Immigrant populations, work and health: A systematic literature review. *Scand J Work Environ Health* 33(2): 96-104. <https://doi.org/10.5271/sjweh.1112>
- Alamgir H, Yu S, Drebit S, Fast C, Kidd C, 2009. Are female healthcare workers at higher risk of occupational injury? *Occup Med* 59(3): 149-152. <https://doi.org/10.1093/occmed/kqp011>
- Arana I, Mangado J, Arnal P, Arazuri S, Alfaro JR, Jarén C, 2010. Evaluation of risk factors in fatal accidents in agriculture. *Span J Agric Res* 8(3): 592-598. <https://doi.org/10.5424/sjar/2010083-1254>
- Bande R, López-Mourelo E, 2015 The impact of worker's age on the consequences of occupational accidents: empirical evidence using Spanish data. *J Labor Res* 36(2): 129-174. <https://doi.org/10.1007/s12122-015-9199-7>
- Baraza X, Cugueró-Escofet, N, 2021. Severity of occupational agricultural accidents in Spain, 2013-2018. *Saf Sci* 143: 105422. <https://doi.org/10.1016/j.ssci.2021.105422>
- Bestratén M, Baraza X, 2015. Rentabilidad de la prevención. In: *Gestión de la prevención en un marco de excelencia*; Bestratén *et al.* (coords), pp: 221-290. Editorial UOC, Barcelona.
- Blanch A, Torrelles B, Aluja A, Salinas JA, 2009. Age and lost working days as a result of an occupational accident: a study in a shiftwork rotation system. *Saf Sci* 47(10): 1359-1363. <https://doi.org/10.1016/j.ssci.2009.03.001>
- Błażejczyk K, Kazandjiev V, Degórski M, Dimitrov P, 2015. Assessment of occupational heat stress risk among agriculture workers in Poland and Bulgaria. *Europa* 21(29): 59-72. <https://doi.org/10.7163/Eu21.2015.29.4>
- Butler RJ, Gardner HH, Kleinman NL, 2013. Workers' compensation: occupational injury insurance's influence on the workplace. In: *Handbook of insurance*; pp. 449-469. Springer, New York. https://doi.org/10.1007/978-1-4614-0155-1_16
- Callejón-Ferre AJ, Montoya-García ME, Pérez-Alonso J, Rojas-Sola JI, 2015. The psychosocial risks of farm workers in south-east Spain. *Saf Sci* 78: 77-90. <https://doi.org/10.1016/j.ssci.2015.04.015>
- Camino-López MA, Ritzel DO, Fontaneda I, González-Alcantara OJ, 2008. Construction industry accidents in Spain. *J Saf Res* 39(5): 497-507. <https://doi.org/10.1016/j.jsr.2008.07.006>
- Campolieti M, Hyatt DE, 2006. Further evidence on the "monday effect" in workers' compensation. *Ind Labor Relat Rev* 59(3): 438-450. <https://doi.org/10.1177/001979390605900306>
- Cattledge GH, Hendricks S, Stanevich R, 1996. Fatal occupational falls in the U.S. construction industry, 1980-1989. *Accid Anal Prev* 28(5): 647-654. [https://doi.org/10.1016/0001-4575\(96\)00025-5](https://doi.org/10.1016/0001-4575(96)00025-5)
- Coleman PJ, Kerkering JC, 2007. Measuring mining safety with injury statistics: Lost workdays as indicators of risk. *J Saf Res* 38(5): 523-533. <https://doi.org/10.1016/j.jsr.2007.06.005>
- Cugueró-Escofet N, Rosanas JM, 2013. The just design and use of management control systems as requirements for goal congruence. *Manag Account Res* 24(1): 23-40. <https://doi.org/10.1016/j.mar.2012.11.001>
- Cugueró-Escofet N, Rosanas JM, 2020. The relative role of the intellectual and moral virtues in sustainable management decisions: The case of practical wisdom and justice. *Sustainability* 12(3): 1156. <https://doi.org/10.3390/su12031156>
- Di Nocera F, Ricciardi O, Longo E, Mastrangelo S, Cutini M, Bisaglia C, 2018. Attentional control in accidents involving agricultural tractor operators. *Ergon Des* 26(1): 17-23. <https://doi.org/10.1177/1064804617737444>
- Döös M, Laflamme L, Backström T, 1994. Immigrants and occupational accidents: A comparative study of the frequency and types of accidents encountered by foreign and Swedish citizens at an engineering plant in Sweden. *Saf Sci* 18(1): 15-32. [https://doi.org/10.1016/0925-7535\(94\)90038-8](https://doi.org/10.1016/0925-7535(94)90038-8)
- EUROSTAT, 2008. Statistical classification of economic activities in the European Community. Luxembourg Publications Office of the European Union <https://ec.europa.eu/eurostat/documents/3859598/5902521/KS-RA-07-015-EN.PDF> [April 27, 2021].
- EUROSTAT, 2013. European Statistics on Accidents at Work (ESAW) - Summary methodology. Luxembourg Publications Office of the European Union <https://ec.europa.eu/eurostat/documents/3859598/5926181/KS-RA-12-102-EN.PDF/56cd35ba-1e8a-4af3-9f9a-b3c47611ff1c> [April 27, 2021].
- EUROSTAT, 2018. Fatal accidents at work 2017. https://ec.europa.eu/eurostat/statistics-explained/index.php/Accidents_at_work_statistics#Analysis_by_activity [April 27, 2021].
- Fabiano B, Curró F, Pastorino R, 2004. A study of the relationship between occupational injuries and firm size and type in the Italian industry. *Saf Sci* 42(7): 587-600. <https://doi.org/10.1016/j.ssci.2003.09.003>
- Fontaneda I, Camino-López MA, González-Alcantara OJ, Ritzel DO, 2019. Gender differences in lost work days due to occupational accidents. *Saf Sci* 114: 23-29. <https://doi.org/10.1016/j.ssci.2018.12.027>
- Gadea M, De Castro C, Pedreño A, Moraes N, 2015. Jornaleros inmigrantes en la agricultura murciana: reflexiones sobre crisis, inmigración y empleo agrícola. *Migraciones* 37: 149-169. <https://doi.org/10.14422/mig.i37.y2015.007>

- García-Arroyo JA, Osca A, 2020. Occupational accidents in immigrant workers in Spain: The complex role of culture. *Saf Sci* 121: 507-515. <https://doi.org/10.1016/j.ssci.2019.09.027>
- Goldcamp M, Hendricks KJ, Myers JR, 2004. Farm fatalities to youth 1995-2000: a comparison by age groups. *J Saf Res* 35(2): 151-157. <https://doi.org/10.1016/j.jsr.2003.11.005>
- Gravel S, Legendre G, Rhéaume J, 2013. Occupational safety and health in small businesses in urban areas: the non-participation of immigrant workers. *Policy Pract Health Saf* 11(1): 19-29. <https://doi.org/10.1080/14774003.2013.11667782>
- Guldenmund F, Cleal B, Mearns K, 2013. An exploratory study of migrant workers and safety in three European countries. *Saf Sci* 52: 92-99. <https://doi.org/10.1016/j.ssci.2012.05.004>
- Holte KA, Follo G, 2018. Making occupational health and safety training relevant for farmers: Evaluation of an introductory course in occupational health and safety in Norway. *Saf Sci* 109: 368-376. <https://doi.org/10.1016/j.ssci.2018.05.020>
- ILO, 2015. Agriculture: a hazardous work. International Labor Organization. https://www.ilo.org/safework/areasofwork/hazardous-work/WCMS_356550/lang--en/index.htm [Feb 28, 2021].
- INSST, 2019. Informe anual de accidentes de trabajo en España 2018. Instituto Nacional de Seguridad y Salud en el Trabajo; Ministerio de Trabajo, Migraciones y Seguridad Social, Spain.
- Jeong BY, 1999. Comparisons of variables between fatal and nonfatal accidents in manufacturing industry. *Int J Ind Ergon* 23(5-6): 565-572. [https://doi.org/10.1016/S0169-8141\(98\)00020-1](https://doi.org/10.1016/S0169-8141(98)00020-1)
- Karttunen JP, Rautiainen RH, 2013. Occupational injury and disease incidence and risk factors in Finnish agriculture based on 5-year insurance records. *J Agromedicine* 18(1): 50-64. <https://doi.org/10.1080/1059924X.2012.742029>
- Kim B, Lim S, Shin SY, Yum S, Kim YY, Yun N, Yu S, 2019. Risk assessment of tractor-related hazards based on accident cases. *J Agric Saf Health* 25(3): 133-152. <https://doi.org/10.13031/jash.13076>
- Kumar GP, Dewangan KN, 2009. Agricultural accidents in north eastern region of India. *Saf Sci* 47(2): 199-205. <https://doi.org/10.1016/j.ssci.2008.03.007>
- Laflamme L, Menckel E, Lundholm L, 1996. The age-related risk of occupational accidents: the case of Swedish iron-ore miners. *Accid Anal Prev* 28(3): 349-357. [https://doi.org/10.1016/0001-4575\(96\)00001-2](https://doi.org/10.1016/0001-4575(96)00001-2)
- Lin YH, Chen CY, Luo JL, 2008. Gender and age distribution of occupational fatalities in Taiwan. *Accid Anal Prev* 40(4): 1604-1610. <https://doi.org/10.1016/j.aap.2008.04.008>
- Llacuna J, Baraza X, Bernal A, 2013. La formación en prevención de riesgos laborales. In: *Formar, comunicar y negociar: Aplicación a la prevención de riesgos laborales*; pp: 13-82. Editorial UOC, Barcelona.
- Margolis KA, 2010. Underground coal mining injury: a look at how age and experience relate to days lost from work following an injury. *Saf Sci* 48(4): 417-421. <https://doi.org/10.1016/j.ssci.2009.12.015>
- Martín-Román AL, Moral A, 2014. Differences between Spanish and foreign workers in the duration of workplace accident leave: a stochastic frontier analysis. In: *Disadvantaged workers*; pp. 277-295. Springer, New York. https://doi.org/10.1007/978-3-319-04376-0_13
- Mastrangelo G, Rylander R, Buja A, Marangi G, Fadda E, Fedeli U, Cegolon L, 2010. Work related injuries: estimating the incidence among illegally employed immigrants. *BMC Res Notes* 3(1): 331. <https://doi.org/10.1186/1756-0500-3-331>
- Mateo AC, 2017. Condiciones de trabajo y salud de los trabajadores inmigrantes en España. *Revisión bibliográfica. Archivos de Prevención de Riesgos Laborales* 20 (4): 225-226. <https://doi.org/10.12961/aprl.2017.20.04.6>
- McCurdy SA, Samuels SJ, Carroll DJ, Beaumont JJ, Morin LA, 2003. Agricultural injury in California migrant Hispanic farm workers. *Am J Ind Med* 44(3): 225-235. <https://doi.org/10.1002/ajim.10272>
- Mekkodathil A, El-Menyar A, Al-Thani H, 2016. Occupational injuries in workers from different ethnicities. *Int J Crit Illn Inj Sci* 6(1): 25. <https://doi.org/10.4103/2229-5151.177365>
- Melchior C, Ruviano R, 2019. Mortality per work accident: A literature mapping. *Saf Sci* 114: 72-78. <https://doi.org/10.1016/j.ssci.2019.01.001>
- Momose Y, Suenaga T, 2015. Gender differences in the occurrence of nonfatal agricultural injuries among farmers in Fukuoka, Japan. *J Rural Med* 10(2): 57-64. <https://doi.org/10.2185/jrm.2897>
- Moral de Blas A, Corrales-Herrero H, Martín-Roman A, 2012. Glass ceiling or slippery floors? Understanding gender differences in the Spanish worker's compensation system. *Estud Econ Apl* 30(1): 311-340. <https://doi.org/10.25115/eea.v30i1.3390>
- Moyce SC, Schenker M, 2018. Migrant workers and their occupational health and safety. *Annu Rev Public Health* 39: 351-365. <https://doi.org/10.1146/annurev-publhealth-040617-013714>
- Patel K, Watanabe-Galloway S, Kofin R, Haynatzki G, Rautiainen R, 2017. Non-fatal agricultural injury surveillance in the United States: A review of national-level survey-based systems. *Am J Ind Med* 60: 599-620. <https://doi.org/10.1002/ajim.22720>
- Pickett W, Dostaler S, Berg RL, Brison RJ, Linne-man JG, Marlenga B, 2008. Hospitalized head injuries in agricultural settings: Who are the vulnerable groups? *Accid Anal Prev* 40(6): 1943-1948. <https://doi.org/10.1016/j.aap.2008.08.005>

- Rezaei R, Seidi M, Karnasioun M, 2019. Pesticide exposure reduction: Extending the theory of planned behavior to understand Iranian farmers intention to apply personal protective equipment. *Saf Sci* 120: 527-537. <https://doi.org/10.1016/j.ssci.2019.07.044>
- Ronda-Pérez, E, Benavides FG, Levecque K, Love JG, Felt E, Van Rossem R, 2012. Differences in working conditions and employment arrangements among migrant and non-migrant workers in Europe. *Ethnicity & Health* 17(6): 563-577. <https://doi.org/10.1080/13557858.2012.730606>
- Ronda-Pérez E, Gosslin A, Martínez JM, Reid A, 2019. Injury vulnerability in Spain. Examination of risk among migrant and native workers. *Saf Sci* 115: 36-41. <https://doi.org/10.1016/j.ssci.2019.01.026>
- Rondelli V, Casazza C, Martelli R, 2018. Tractor rollover fatalities, analyzing accident scenario. *J Saf Res* 67: 99-106. <https://doi.org/10.1016/j.jsr.2018.09.015>
- Rubiales-Gutierrez E, Agudelo-Suarez A, López-Jacob MJ, Ronda-Perez E, 2010. Differences in occupational accidents in Spain according to the worker's country of origin. *Salud Publica de Mexico* 52(3): 199-206. <https://doi.org/10.1590/S0036-36342010000300003>
- Salami B, Meharali S, Salami A, 2015. The health of temporary foreign workers in Canada: A scoping review. *Can J Public Health* 106(8): 546-554. <https://doi.org/10.17269/CJPH.106.5182>
- Salminen S, Saari J, Saarela KL, Räsänen T, 1993. Organizational factors influencing serious occupational accidents. *Scand J Work Environ Health* 19(5): 352-357. <https://doi.org/10.5271/sjweh.1463>
- Salvatore MA, Baglio G, Cacciani L, Spagnolo A, Rosano A, 2013. Work-related injuries among immigrant workers in Italy. *J Immigr Minor Health* 15(1): 182-187. <https://doi.org/10.1007/s10903-012-9673-8>
- Smith PM, Mustard CA, 2010. The unequal distribution of occupational health and safety risks among immigrants to Canada compared to Canadian-born labour market participants: 1993-2005. *Saf Sci* 48(10): 1296-1303. <https://doi.org/10.1016/j.ssci.2010.03.020>
- Solé M, Rodríguez M, 2010. Disparidades entre inmigrantes y nativos en el impacto de las condiciones laborales en la salud. *Gaceta Sanitaria* 24(2): 145-150. <https://doi.org/10.1016/j.gaceta.2009.10.006>
- Solomon C, 2002. Accidental injuries in agriculture in the UK. *Occup Med* 52(8): 461-466. <https://doi.org/10.1093/occmed/52.8.461>
- Sousa E, Agudelo-Suárez A, Benavides FG, Schenker M, García AM, Benach J, Porthé V, 2010. Immigration, work and health in Spain: the influence of legal status and employment contract on reported health indicators. *Int J Public Health* 55(5): 443-451. <https://doi.org/10.1007/s00038-010-0141-8>
- SPEE, 2019. Informe del mercado de trabajo de los extranjeros. Servicio Público de Empleo Estatal; Ministerio de Trabajo, Migraciones y Seguridad Social, Spain.
- Svendsen K, Oddfrid A, Bjørn H, 2014. Nonfatal occupational injuries in Norwegian farmers. *Saf Health Work* 5(3): 147-151. <https://doi.org/10.1016/j.shaw.2014.05.001>
- Valero E, Abril I, 2016. Diagnóstico de la prevención de riesgos laborales en el sector Agrario. *Seguridad en el Trabajo* 87: 18-25.
- Zambon I, Piergentili A, Salvati L, Monarca D, Matyas-Lysakowska P, Colantoni A, 2018. Applied research for a safer future: exploring recent job accidents in agriculture, Italy (2012-2017). *Processes* 6 (7). <https://doi.org/10.3390/pr6070087>