MUSCULOSKELETAL DISORDERS AMONG NURSING ASSISTANTS IN SPAIN; DIFFERENCES BETWEEN OLD PEOPLE'S HOMES AND HOSPITALS

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MUSCULOSKELETAL DISORDERS AMONG NURSING ASSISTANTS IN SPAIN; A COMPARATIVE STUDY BETWEEN OLD PEOPLE'S HOMES AND HOSPITALS

ABSTRACT

An analysis of musculoskeletal injuries among nursing assistants and the duration of sick leave due to musculoskeletal-related injuries is presented. 33,200 injuries are analyzed in Spain, over the period 2013-2017. Our results showed differences for injuries, their causes and injured body parts, confirming a greater frequency of back-related injuries at old people's homes, and of shoulder-related injuries at hospitals. As regards organization at work, the highest number of injuries at old people's homes and hospitals were registered between 8:00 and 10:00 and, between 11:00 and 14:00 hours, respectively. The average duration of sick leave at hospitals (35.63 days) was higher than at old people's homes (26.89). Differences that were influenced by the older average age of hospital workers. The lengthier duration of sick leave was associated with centers within the public sector. These results recommend active breaks and physical exercise for older workers, reviewing sick leave at public centers and the incorporation of ergonomic training.

KEYWORDS: nursing assistants; overexertion; musculoskeletal disorders.

1.- INTRODUCTION

A gradual aging of the population is taking place within the societies of Europe and North America. This situation may provoke higher demand *for* care among older people, both in hospitals and old people's homes. In consequence, there will logically be an increase in the demand for nurses and nursing assistants (Collins, Nelson, & Sublet, 2006; Walton & Rogers, 2017).

This higher demand may be aggravated by high rates of staff turn-over, exhaustion, low working satisfaction, and the long-term abandonment of medical care for the work force (McCaughey *et al.*, 2016). In fact, the scarcity of nurses and nursing assistants has surfaced as a problem. The departure of nurses from the profession and health institutions and, in consequence, rapid staff turn-over rates, all cause serious planning difficulties (Samur & Intepeler, 2019).

Moreover, it was forecast that one third of all nurses would be older than 50 in 2015 (Phillips & Miltner, 2015). Older workers present more specific work-related health problems (Nicholson & Sharp, 2016). In fact, more Musculoskeletal Disorder (MSD) related problems have been reported in Europe (Schneider & Irastorza, 2010), which may be associated with the reduction of their functional capabilities associated with deficiencies of the muscular system (Kenny, Groeller, McGinn, & Flouris, 2016).

The group of nurses and nursing assistants have a high risk of suffering from MSD. Thus, Reme *et al.* (2014) affirmed that health workers caring for hospital patients have high injury rates at their place of work, particular musculoskeletal injuries. In particular, nursing assistants are found among the work force with the highest levels of pain (Eriksen, 2003), injuries and days off work (Pompeii, Lipscomb, & Dement, 2008).

Forty million European workers are estimated to suffer from MSD, an estimated cost between 0.5% and 2% of GDP (EUROGIP, 2007). In Spain, according to official data, in 2012 there were 800,000 MSD injuries and 21 million work days were lost (Ministerio de Sanidad, 2013). Davis and Kotowski (2015), for the USA, estimated the cost of the MSDs in 2,335 million dollars, for nurses and nursing assistants, in the year 2013.

In consequence, we are facing a serious problem of increased incidence of MSD among health-care professionals and, more specifically, among nursing assistants. In this study, the MSD affecting nursing assistants will be approached, analyzing personal, organizational, and psychosocial risk factors.

Age is one of the most widely studied and debated factors that has been associated with MSD. Arvidsson *et al.* (2016) have associated age with the part of the body that MSD affects, while others have found no significant association between age and the appearance of MSD (Landry, Raman, Sulway, Golightly, & Hamdan, 2008; Merchaoui *et al.*, 2017), and Feng, Chen, & Mao (2007) have only found significant associations with chronic pain in the lumbar region.

Regarding sex, Alamgir, Yu, Drebit, Fast, & Kidd (2009) reached the conclusion that women have a higher probability of suffering an injury, as was concluded within the health sector of the Canadian province of British Colombia. Kelsh & Sahl (1996) examined the different physical capabilities of men and women, as a reason for men and women suffering different types of injuries. Thus, Smith & Mustard (2004) found a higher incidence rate of chronic MSD among women rather than men. Ghilan *et al.* (2013) investigated tangential aspects as risk factors in connection with MSD, such as menstrual disorders among women and cultural diversity

However, the majority of researchers have focused on the association between structural or organizational aspects and the appearance of MSD. Thus, night shifts (Eriksen, Bruusgaard, & Knardahl, 2004), the quick pace of work, an insufficient number of workers, and a highly demanding working routine (Fajardo, 2015; Haas, Hunter, & Howard, 2018; Valena & de Alencar, 2015) have all been analyzed. MSD were also associated with psychosocial factors, such as the imbalance between effort and reward and excessive commitment (Lamy *et al.*, 2014; Reme *et al.*, 2014), and the influence of insufficient support from superiors, and the absence of an agreeable and supportive working environment (Eriksen *et al.*, 2004).

Significant relations with MSD, both in the back and in the hand-wrist (Montalvo Prieto, Cortés Múnera, & Rojas López, 2015), were determined through frequent investigations

of the physical effort expended by nurses and nursing assistants (Stevens *et al.*, 2019). In fact, it has been shown that carrying an excessively heavy load has twice the likelihood of resulting in MSD than bad postures (Estryn-Behar *et al.*, 1990).

Specifically, the risk of MSD among nursing assistants has been widely investigated, as this collective is the most highly affected within the area of health care (Santana *et al.*, 2013), which suffers the highest number of cases of MSD in the lower lumbar region (53.9%) (Ribeiro, Fernandes, Solla, Santos Junior, & Sena Junior, 2012). Nursing assistants, in fact, appear to have higher rates of musculoskeletal injuries and sprains than nurses (Boden *et al.*, 2012).

Likewise, the risk of injury due to lifting was higher among nursing assistants than among nurses. Nursing assistants, looking after the most physically demanding patients, are responsible for many activities: Making beds; grooming and cleaning residents and hospital in-patients; cleaning furniture, material and clinical devices; sorting and organizing bed linen; helping residents and hospital in-patients take their meals. Walton & Rogers (2017) forecast that the number of MSD will continue increasing. The educational requirements to become a nursing assistant are minimal and they occupy the job positions with the lowest salaries (Pompeii *et al.*, 2008; Rodriguez-Acosta *et al.*, 2009).

Within the group of assistant nurses, the incidence rates of musculoskeletal pain varied by age, sex, and weekly working hours. The prevalence of pain in the limbs increased with age, while the prevalence of headache was reduced at older ages. Back pain was more frequent among people working in old people's homes (Eriksen, 2003).

Other studies investigated the nature of the work of nursing assistants and the way in which their activities are a cause of MSD. The scarcity of qualified staff, ineffective manipulation due to little training, long days without sufficient rest, working even with MSD, inadequate maintenance of equipment, and an aging labor force with a strong commitment towards attending to residents are factors that play a crucial role in these types of injuries (Ching *et al.*, 2018). The training of nursing assistants in old people's homes for older people is associated with a notable reduction of the probability of suffering from MSD. However, the initial training is not associated with any likelihood of injury (D'Arcy, Sasai, & Stearns, 2012).

Another of the important aspects of MSD is the duration of sick leave. In 1984, the results of a survey of 3,912 nurses suggested that 750,000 working days were lost in that year due to back pain and that 1 out of every 6 (159 for each 1000 at-risk staff) attributed the appearance of pain to an incident involving patient manipulation. Other studies related the sick-leave duration with the type of hospital (training, Catholic, Dutch) and with workloads (Burton *et al.*, 1997). The association between the rate of absenteeism in old people's homes providing geriatric care was also studied, concluding that 16% had taken sick leave over the past 12 months (Dulon, Kromark, Skudlik, & Nienhaus, 2008). Similar conclusions in relation to Norwegian (Eriksen *et al.*, 2004) and Taiwanese nursing assistants (Feng *et al.*, 2007) were also reached.

Reviewing the scientific literature, a series of significant gaps were found in the investigation of MSD in the field of health care. Thus, scarce few investigations may be found on MSD that affects nursing assistants working in old people's homes. There are also few investigations on MSD in upper and lower limbs. In addition, few investigations have investigated real injuries, because the majority of studies have been based on subjective evaluations of pain, which can influence the results. Additional studies are therefore necessary on sick leave due to MSD that affects nursing assistants as a collective group (Davis & Kotowski, 2015).

This investigation will try to fill that gap, by analyzing the MSD-related injuries affecting nursing assistants. The aim is to know whether there are differences between the injuries in hospitals and in old people's homes, paying special attention to days off work.

2.- DATA AND METHODOLOGY

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, the labor authorities must be notified of all accidents

sustained by a worker that arises out of or in connection with work that is defined as an occupational accident (Raheem & Hinze, 2014).

We may consider that the notification of workplace accidents is close to 100% in Spain for two reasons: Comparison of reported accidents with the data from the Labour Force Survey LFS) and the insurance-based accident-reporting system (Eurostat, 2020). Sick leave pay *per diem* is higher for the worker when due to an accident at work (75% to 100% of the regulatory base in the event of an occupational accident from the first day and 60% in the event of a non-occupational accident from the fourth day - nothing from the first to the third day).

In our study, we selected all accidents with injuries to nursing assistants, both in hospitals and in nursing homes, due to physical stress, that occurred in Spain during the period 2013-2017. Figure 1 shows the number of hospitals and old people's homes, by number of sites and number of beds (places), differentiating between public and private management.

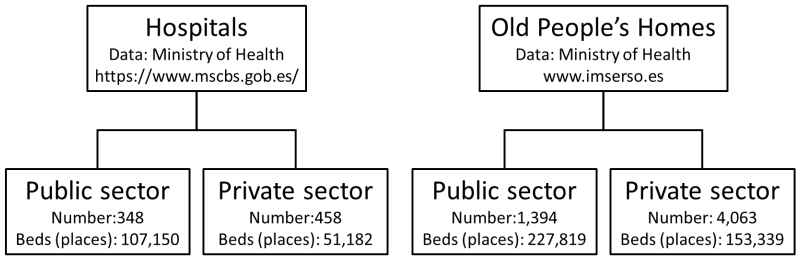

Figure 1.- Number of sites and beds (Hospitals and Old People's Homes)

The EUROSTAT European Statistics on Accidents at Work (ESAW) – Summary Methodology (Eurostat, 2012), defines the variable "Contact – Mode of Injury" as the way in which the worker involved in the accident was injured. In addition, it refers to Code 71 "Physical stress – on the Musculoskeletal system" as an injury that involves no material agent. This code should be used in cases of both significant or light stress on the muscles, the articulations, the organs and the tissue, caused by excessive movements, overexertion, and physical stress.

Moreover, we exclusively selected physical stress on the musculoskeletal system that affects nursing assistants, in order to ensure that the work or task that the injured worker carried out was equal or similar. Nursing care homes with health care for older people and people with

physical or intellectual disabilities were included under the heading of old people's homes. Healthcare establishments offering hospital health care were included under hospitals.

The number of accidents due to physical stress under analysis amounted to 33,200 (Thirty-three thousand, two hundred), the total MSD due to physical stress that affected nursing assistants in hospitals and old people's homes in Spain over the period 2013-2017. From among these accidents, sixteen thousand eight hundred and fifty-seven (16,857) occurred in hospitals and sixteen thousand three hundred and forty-three (16.343) in old people's homes (figure 2).

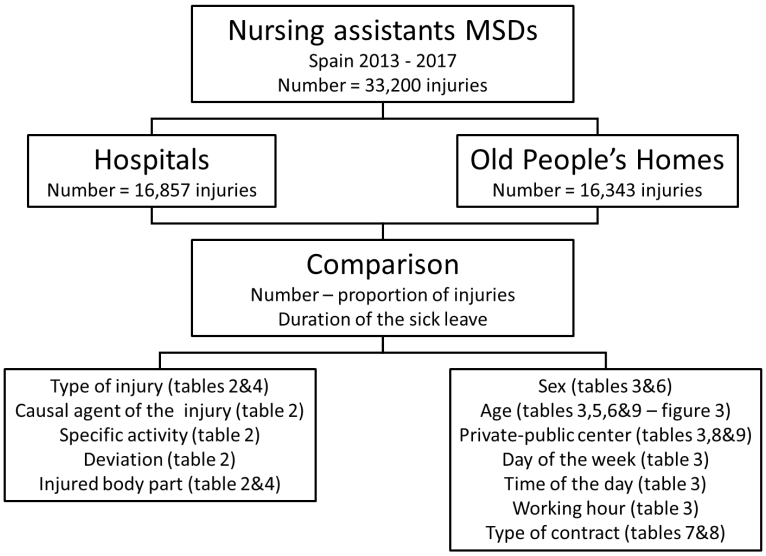

Figure 2.- Conceptual framework (MSDs Hospitals and Old People's Homes)

2.2. Study design

We will study the data related to the accidents that occurred. Unfortunately, we have no data on the number of nursing assistants exposed to similar risks. We will compare accidents in old people's homes and hospitals: the causes, the injuries and the injured body part. In addition, the duration of the sick leave from old people's homes and hospitals will be studied, analyzing the reasons for any possible differences.

In brief, we set out the following hypotheses within this work, which we will then test, in relation to the data on accidents due to physical stress suffered by Nursing Assistants:

Hypothesis 1.- The percentage of injuries is the same in Hospitals and Old People's Homes regarding: a.- type of injury; b.- cause of the injury; c.- Injured body part.

Hypothesis 2: The duration of sick leave due to injuries will be similar in Hospitals and in Old People's Homes.

Hypothesis 3.- The type of employment contract and whether the employment is in the public or private sector will not influence the duration of sick leave.

2.3. Statistical Analysis

We used the proportion z-test to test the percentage differences between accidents in hospitals and in old people's homes, calculating both the *z* value and the p-value of the intervals with the two following equations:

$$z = \frac{\bar{p}_1 - \bar{p}_2}{\sqrt{\left(\frac{\bar{p}_1(1-\bar{p}_1)}{n_1} + \frac{\bar{p}_2(1-\bar{p}_2)}{n_2}\right)}} \qquad I = (\hat{p}_1 - \hat{p}_2 \pm z_{\alpha/2} \cdot \sqrt{\frac{\hat{p}_1(1-\hat{p}_1)}{n_1} + \frac{\hat{p}_2(1-\hat{p}_2)}{n_2}})$$

The statistical analyses of the duration of sick leave were completed with the Student-*t* test for the calculation of the significance of the difference found between independent means. Equal variances were not assumed, calculating the lower and upper confidence intervals of those differences with a confidence interval of 95%.

All the analyses were computed with the statistical analysis software package SPSS 24.

3.- RESULTS

The physical-stress incidence index for all workers in each different sector in Spain, over the period 2013-2017, is shown in table 1. Total health care activities include hospitals, old people's homes and social service activities without accommodation. The incidence rate for hospitals and old people's homes, the places of interest in this research, are shown in the two lower rows of the table.

We can see that in Spain the highest probability of taking sick leave due to physical stress over the period 2013-2017 was registered in health care activities in old people's homes, with a very much higher index than, for example, construction activity that followed it in importance.

One limitation of this work arises here, because we were unable to ascertain the incidence rates of nursing assistants, as we were unaware of exactly how many of them were exposed to the risk of physical stress at both hospitals and old people's homes.

Physical stress x 1000 workers	**2013**	**2014**	**2015**	**2016**	**2017**
Agriculture, livestock, and hunting	12.9	14.0	15.3	15.5	15.7
Food industry	19.5	21.5	22.9	24.4	24.5
Manufacture of machinery and equipment	15.3	16.6	17.5	17.7	17.2
Construction	21.8	22.8	24.6	26.0	26.7
Hostelry services	9.6	10.4	10.7	11.1	10.5
Transport and Storage	18.6	19.7	21.0	22.0	21.1
Health care activities totals	15.0	16.3	16.8	17.1	15.9
Hospitals	11.8	12.5	12.9	12.9	11.5
Old People's Homes	27.6	30.4	31.5	32.3	31.1

*: Author's own preparation using data from the Ministry

Table 1: Incidence index of Physical Stress by activity

In this paper, we studied the differences between the accidents due to physical stress suffered by nursing-clinical assistants in both hospitals and old people's homes. All the following tables (2 to 9) and figure 3 refer to accidents suffered by nursing assistants. We will move on to the proposed hypotheses and the hypothesis testing in the following lines.

We studied the variables that defined the injury and consequent sick leave due to physical stress-MSD, in order to test the first hypothesis (percentages of injuries are the same in Hospitals and Old People's Homes). In Table 2, we can see the main results.

ACCIDENT-RELATED VARIABLES	% Accidents		Difference	Confidence Level 95 %		P-Value
	Old People's Homes N=16 857	Hospitals N= 16 343		Upper	Lower	
INJURY						
Sprains and strains	37.22%	39.05%	-1.83%	-2.88%	-0.79%	<0.01
Other dislocations/sprains/ strains	28.83%	31.14%	-2.31%	-3.29%	-1.32%	<0.01
Dislocations and subluxations	12.26%	10.11%	2.15%	1.48%	2.83%	<0.01
Wounds and superficial injuries	11.87%	12.14%	-0.27%			
Internal injuries (Pulled muscles)	7.17%	3.38%	3.79%	3.32%	4.27%	<0.01
Other injuries	1.76%	3.16%	-1.41%	-1.74%	-1.07%	<0.01
Fractures	0.63%	0.86%	-0.22%	-0.41%	-0.04%	<0.03
Multiple Injuries	0.26%	0.17%	0.09%			
CAUSAL AGENT OF THE INJURY						
Persons Handling Equipment	71.72%	57.56%	14.16%	13.14%	15.17%	<0.01
No Agent	8.73%	6.74%	2.00%	1.42%	2.57%	<0.01
Other Loads	5.17%	8.25%	-3.09%	-3.63%	-2.55%	<0.01
Furniture/Fixed equipment	0.94%	2.91%	-1.97%	-2.26%	-1.67%	<0.01
Other Agents	13.45%	24.54%				
SPECIFIC ACTIVITY						
Physical movement on the spot	25.43%	17.87%	7.56%	6.68%	8.45%	<0.01
Holding with the hand, gripping	22.55%	26.26%	-3.71%	-2.79%	-4.64%	<0.01
Vertical transport	18.97%	18.44%	0.54%			>0.05
Other transport of loads	8.50%	7.16%	1.34%	0.76%	1.92%	<0.01
Other movements	8.00%	4.33%	3.67%	3.16%	4.19%	<0.01
Walking, climbing, descending, running	5.56%	9.65%	-4.08%	-4.65%	-3.52%	<0.01
Horizontal transport	3.41%	8.14%	-4.73%	-5.23%	-4.23%	<0.01
Others	7.58%	8.16%				
CAUSE OR DEVIATION						
Lifting or transporting	49.20%	44.48%	4.72%	3.65%	5.79%	<0.01

Uncoordinated movement	16.80%	14.51%	2.29%	1.51%	3.07%	<0.01
Pushing, pulling	8.32%	14.96%	-6.64%	-7.33%	-5.96%	<0.01
Twisting or turning while handling	8.19%	7.62%	0.56%			>0.05
Laying down a load	3.22%	3.35%	-0.13%			>0.05
Falls to the same level	1.50%	1.44%	0.06%			>0.05
Others	12.77%	13.63%				
INJURED BODY PART						
Back	40.06%	37.07%	2.99%	1.95%	4.04%	<0.01
Wrist, hand and fingers	14.02%	13.87%	0.16%			>0.05
Shoulder	11.71%	12.49%	-0.78%	-1.49%	-0.08%	<0.02
Neck	9.94%	10.27%	-0.33%			>0.05
Hip, leg and knee	7.56%	8.76%	-1.19%	-1.78%	-0.60%	<0.01
Arm	6.07%	4.85%	1.22%	0.73%	1.71%	<0.01
Ankle, foot and fingers	3.70%	5.59%	-1.89%	-2.34%	-1.44%	<0.01
Torso	3.56%	3.68%	-0.12%			>0.05
Upper limbs (various)	1.46%	1.01%	0.45%	0.21%	0.69%	>0.01
Other body parts	0.98%	1.50%	-0.51%	-0.75%	-0.28%	<0.01
Lower limbs (various)	0.93%	0.92%	0.01%			>0.05

Table 2.- Number of Accidents and Percentages of Physical Stress in Old People's Homes and Hospitals. Accident Variables.

We found that sprains were the most frequent injury, the agent that caused most injuries was the manipulation of persons, and the most frequently injured zone was the back.

Analyzing the injuries by old people's homes and hospitals, it was found that injuries to staff at old people's homes presented significant differences from injuries at hospitals, both for the injury and the cause, as well as the activity, the causal agent, and the injured body part.

In the section relating to the type of injury, significant differences may be observed between injuries. Dislocations and subluxations are more frequent in old people's homes (12.26% of the accidents versus 10.11%) and internal injuries (7.17% versus 3.38%). On the contrary, problems relating to muscles and ligaments were more frequent in hospitals. However, approximately 30% of the total of accidents (9.893) were placed under the heading "Other types of dislocations, subluxations, strains and sprains". It was unclear whether these injuries were muscular or skeletal. This investigation should be enlarged with a study on injuries at hospitals and old people's homes.

There were likewise differences with regard to the injured body part. Thus, injuries to the back occurred in 40.06% of the injuries in old people's homes versus 37.07% in hospitals, while shoulder injuries were registered in 12.49% of the injuries in hospitals versus 11.71% in old people's homes.

Regarding the cause of the injury, we can confirm that the highest numbers of cases of the most repeated cause was lifting or transporting loads in old people's homes (49.20%) and in

hospitals (44.48%). In contrast, around 6-7% more injuries were due to pushing or pulling (e.g. trolleys, hospital beds) in hospitals. We also found that the main agent or load causing the injury was in the course of manipulating or moving people. The importance of this agent was much greater in old people's homes than in hospitals.

In the following, we analyze the circumstances of the injured worker, or the firm and of the organization of the work. In table 3, we can see the differences between old people's homes and hospitals:

PERSONAL AND ORGANIZATIONAL VARIABLES	% Accidents		Difference	IC 95 %		P-Value
	Old People's Homes N=16 857	Hospitals N= 16 343		Lower	Upper	
SEX						
- Male	6.68%	9.68%	-3.00%	-3.59%	-2.41%	<0.01
- Female	93.32%	90.32%	3.00%			
AGE						
From 16 to 35 years old	32.67%	18.41%	14.26%	13.33%	15.18%	<0.01
From 36 to 55 years old	57.07%	61.21%	-4.13%	-5.19%	-3.08%	<0.01
56 years old and over	10.26%	20.38%	-10.12%	-10.89%	-9.36%	<0.01
TYPE OF CENTER						
- Private Sector	84.24%	32.68%	51.56%	50.66%	52.47%	<0.01
- Public Sector	15.76%	67.32%	-51.56%			
DAY OF THE WEEK						
- Monday	16.81%	18.69%	-1.88%	-2.70%	-1.06%	<0.01
- Tuesday	15.00%	16.96%	-1.96%	-2.75%	-1.18%	<0.01
- Wednesday	14.64%	15.53%	-0.89%	-1.66%	-0.12%	<0.02
- Thursday	14.18%	15.23%	-1.05%	-1.81%	-0.29%	<0.01
- Friday	14.37%	14.12%	0.25%			>0.05
- Saturday	12.77%	10.08%	2.69%	2.00%	3.37%	<0.01
- Sunday	12.23%	9.38%	2.85%	2.19%	3.52%	<0.01
TIME OF DAY						
From 22:00 to 07:00	12.89%	17.89%	-4.99%	-5.77%	-4.22%	<0.01
08:00, 09:00 to 10:00	39.89%	25.96%	13.93%	12.93%	14.93%	<0.01
From 11:00 to 14:00	17.99%	28.92%	-10.93%	-11.84%	-10.03%	<0.01
From 15:00 to 19:00	18.94%	21.40%	-2.46%	-3.33%	-1.60%	<0.01
20:00 and 21:00	10.29%	5.84%	4.46%	3.87%	5.04%	<0.01
WORKING HOUR						
1st Hour	19.30%	16.17%	3.13%	2.31%	3.95%	<0.01
2nd Hour	28.81%	21.53%	7.28%	6.35%	8.21%	<0.01
3rd Hour	15.98%	17.47%	-1.49%	-2.29%	-0.68%	<0.01
4th Hour	10.41%	15.14%	-4.73%	-5.44%	-4.01%	<0.01
5th Hour	7.16%	10.75%	-3.59%	-4.20%	-2.98%	<0.01
6th Hour	7.55%	7.44%	0.11%			>0.05
7th Hour	5.51%	5.31%	0.20%			>0.05
8th Hour	2.46%	2.23%	0.23%			>0.05
Others	2.80%	4.00%	-1.20%	-1.59%	-0.81%	<0.01

Table 3.- Number of Accidents and Percentages of Physical Stress in Old People's Homes and Hospitals. Personal and Organizational Variables

It is difficult to complete a joint analysis of MSD in hospitals and old people's homes, because the differences are very significant between each type of center, as we can see below.

In hospitals, 3% more male nursing assistants suffered injuries than in old people's homes. By age, we can highlight that workers between 16 and 35 years old suffered 32.67% of all physical stress-related injuries in old people's homes, as opposed to 18.41% in the same age range in hospitals.

The nature of the work center may also be highlighted. Thus, while the injured workers in old people's homes at private sector centers represented 84.24%, that percentage in hospitals amounted to 32.68%.

The day of the week with the highest injury rates in hospitals and old people's homes was Monday. However, the highest difference between those centers was for the accident rates registered at the weekend, and it was higher in old people's homes, with a difference higher than 5% of all accidents.

Regarding the time of day and the working hour at which the accident occurred, we found that the differences were very important between hourly time bands and the tendencies varied as a function of the time of day. Thus, the highest numbers of physical stress-related accidents in old people's homes were registered between 8 and 10 in the morning, while it was between 11 and 14 hours in hospitals. Perhaps the routine of waking and helping old people out of bed every day, in the early hours of the morning, is somehow related to these results.

Significant differences were also observed in the working hours. It was concluded that the early hours were always those of highest risk of physical stress-related accidents, both in old people's homes and in hospitals and that those hours were those of greatest risk in old people's homes. The injuries on extraordinary working days longer than 8 hours were not very important, although they were higher in hospitals than in old people's homes.

Consequently, we **reject hypothesis 1**, since the accident percentages presented differences between hospitals and old people's homes. It presented differences in the **type** and the **cause** of injury, the **injured body part** (back injuries more frequent in old people's homes and shoulder injuries in hospitals). There were also differences in: **gender** (higher percentage of men injured in hospitals); **age** (older in workers injured in hospitals); **sector** (more injured in the public sector in hospitals); **day of the week** (more accidents in old people's homes on

weekends); **time of day** (from 8 a.m. to 10 a.m. in old people's homes and from 11 a.m. to 2 p.m. in hospitals); **working hours** (higher accidents the first two hours of work in old people's homes).

Hypothesis 2: The duration of the injuries will be similar in Hospitals and in Old People's Homes.

We will refer to the average duration of the sick leave due to physical stress at hospitals and old people's homes for the purposes of this analysis. The duration of the different types of injuries (Eurostat, 2013) will be analyzed, as well as the different injured body parts which are summarized below in table 4.

INJURY AND INJURED BODY PART	Duration in days		Difference	CI 95 %		P-Value
	Old people's homes	Hospitals		Lower	Upper	
Average of all accidents	26.89	35.63	8.74	-9.7	-7.8	<0.01
INJURY						
Sprains and strains	25.9	34.4	-8.5	-10.0	-6.9	<0.01
Other dislocations/sprains/ strains	29.1	37.4	-8.3	-10.2	-6.4	<0.01
Dislocations and subluxations	25.7	35.1	-9.4	-12.3	-6.5	<0.01
Wounds and superficial injuries	24.1	33.8	-9.7	-12.4	-7.0	<0.01
Internal injuries (Pulled muscles)	26.8	32.4	-5.6	-10.1	-1.0	<0.01
Other injuries	27.9	37.6	-9.7	-16.1	-3.2	<0.01
Fractures	60.7	68.0	-7.2			>0.05
Multiple Injuries	25.2	36.6	-11.4			>0.05
INJURED BODY PART						
Back	22.3	31.3	-9.0	-10.4	-7.6	<0.01
Wrist, hand and fingers	26.8	34.9	-8.1	-10.6	-5.7	<0.01
Shoulder	36.9	52.2	-15.3	-19.2	-11.5	<0.01
Neck	23.9	30.2	-6.3	-8.9	-3.7	<0.01
Hip, leg and knee	35.3	40.8	-5.5	-9.5	-1.6	<0.01
Arm	33.2	42.2	-9.0	-13.6	-4.5	<0.01
Ankle, foot and fingers	24.5	27.1	-2.6			>0.05
Torso	22.5	27.0	-4.5	-8.1	-1.0	<0.02
Upper limbs (various)	33.2	42.2	-9.0			>0.05
Other body parts	29.6	45.1	-15.6	-25.3	-5.8	<0.01
Lower limbs (various)	36.1	35.0	1.1			>0.05

Table 4.- Average duration of Physical Stress at Old People's Homes and Hospitals due to Injuries and Injured Body Part

The average duration of the sick leave due to physical stress-related injuries was 8.74 days greater in hospitals than those registered in old people's homes. Can we consider that the injuries in hospitals were of greater severity than those in old people's homes or are other personal and organizational factors influencing that lengthier duration?

With regard to serious physical stress, 33 cases were registered throughout the whole period of analysis. From among those, 30 were registered in hospitals, with an average duration of 90.23 days. The 3 registered in old people's homes recorded an average duration of 43.67

days. The difference of 46.56 days presented significant differences (t: -2.309; Lower: -92.332, Upper: -0.801; $p<0.05$). However, this difference cannot be the only cause of the difference noted here for all cases of physical stress suffered in old people's homes and hospitals.

In table 4, we found that, regardless of the injury that was inflicted and the injured body part (except for lower limbs, various), sick leave due to physical stress suffered by nursing assistants was greater in hospitals (average of 35.63 days) than in old people's homes (average of 26.89 days).

Regarding the injured body part due to physical stress, we found that a longer duration was registered in hospitals than in old people's homes. We may, for example, highlight shoulder-related physical stress, recovery from which took 15.3 days longer in hospitals. In consequence, neither can we find support for the second hypothesis.

The average age of the workers injured by physical stress was higher in hospitals (46.14 years) than it was in old people's homes (41.36). This difference of 4.78 years presented the following statistical significance (t: -40.524; CI-Lower: -5.02, Upper: -4.56; p-valor<0.01).

In table 5, we can see that the average duration was, within all age groups, always greater for physical stress suffered in hospitals. In addition, it is remarkable that the duration of sick leave follows a direct relation with age, both in old people's homes and in hospitals. In other words, regardless of the type of center, it appears that the older the nursing assistant, the lengthier the duration of the sick leave.

AGE GROUP	Number of injuries		Duration in days		Difference	CI 95 %		P-Value
	Old People's Homes N=16 857	Hospitals N= 16 343	Old People's Homes	Hospitals		Lower	Upper	
16-35 years old	5,507	3,009	21.2	26.2	-5.1	-6.7	-3.5	<0.01
36-55 years old	9,621	10,003	28.7	36.5	-7.8	-9.2	-6.5	<0.01
> 55 years old	1,729	3,331	35.1	41.4	-6.3	-9.4	-3.3	<0.01

Table 5.- Average Duration of Sick Leave due to Physical Stress in Old People's Homes and Hospitals by Age of Injured Worker

In figure 3, which refers to the average duration of sick leave by age, we can see that, except for some exceptions with a reduced number of cases, the duration was always lengthier in hospitals than in old people's homes. So, nursing assistants of 27 years of age in hospitals, with a total of 543 injuries due to physical stress, presented a difference in the average duration of their sick leave with regard to nursing assistants in old people's homes of 12.31 days (t: -

9.993; IC-Lower: -9.283, Upper: -6.239; p-valor<0.01). The nursing assistants of 33 years old presented a difference of 10.10 days and a total of 693 injuries; those of 38 years old presented a difference of 10.99 days and a total of 876 injuries; and, those of 49 years old presented a difference of 12.08 days and a total of 1,139 injuries. Moving on to older ages, the nursing assistants of 58 years old in hospitals presented a difference in the average duration of their sick leave of 12.06 days with regard to old people's homes, and a total of 761 injuries; and, finally, the nursing assistants of 64 years old presented an average duration of sick leave of 12.52 days and a total of 216 injuries.

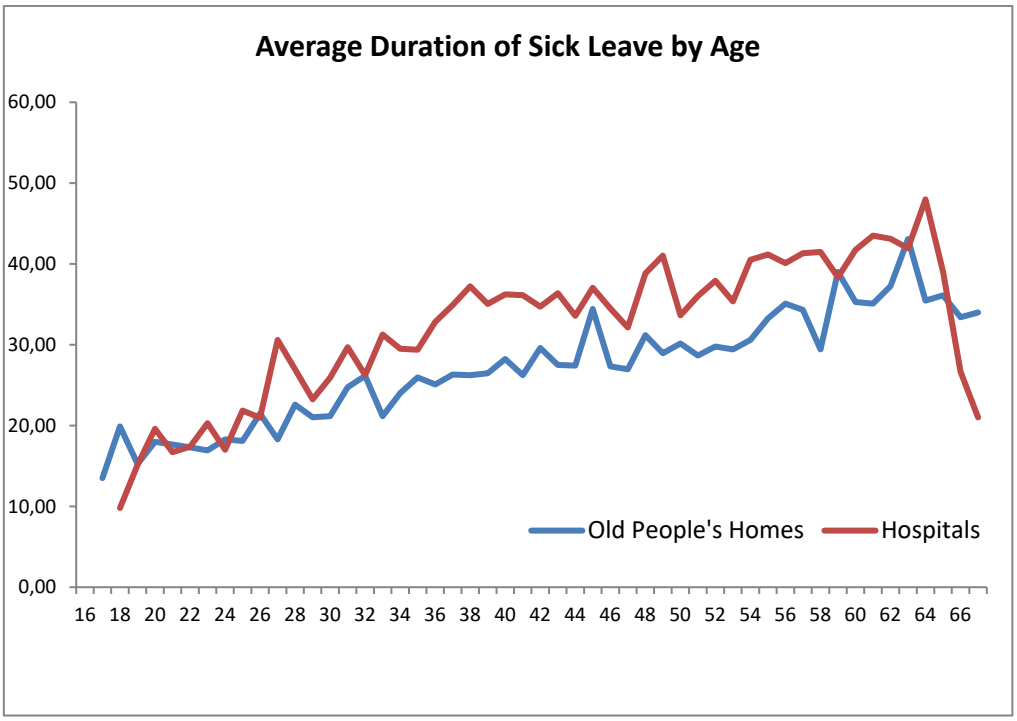

Figure 3.- Average Duration of Sick Leave by Age of Injured Worker

Age may perhaps be one of the factors that most decisively influences the duration of sick leave due to physical stress, but it cannot be the only cause of the differences between the duration of sick leave in both old people's homes and hospitals.

In what follows, we will confirm whether the duration is similar for physical stress suffered by men in old people's homes and hospitals. We will do likewise with the group of women. From table 6, we can confirm that, firstly, the duration was lengthier in the group of women; and, secondly, regardless of the gender of the injured worker, the average duration was always lengthier in hospitals.

AGE GROUP	Number of Injuries		Duration in days		CI 95 %			P-Value
	Old People's Homes N=16 857	Hospitals N= 16 343	Old People's Homes	Hospitals	Difference	Lower	Upper	
TOTALES								
Men	1,126	1,582	24.69	29.32	-4.63	-7.68	-1.58	<0.01
Women	15,731	14,761	27.05	36.31	-9.26	-10.31	-8.22	<0.01
GROUP: 16-35 years old								
Men	468	450	20.09	17.20	2.89			>0.05
Women	5,039	2,559	21.27	27.83	-6.56	-8.34	-4.78	<0.01
GROUP: 36-55 years old								
Men	595	956	26.53	33.81	-7.28	-11.46	-3.10	<0.01
Women	9,026	9,047	28.84	36.82	-7.98	-9.38	-6.60	<0.01
GROUP: > 55 years old								
Men	63	176	41.48	35.90	5.58			>0.05
Women	1,666	3,155	34.86	41.72	-6.86	-9.99	-3.75	<0.01

Table 6.- Average Duration of Physical Stress in Old People's Homes and Hospitals by Sex and Age

There are a direct relation between sick leave duration and age, the older the worker the longer duration of sick leave (table 6). Both, for men and women, in hospitals and in old people's homes. The sick leave is longer in hospitals than in old people's homes for women of any age and for men between 36 and 55 years. The different duration of the sick leave is not statistically significant, between injuries in hospitals and old people's homes, for men between 16 and 35 years old and those over 55 years old.

Contrasting the duration of physical stress-related sick leave in old people's homes among male (24.69 days) and female nursing assistants (27.05), the gap between both figures was confirmed to be significative (t: -1.988; CI-Lower: -4.696, Upper: -0.031; p-valor<0.05). The difference found in hospitals was even greater: 29.32 days for men and 36.31 for women (t: -6,152; CI-Lower: -9,227, Upper: -4,766; p-valor<0.01).

However, when we adjust the results for age, the statistical significance was lost for all the age bands in old people's homes and was only recorded in hospitals within the age band between 16 and 35 years old: 17.20 days for men; and, 27.83 days for women (t: -8,876; CI-Lower: -12,977, Upper: -8,279; p-valor<0.01).

In the following, we will study the influence of the most organizational or structural aspects on a lengthier or a shorter duration of sick leave and the differences between the duration of sick leave in hospitals and in old people's homes. We will analyze any possible influence that such aspects as the type of contract and the public or the private nature of the work center may have on sick-leave duration.

Hypothesis 3.- The type of employment contract and whether the employment is in the public or private sector will not influence the duration of sick leave.

56.27% of the injured nursing assistants, both in hospitals and in old people's homes, held a permanent employment contract (average sick-leave duration: 31.6 days), followed by 29.66% with a temporary employment contract (average sick-leave duration: 32.9 days) and 14.08% with a part-time contract (average sick-leave duration: 24.8 days). The accidents suffered by workers with other sorts of contracts were excluded from the study, due to their reduced number (34). We found that the injury-related sick-leave of the workers with part-time contracts was of a shorter duration than the injury-related sick leave of the workers with permanent contracts. However, no significant differences were recorded between the sick-leave of workers with either temporary or permanent contracts.

Contrasting the duration of sick leave in old people's homes and in hospitals, we can see from Table 7 that the nursing assistants registered a much shorter duration of sick leave at both centers when employed with a part-time contract. However, the duration of physical stress-related sick leave was still much greater in hospitals.

TYPE OF EMPLOYMENT CONTRACT	Injuries		Duration in days		Difference	IC 95 %		P-Value
	Old People's Homes N=16 857	Hospitals N= 16 343	Old People's Homes	Hospitals		Lower	Upper	
Permanent	9.353	9.314	27.97	35.68	-7.71	-9.03	-6.38	<0.01
Temporary	4.112	5.727	27.2	37.7	-10.47	-12.29	-8.64	<0.01
Part-time permanent	1.899	686	24.6	27.9	-3.35	-6.60	-0.11	<0.05
Part-time temporary	1.477	608	22.1	24.5	-2.37			>0.05

Table 7.- Average Duration in Old People's Homes and in Hospitals by contract of injured worker.

Another of the variables that can have some influence on the duration of the injuries is whether the old people's home or hospital is within the public or private sector. In all, 19,542 (58.9%) cases of physical stress were recorded at private centers and 13,643 (41.1%) at public centers. The average duration of the sick leave due to physical stress at private centers was 26.26 days, whilst it rose to 38.14 days at public centers. This difference of 11.88 days presented the following statistical significance (t: -22,382; CI-Lower: -12,926, Upper: -10.844; p-value<0.01). A significant association appears to exist between the public nature of the center and the duration of the sick leave.

Contrasting the old people's homes and the hospitals, in table 8, we can see a lengthier duration of sick leave in hospitals than in old people's homes. However, the differences are considerable, amounting to 2.59 days in private centers and 4.64 in public centers.

Type of Center / Type of Contract	Injuries		Duration in days		Difference	CI 95 %		P-Value
	Old People's Homes	Hospitals	Old People's Homes	Hospitals		Lower	Upper	
TYPE OF CENTER								
Private Sector	14,201	5,341	25.44	28.03	-2.59	-3.79	-1.39	<0.01
Public Sector	2,644	10,999	34.7	39.3	-4.64	-6.64	-2.64	<0.01
PERMANENT CONTRACT								
Private Sector	8,394	3,763	27.3	29.4	-2.14	-3.66	-0.61	<0.01
Public Sector	959	5,551	34.1	39.9	-5.84	-9.13	-2.55	<0.01
TEMPORARY CONTRACT								
Private Sector	2,628	685	22.9	23.0	-0.03			>0.05
Public Sector	1,484	5,042	34.8	39.7	-4.89	-7.58	-2.21	<0.01
PART-TIME TEMPORARY CONTRACT								
Private Sector	1,314	336	20.3	22.5	-2.22			>0.05
Public Sector	163	272	36.9	26.9	9.99	1.44	18.54	<0.03
PART-TIME TEMPORARY CONTRACT								
Private Sector	1,856	554	24.3	28.1	-3.78	-7.39	-0.16	<0.05
Public Sector	33	132	37.4	27.1	10.25			>0.05

Table 8.- Average Sick-Leave Duration in Old People's Homes and in Hospitals by Type of Center and Employment Contract of Injured Worker

It appears that the nature of the center has a decisive influence on both the duration of the sick leave and on a lengthier duration of sick leave in hospitals (both for permanent and temporary contracts).

Looking at the type of center and age, the two variables that appeared to have the strongest links with both the duration of sick leave and the difference in the duration of sick leave between old people's homes and hospitals, we can see from Table 9 that the significant differences were substantially reduced and, in various age groups, were of no statistical significance.

Type of Center / Age of Worker	Injuries		Duration in days		Difference	CI 95 %		P-Value
	Old People's Homes	Hospitals	Old People's Homes	Hospitals		Lower	Upper	
PRIVATE SECTOR								
16- 35 years old	5,130	1,731	20.44	22.81	-2.37	-4.07	-0.66	<0.01
36- 45 years old	7,859	2,964	27.7	29.8	-2.09	-3.80	-0.38	<0.02
> over 55 years old	1,212	646	31.8	33.8	-2.06			>0.05
PUBLIC SECTOR								
16- 35 years old	373	1,276	31.2	30.9	0.31			>0.05
36- 45 years old	1,755	7,038	33.0	39.4	-6.35	-8.71	-4.00	<0.01
> over 55 years old	516	2,685	42.9	43.3	-0.34			>0.05

Table 9.- Average Duration of Sick Leave in Old People's Homes and Hospitals by Type of Center and Age of Injured Worker

The influence of the type of center and the age of the worker, both on the duration of sick leave and on the differences in sick-leave duration between physical stress-related injuries among nursing assistants working at old people's homes and at hospitals have been confirmed.

4.- DISCUSION AND CONCLUSIONS

In Spain, the probability of suffering an injury due to physical stress is greater in old-people's homes than in other activities with a high demand for physical effort, such as construction. As commented upon in the Introduction, there will be an increasing need for health-care professionals such as nursing assistants and therefore, hiring will increase. Thus, greater attention must be given to work situations so that injuries will not increase too. Likewise, preventive actions can also reduce injuries.

Nursing assistants who frequently work in old people's homes have been associated with a higher risk of MSD (Dulon *et al.*, 2008; Eriksen *et al.*, 2004; Feng *et al.*, 2007; Owen, Garg, & Jensen, 1992). The injuries of nurses and nursing assistants have also been investigated in hospitals (Burton *et al.*, 1997; Ghilan *et al.*, 2013; Landry *et al.*, 2008; Smedley *et al.*, 2003). In this investigation, the physical stress-related injuries among nursing assistants in old people's homes and in hospitals have been compared.

In our analysis we demonstrated, that there are significant differences between physical stress-related accidents among nursing assistants in hospitals and in old people's homes. There are differences in injury type, causes of the accidents, physical activity of the worker at the time of injury, causal agent and the injured body part. Almost all the results of investigative studies on MSD among nursing assistants have coincided; the body part most affected by pains and injuries is the back (Dulon *et al.*, 2008; Eriksen *et al.*, 2004; Estryn-Behar *et al.*, 1990). The results of our investigation also coincide on that point, but to a greater extent in old people's homes (40.06%) than in hospitals (37.07%).

Back pain has been associated with psychosocial risk factors: when there are high demands and low job control, imbalance between effort and reward or low social support

(Bernal *et al.*, 2015). Acting on the perception of control, the effort-reward ratio and social support could reduce the number of MSD and injuries.

The manipulation of people causes the highest number of injuries among nursing assistants (Bakker, Verhagen, van Trijffel, Lucas, & Koes, 2009). The highest number of injuries were also recorded for the same cause in this study, observing that physical stress-related injuries in old people's homes were over 14 percentage points higher than in hospitals for the same cause.

In our investigation, significant differences have been found between the personal characteristics of nursing assistants who have suffered physical stress in old people's homes and in hospitals. The greater presence of women has been confirmed in old people's homes, and the average age is likewise lower, and the day of the week with the highest number of recorded injuries was Monday. One explanation might perhaps be the Monday effect (Card & McCall, 1996). However, accidentality may be highlighted at weekends in the old people's homes. It appears that the organization of daily work might influence those data. In fact, the highest number of physical stress-related injuries was recorded in old people's homes between 8 to 10 in the morning, while the time band in hospitals was between 11 and 14 hours. Perhaps the process of waking residents early in the morning may be connected with these results. Studies should therefore be conducted with these professionals on their week-end working activities.

The effect of long working days has been studied in relation to the appearance of MSD, finding that working weeks of 50 hours or more increased the probability of back-related MSD problems by 50% (Landsbergis-P, 2006). In this study, the injuries on extraordinary working days of over 8 hours were not significant, although they were greater in hospitals than in old people's homes.

Among the most serious social and employment-related consequences of the injuries are the days off work due to sick leave. It was estimated, as early as 1984, that approximately 40,000 nurses a year took sick leave, in Great Britain, due to back pain. The estimated total number of days off work amounted to 750,000 working days lost each year (Stubbs, Buckle, Hudson, Rivers, & Worringham, 1983). In this investigation, having seen the differences found

for the accidents, we were able to envisage some differences in the duration of sick leave, due to those physical stress-related accidents. We found very high differences between the average duration of sick leave at hospitals (35.63 days) and at old people's homes (26.89 days). Sick leave due to sprains was 32.8% longer in hospitals, likewise sick leave due to dislocations and sub-luxations was 36.6% longer than in old people's homes. Sick leave due to back injuries lasted 40.4% longer in hospitals and sick leave due to shoulder injuries lasted 40.7% longer. A higher number of working hours was linked to back-related rather than shoulder-related MSD (Landsbergis-P, 2006). Warnings have been given of the need for more studies on MSD relating to the shoulder, the neck and the upper limbs, because this type of disorder has been increasing for years and is especially linked to a duration of sick leave of over four weeks (Lusted, Carrasco, Mandryk, & Healey, 1996). These injuries might be the ones that will increase in the future (Davis & Kotowski, 2015). A study of real injuries to the shoulders is necessary, analyzing the differences between those suffered in old people's homes and in hospitals.

We know that MSD-related injuries are among those with the highest risks that older nursing assistants have to confront (Phillips & Miltner, 2015). It has previously been shown that the most serious injuries were among workers of 60 years old (Farrow & Reynolds, 2012). In our study, the average age of the nursing assistants injured in old people's homes (41.36) was lower than the average age recorded in hospitals (46.14). This age factor could be another cause of that longer duration in hospitals (Pompeii *et al.*, 2008). In fact, contrasting the results by the age of the worker, a lengthier duration of sick leave was still recorded in all the age groups for the injuries in hospitals. The differences were reduced to 5.1 days, in the age group between 16 and 35 years old, 7.8 days in the age group between 36 and 55 years old and 6.3 days in the age group older than 55 years old. On the other hand, Jackson (2005) states that older workers had approximately half as many injuries as younger workers (injury rates are lower). Aging is associated with increases in experience (Bande & Lopez-Mourelo, 2015; Haight & Miles, 2005).

The sex of the injured person appeared not to have a decisive influence on the lengthier duration of sick leave in old people's homes. However, in hospitals, we can conclude that sick

leave among women was of a lengthier duration than among men. Both, for men and for women, the injuries suffered in hospitals were of lengthier duration than those suffered in old people's homes. It would be necessary to investigate whether the tasks assumed by men and women are the same or there are gender differences that justify these differences.

Aspects such as economic vulnerability among nursing assistants or scant concern with the centers for worker safety are factors than can influence the appearance of MSD (Haas *et al.*, 2018). It has also been concluded that shift work influenced the higher physical load of the nurses (Merchaoui *et al.*, 2017), that highly demanding work in intensive care units (Fajardo, 2015), an insufficient number of nursing assistants (Valena & de Alencar, 2015), an imbalance between effort expended and rewards received (Pelissier *et al.*, 2014), and, in general, the poor relations of nursing assistants at work (Lamy *et al.*, 2014; Reme *et al.*, 2014), and especially with nurses (Graham & Dougherty, 2012), all contributed to the appearance of MSD. A psycho-social factor that can affect the duration of sick leave might be the temporary nature of employment contracts and part-time working days. Temporary contracts hardly generated differences in the duration of physical stress-related sick leave. In general, the physical stress that affected nursing assistants with permanent contracts lasted only 1.3 days longer than the physical stress affecting nursing assistants with temporary contracts. Moreover, the physical stress affecting nursing assistants with indefinite contracts lasted 0.77 days longer than the physical stress that affected workers with temporary contracts. However, the difference between the duration of sick leave among workers with temporary contracts was 10.47 days in hospitals. We have confirmed that the modality of the contract, rather than having an association with the duration of sick leave, was in fact related with the center of employment. On another point, the part-time work has been linked to a clear reduction in the duration of sick leave and its difference within old people's homes and hospitals. These shorter durations of sick leave should be investigated in greater depth.

Another organizational, structural and, definitively, psycho-social aspect that can affect nursing assistants could be linked to working either within the public or the private sector. In our work, it has been found that this variable has a strong relation with the duration of sick

leave. In fact, the duration of sick leave at public centers was 45.2% higher than the sick leave registered at private centers. The differences in sick-leave duration between old people's homes and hospitals were also reduced when public and private sector centers were compared. Thus, in both private and public sector old people's homes and hospitals, the differences in the duration of sick leave were 2.59 days and 4.64 days, respectively. Part of the different duration of sick leave, between hospitals and old people's homes, is explained by the age of the injured worker (table 9).

4.1. Conclusions

The main conclusions of this study may be presented as follows:

1. The injuries and the injured body part due to MSD among nursing assistants in old people's homes presented significant differences to similar injuries among nursing assistants in hospitals.
2. The duration of sick leave due to MSD was much lengthier in hospitals than in old people's homes.
3. This lengthier duration of sick leave is associated with the public or private status of the work center, both for old people's homes and hospitals
4. The age of the patient is strongly associated with the duration of sick leave due to MSD, regardless of the center with which it is linked.

4.2. Limitations

This study is on the injuries of nursing assistants and we have no data on the number of nursing assistants exposed to the same risks. There is no way, therefore, that we could calculate incidence rates (as percentages of the total workforce) and it could involve a bias that makes the interpretation of the results more difficult.

The grouping of people with physical or intellectual disabilities into the old people's home may have introduced bias into the sample. Only 20 sites out of 5,457 of old people's homes are specific for those with physical or intellectual disabilities. However, different capacities of the residents can imply a greater or lesser physical burden for nursing assistants, affecting the number and the severity of injuries.

4.3. Future research

We suggest future qualitative analysis on human and organizational factors (as ergonomic analysis of activity, interviews or surveys, etc.) to find the causes of musculoskeletal injuries and to reduce their number and consequences in hospitals and old people's homes. The quantitative analysis of this article can be used as an important base to motivate more specific analysis.

We recommend future analysis of activities, which can take advantage of the conclusions of this study, such the hours when most injuries occur, from 8 to 10 in old people's homes and from 11 to 14 in hospitals.

We believe it is important to adapt jobs to the characteristics of the worker, such as age, strength, sex. It would be useful to investigate whether there are adaptations that are already influencing the type of accidents, their number and the duration of sick leaves. Also, adapt jobs to the different characteristics of the workplace, a different percentage of residents with physical or intellectual disabilities may influence the burden of nursing assistants.

IMPORTANT POINTS

Old people's homes will expand in the future, due to the progressive increase in demand for their services. Moreover, the duration of sick leave implies significant costs for firms. In this study, it appears to have been confirmed that the public or private status of the center and the age of the injured worker are two factors that determine the duration of the sick leave. It would therefore be advisable to afford greater opportunities to older workers for active rests and physical exercises. In addition, a better system for reviewing the health of the injured worker during sick leave from public health centers would be recommendable.

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