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THE INFLUENCE OF INFORMATION ON THE PREVENTION OF OCCUPATIONAL RISKS AND ERGONOMIC REQUIREMENTS IN THE DEVELOPMENT OF NON-TRAUMATIC OSTEOMUSCULAR DISEASES OF THE SHOULDER – A PILOT STUDY

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Abstract

Objectives: Shoulder pain associated with upper limb musculoskeletal disorders is an important health problem in clinical practice due to its high prevalence, frequent consultations in primary healthcare and occupational health. Preventive strategies, including information disseminated among workers, can be useful. The aim of this study is to analyze the associations between non-traumatic osteomuscular diseases of the shoulder and the workers' knowledge of the risks at the workplace and preventive measures developed there, as well as the association with ergonomic requirements. **Material and Methods:** An observational case-control study was carried out on an occupationally active population assisted during 1 year in 1 healthcare center, involving 690 participants. Data were collected through a questionnaire including sociodemographic variables, the workplace, the knowledge of prevention and ergonomic requirements. The independent effect of the variables associated with non-traumatic shoulder pathology was explored through logistic regression. **Results:** In total, 66.7% of the participants stated that they had been informed of the occupational hazards related to their jobs. The following variables were associated with a lower probability of shoulder injuries: male gender, working hours > 9 h/day or > 40 h/week, as well as having information on the risks associated with the workplace, using personal protective equipment, the existence of an occupational risks prevention service and/or risk assessment, the knowledge of the prevention plan, periodic medical examinations, and using one arm or physical force at work. A multivariate analysis revealed that the risk increased with age and lower educational levels, forced postures, repeated gestures, monotony and temporary absences from work. Furthermore, being informed of workplace risks, and using a single arm as well as physical force were shown as independent protective factors. **Conclusions:** Information on both the ergonomic requirements and how

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to prevent occupational risks is a useful tool for the prevention of non-traumatic shoulder diseases. Preventive policies including health education interventions in the workplace could benefit other developed preventive activities. Int J Occup Med Environ Health. 2019;32(6):825–40

Key words:
prevention, occupational health, primary healthcare, shoulder, musculoskeletal disorders, cumulative trauma disorders

INTRODUCTION

Non-traumatic pathology of the shoulder falls within a broader concept of shoulder pain. It is one of the most important upper limb musculoskeletal disorders in clinical practice. Its main cause is tendinitis or tendinosis of the rotator cuff, responsible for more than two-thirds of adult shoulder pain cases [1]. Its prevalence affects approx. 7–26% of the population [2–4], and it is estimated that there are incidences between 9–25 cases/1000 inhabitants each year although these numbers vary by country, age, methodology, response rates, or case definition [4–6]. In addition, it is among the most important occupational health problems in both developed and developing countries [7,8]. In many cases, the discomfort or pain can lead to more severe pathologies, disabling the worker from many types of work, and exerting a significant impact on the patient's quality of life [9]. Furthermore, its annual cost is high [10]. Therefore, its prevention is a priority and would be very profitable [11].

Shoulder pain is a frequent reason to visit a primary care physician. It occupies the third place in terms of the attended musculoskeletal pathology [5,12]. In many cases, the general practitioner (GP) is the first health professional consulted, and patients attending a healthcare centre frequently consider their pathology related to or aggravated by their work [3]. However, information on the possible employment relationship is not usually recorded in the medical records. Therefore, primary care physicians have a key role in the detection and management of work-related diseases [3].

In the workplace, it is also one of the most frequent reasons for consultation [13]. Thus, the World Health Organization considers musculoskeletal disorders of the shoulder as a "work-related disease" [14], with an important multifactorial component, where work contributes significantly but not exclusively to the disorder. Furthermore, Spanish legislation contemplates chronic tendon-related pathology of the rotator cuff as a possible occupational disease of the shoulder [15]. The occupational origin of the pathology is different according to the physical requirements of the job, the intensity or level of exposure to risk factors at the workplace, or whether frequent tasks are carried out involving the mobilization or use of the shoulder joint complex. The potential physical risk factors for the shoulder pathology include: a manual handling of loads, awkward postures, performing work above the shoulder level, loading on a single shoulder, repetitive movements, and situations involving the presence of vibration, pull or push [9,13,16–20].

Regarding the socioeconomic cost, the non-traumatic shoulder pathology involves costs which affect workers, companies and the society, in terms of the benefits claimed due to temporary or permanent disability, pharmaceutical and care expenses, as well as human costs in healthcare, personal autonomy and the quality of life, which are difficult to quantify in monetary terms [21,22]. Overall, musculoskeletal disorders are thought to represent the most prevalent work-related health problem in Europe. They are the main cause of occupational diseases, representing > 50% of all occupational diseases in the European Union [23]. Referring to the costs of musculoskeletal disorders of the upper limb, some European studies have estimated their cost at 0.5%–2% of the gross domestic product [22]. In addition, they are the cause of most work absences (49.9% of all absences of > 3 days) and permanent disability from work (60%) [24].

Nowadays, there is growing evidence on the need to develop combined preventive strategies in the management of work-related shoulder pain. Physical, psychosocial and organizational aspects, including premature return to work, must be considered in their design [2,13,25]. In addition, some studies point to potential benefits of educational intervention focused on increasing workers' self-efficacy and empowerment through information [25,26].

This study aims to analyze the association between the existence of non-traumatic shoulder diseases, workers' knowledge of the risks associated with their jobs, and the preventive measures developed in their company, as well as the association with the ergonomic requirements.

MATERIAL AND METHODS

Design

An observational case-control pilot study was carried out on a population of productive age during 1 year, as part of medical consultations at the primary healthcare centre in the Health Department of Alicante, Spain.

Inclusion criteria

Cases: men and women aged 16–64 years, who consulted their GP for shoulder pain throughout the year at the Healthcare Center. The authors included the following diseases: fatigue and inflammation of tendinous sheaths, peritendinosus tissues, and tendon or its insertions in the shoulder (tendinitis, tendon rupture, subacromial syndrome), shoulder bursitis and joint pain of the shoulder. The following ICD-9-CM codes were included: 726.1, 726.10, 726.11, 726.12, 726.13, 726.19, 726.2, 719.01, 719.41, 719.61, 719.81, 719.91, and 840.3–840.6.

Controls: men and women, aged 16–64 years, who did not consult their GP for shoulder pain within the population served at the Healthcare Center. Exclusion criteria:

- age < 16 years or ≥ 65 years;
- diagnosis by direct trauma and arthritic origin in the shoulder;
- not carrying out any labor activity for at least a year preceding the study.

Variables

The variables analyzed in this study were as follows:

- Personal information, including gender, age and education.
- Workplace: the current position held, classified in terms of the occupation and economic activity; the hours of daily work referred to, as well as the weekly hours referred to.
- Knowledge of the prevention of occupational hazards in the workplace environment: information on risks, the use of personal protective equipment (PPE), the Occupational Risk Prevention Service (ORPS), risk assessment, the prevention plan, and periodic health surveillance.
- Ergonomic requirements of the position: awkward postures, the use and lifting of the arms, the working posture, a manual handling of loads, repetitive movements, the use of turning tools, striking surfaces and the use of physical force; the existence of rest pauses and their duration, monotonous work, and the possibility of temporary absences without being replaced.

Procedure

The authors obtained a total of 514 possible cases with shoulder diseases, of which 345 cases were included, with 690 participants constituting the final study population (including a total of 345 controls). The authors excluded 54 possible cases that did not meet the criterion of work activity, and 56 people that could not be contacted due a wrong or no contact telephone number being provided. A total of 53 people were not located after 3 repeated attempts on 3 different days. Finally, 5 possible cases expressed their reluctance to participate, and 1 case was eventually excluded due to an unrelated cause.

The data was obtained by a semi-structured survey (Appendix), conducted by telephone, and with an approximate duration of about 20–25 min/participant. After contacting the

subjects explaining the reason for the study and requesting their participation, the data was collected by a medical specialist in occupational medicine. The average response rate was 67.1%.

Statistical analysis

A descriptive analysis was carried out based on frequencies and percentages. The authors compared the case and control groups to each other, quantifying the magnitude of the association between qualitative variables by the χ^2-test and using the odds ratio (OR) with a 95% confidence interval (CI). Subsequently, a multivariate logistic regression analysis was performed to determine the independent effect of the explanatory variables that were statistically significant in the bivariate analysis. The level of statistical significance used in the hypothesis tests was $p < 0.05$.

Ethical considerations

All the participants were asked for their collaboration, having been informed of the reason for collecting data, and their informed consent to participate was obtained. The participants were also informed of the right to decide to terminate the interview at any time (the revocation of their consent), resulting in the immediate withdrawal of that questionnaire from the study and subsequent analyzes. The possibility of consent by representation was not admitted.

RESULTS

A total of 345 cases and 345 controls were studied. Fifty-eight percent of respondents were women, with a global mean age of 47.7 years (standard deviation [SD] = 12.2). The characteristics of the frequency of exposure in the cases and controls are shown in Tables 1–3.

At higher ages and lower educational levels, there was an increased risk of non-traumatic shoulder injuries, with an OR of 3.9 (95% CI: 2.8–5.3) being recorded for the primary or non-formal educational level. By occupations, the professional groups of cleaners, artisans, farmers and ranchers, mechanics, welders and industrial assemblers were more likely to suffer from shoulder diseases (Table 1). The greater use of awkward postures at work (OR = 6.8 [95% CI: 4–11.6]) and the raising of the arm above the shoulder showed a greater probability of presenting non-traumatic pathology of the shoulder. The cases that referred to performing repetitive movements at work presented a 5 times higher risk of shoulder pathology, compared to those that did not. Also, the monotonous work and the possibility of being temporarily absent from the position seem to increase the risk of shoulder pathology (Table 3).

A lower probability of non-traumatic shoulder injuries is associated with:

- male gender,
- working hours > 9 h/day or > 40 h/week,
- having information about the risks associated with the job,
- the use of PPE,
- the existence of ORPS and/or an evaluation of the risks associated with the workplace,
- the knowledge of the prevention plan and periodic medical examinations,
- the use of a single arm or physical force at work.

Therefore, all the variables analyzed were shown to be protective against presenting shoulder pathology with $p < 0.004$ (Tables 1–3).

In the multivariate analysis, it was observed that the risk of presenting the pathology increased with age: 51–65 years old, aOR = 3.0 (95% CI: 2.0–4.5) and a lower educational level: with primary or non-formal education, aOR = 2.7 (95% CI: 1.7–4.4), independently. Nevertheless, being informed of workplace risks is shown as an independent protective factor (aOR = 0.2 [95% CI: 0.1–0.3]), once adjusted to the remaining variables (Tables 1 and 2). The probability of presenting shoulder injuries was 3.5 times higher in those cases that maintained forced postures in the workplace. The use of repetitive gestures (aOR = 2.3 [95% CI: 1.3–4.1]), monotony (aOR = 2.0 [95% CI: 1.3–3.1]) and

Table 1. Analysis of the association between shoulder pathology and sociodemographic variables in the population assisted during 1 year in 1 primary healthcare center in Alicante, Spain

Variable	Participants (N = 690) [n (%)]		OR (95% CI)	p	aOR (95% CI)	p
	cases (N = 345)	controls (N = 345)				
Gender						
male	111 (32.2)	179 (51.9)	0.4 (0.3–0.6)	< 0.001	0.8 (0.4–1.4)	n.s.
female	234 (67.8)	166 (48.1)	1		1	
Age						
51–65 years	233 (67.5)	107 (31.0)	4.6 (3.3–6.4)	< 0.001	3.0 (2.0–4.5)	< 0.001
16–50 years	112 (32.5)	238 (69.0)	1		1	
Educational level						
no formal education/primary	187 (54.2)	81 (23.5)	3.9 (2.8–5.3)	< 0.001	2.7 (1.7–4.4)	< 0.001
secondary/vocational/higher education	158 (45.8)	264 (76.5)	1		1	
Economic activity						
construction, agriculture, livestock and fisheries	24 (7.0) (24)	32 (9.3)	1.4 (0.7–2.7)	n.s.	2.0 (0.5–7.9)	n.s.
trade and hospitality	42 (12.2)	44 (12.8)	1.8 (1.0–3.1)	0.045	2.0 (0.6–7.1)	n.s.
health and social services	29 (8.4)	47 (13.6)	1.1 (0.6–2.1)	n.s.	1.7 (0.3–9.3)	n.s.
transport and warehouse	29 (8.4)	26 (7.5)	2.1 (1.1–4.0)	0.027	2.5 (0.8–7.9)	0.128
cleaning	122 (35.4)	44 (12.8)	5.1 (3.1–8.5)	< 0.001	0.6 (0.1–3.3)	n.s.
services	30 (8.7)	50 (14.5)	1.1 (0.6–2.0)	n.s.	1.3 (0.4–3.9)	n.s.
industry	26 (7.5)	22 (6.4)	2.2 (1.1–4.3)	0.023	1.1 (0.3–4.4)	n.s.
administration, banking and insurance, teaching	43 (12.5)	80 (23.2)	1			
Occupation						
masons	19 (5.5)	25 (7.2)	2.4 (0.9–6.2)	0.079	0.5 (0.1–2.5)	n.s.
drivers	17 (4.9)	19 (5.5)	2.8 (1.0–7.5)	< 0.05	0.4 (0.1–2.0)	n.s.
healthcare personnel	25 (7.2)	39 (11.3)	2.0 (0.8–4.9)	0.134	0.8 (0.2–3.6)	n.s.
teachers	10 (2.9)	18 (5.2)	1.7 (0.6–5.1)	n.s.	1.0 (0.2–5.7)	n.s.
cleaners	134 (38.8)	54 (15.7)	7.7 (3.4–17.4)	< 0.001	0.8 (0.1–4.3)	n.s.
commercial	35 (10.1)	44 (12.8)	2.5 (1.0–5.9)	< 0.05	0.6 (0.2–2.1)	n.s.
administrative and managerial	45 (13.0)	70 (20.3)	2.0 (0.9–4.6)	0.105	0.7 (0.2–2.4)	n.s.
artisans, farmers and ranchers	23 (6.7)	15 (4.3)	4.8 (1.8–12.9)	< 0.05	0.4 (0.1–1.8)	n.s.
defense and security	5 (1.4)	10 (2.9)	1.5 (0.4–5.8)	n.s.	2.3 (0.3–15.8)	n.s.

Table 1. Analysis of the association between shoulder pathology and sociodemographic variables in the population assisted during 1 year in 1 primary healthcare center in Alicante, Spain – cont.

Variable	Participants (N = 690) [n (%)]		OR (95% CI)	p	aOR (95% CI)	p
	cases (N = 345)	controls (N = 345)				
Occupation – cont.						
mechanics, welders, industrial assemblers	23 (6.7)	23 (6.7)	3.1 (1.2–8.0)	< 0.05	1.0 (0.2–3.8)	n.s.
computer science, engineers	9 (2.6)	28 (8.1)	1		1	
Working time						
≥ 9 h/day	28 (8.1)	58 (16.8)	0.4 (0.2–0.7)	0.001	0.6 (0.2–2.7)	n.s.
8 h/day	170 (49.3)	157 (45.5)	0.9 (0.7–1.3)	n.s.	1.7 (0.6–4.4)	n.s.
≤ 7 h/day	147 (42.6)	130 (37.7)	1		1	
> 40 h/week	32 (9.3)	57 (16.5)	0.5 (0.3–0.8)	0.004	1.1 (0.3–4.4)	n.s.
40 h/week	170 (49.3)	164 (47.5)	0.9 (0.6–1.2)	n.s.	1.0 (0.4–2.7)	n.s.
< 40 h/week	143 (41.4)	124 (35.9)	1		1	

n.s.: $p > 0.200$.
aOR: gender, age, educational level, economic activity, occupation, working hours daily, working hours weekly, risk information, protective equipment, prevention service, risks evaluation, prevention plan, health surveillance, awkward postures, arm used, dominant arm, raising arm, strike surfaces, physical force, repeated postures, monotonous work, temporary absences.

Table 2. Analysis of the knowledge of workplace risks and prevention in the population assisted during 1 year in 1 primary healthcare center in Alicante, Spain

Variable	Participants (N = 690) [n (%)]		OR (95% CI)	p	aOR (95% CI)	p
	cases (N = 345)	controls (N = 345)				
Risk information						
yes	168 (48.7)	292 (84.6)	0.2 (0.1–0.2)	< 0.001	0.2 (0.1–0.3)	< 0.001
no	177 (51.3)	53 (15.4)	1		1	
Protective equipment						
yes	149 (43.2)	198 (57.4)	0.6 (0.4–0.8)	< 0.001	0.7 (0.4–1.2)	n.s.
no	196 (56.8)	147 (42.6)	1		1	
Prevention service						
yes	169 (49.0)	246 (71.3)	0.4 (0.3–0.5)	< 0.001	1.6 (0.8–3.2)	n.s.
no	176 (51.0)	99 (28.7)	1		1	

Table 2. Analysis of the knowledge of workplace risks and prevention in the population assisted during 1 year in 1 primary healthcare center in Alicante, Spain – cont.

Variable	Participants (N = 690) [n (%)]		OR (95% CI)	p	aOR (95% CI)	p
	cases (N = 345)	controls (N = 345)				
Risks evaluation						
yes	135 (39.1)	215 (62.3)	0.4 (0.3–0.5)	< 0.001	0.9 (0.4–2.2)	n.s.
no	210 (60.9)	130 (37.7)	1		1	
Prevention plan						
yes	134 (38.8)	221 (64.1)	0.4 (0.3–0.5)	< 0.001	1.0 (0.4–2.4)	n.s.
no	211 (61.2)	124 (35.9)	1		1	
Health surveillance						
yes	184 (53.3)	250 (72.5)	0.4 (0.3–0.6)	< 0.001	0.9 (0.5–1.6)	n.s.
no	161 (46.7)	95 (27.5)	1		1	

Explanations as in Table 1.

Table 3. Analysis of the association between shoulder pathology and the ergonomic requirements of the workplace in the population assisted during 1 year in 1 primary healthcare center in Alicante, Spain

Variable	Participants (N = 690) [n (%)]		OR (95% CI)	p	aOR (95% CI)	p
	cases (N = 345)	controls (N = 345)				
Awkward postures						
yes	327 (94.8)	251 (72.8)	6.8 (4–11,6)	< 0.001	3.5 (1.7–7.0)	< 0.001
no	18 (5.2)	94 (27.2)	1		1	
Arm used						
single arm	51 (14.8)	135 (39.1)	0.3 (0.2–0.4)	< 0.001	0.4 (0.2–0.6)	< 0.001
both arms	294 (85.2)	210 (60.95)	1		1	
Dominant arm						
right	333 (96.5)	324 (93.9)	1.8 (0.9–3.7)	n.s.	1.6 (0.6–3.9)	n.s.
left	12 (3.5)	21 (6.1)	1		1	
Raising arm						
yes	259 (75.1)	191 (55.4)	2.4 (1.7–3.3)	< 0.001	1.5 (0.9–2.6)	0.094
no	86 (24.9)	154 (44.6)	1		1	
Turning tools						
yes	60 (17.4)	59 (17.1)	1.0 (0.7–1.5)	n.s.	–	–
no	285 (82.6)	286 (82.9)	1			

Table 3. Analysis of the association between shoulder pathology and the ergonomic requirements of the workplace in the population assisted during 1 year in 1 primary healthcare center in Alicante, Spain – cont.

Variable	Participants (N = 690) [n (%)]		OR (95% CI)	p	aOR (95% CI)	p
	cases (N = 345)	controls (N = 345)				
Striking surfaces						
yes	44 (12.8)	62 (18.0)	0.7 (0.4–1.0)	0.057	1.0 (0.4–2.3)	n.s.
no	301 (87.2)	283 (82.0)	1		1	
Working posture						
seated	60 (17.4)	87 (25.2)	0.7 (0.5–1.0)	0.063	–	–
standing	132 (38.3)	106 (30.7)	1.2 (0.9–1.7)	n.s.		
switch and squatting positions	153 (44.35)	152 (44.1)	1			
Turning neck-spine						
yes	318 (92.2)	320 (92.8)	0.9 (0.5–1.6)	n.s.	–	–
no	27 (7.8)	25 (7.2)	1			
Load handling > 15 kg						
yes	105 (30.4)	104 (30.1)	1.0 (0.7–1.4)	n.s.	–	–
no	240 (69.6)	241 (69.9)	1			
Physical force						
yes	57 (16.5)	79 (22.9)	0.7 (0.4–1)	< 0.05	0.4 (0.2–0.9)	0.017
no	288 (83.5)	266 (77.1)	1		1	
Repeated gestures						
yes	315 (91.3)	234 (67.8)	5.0 (3.2–7.7)	< 0.001	2.3 (1.3–4.1)	0.004
no	30 (8.7)	111 (32.2)	1		1	
Monotonous work						
yes	153 (44.3)	92 (26.7)	2.2 (1.6–3)	< 0.001	2.0 (1.3–3.1)	0.002
no	192 (55.7)	253 (73.3)	1		1	
Rest breaks						
yes	303 (87.8)	310 (89.9)	0.8 (0.5–1.3)	n.s.	–	–
no	42 (12.2)	35 (10.1)	1			
Length of rest breaks						
< 30 min	162 (53.5)	113 (36.5)	2.0 (1.4–2.8)	< 0.001	–	–
≥ 30 min	141 (46.5)	197 (63.5)	1			
Temporary absences						
yes	236 (68.4)	191 (55.4)	1.7 (1.3–2.4)	< 0.001	1.6 (1.1–2.5)	0.027
no	109 (31.6)	154 (44.6)	1		1	

Explanations as in Table 1.

temporary absence from the position also acted as risk factors (aOR = 1.6 [95% CI: 1.1–2.5]), once adjusted to the other variables. However, using a single arm as well as physical force was found to constitute a protective effect for shoulder injuries (Table 3).

DISCUSSION

Two-thirds of the respondents reported that they had been informed of the occupational hazards related to their jobs. About 63% went to medical examinations periodically, but only 60% acknowledged the existence of ORPS in charge of carrying out such surveillance of their health. In accordance with European legislation, particularly that binding in Spain, there is a corporate obligation to inform and train the workers about the specific risks that affect their job, and the prevention and protection measures against them [27,28]. In addition, the International Labour Organization argues that ORPS should play an active role in this field [29]. They are supposed to increase workers' awareness of risks, thus contributing significantly to improved conditions in the workplace environment. Those workers that have been informed of the risks associated with their jobs are less likely to experience non-traumatic shoulder injuries. The other preventive measures analyzed were also shown to be protective against the development of pathology, although these associations disappeared when adjusted for the remaining variables.

Advanced age and low educational attainment are the characteristics that increase the risk of shoulder injuries. The remaining sociodemographic variables analyzed did not show an independent effect. The increased risk in patients > 50 years is consistent with what is expected for the general population, and also with the findings of other studies, since the incidence of the rotator cuff disease increases with age [9,11,30]. Regarding the level of studies, the findings presented in this paper are compatible with other investigations revealing that the lower the academic achievement, the greater the risk and the worse the prognosis of the lesion. This may be due to the fact that jobs involving a greater physical burden and less autonomy are usually carried out by workers with a lower level of education or can be explained by the adoption of inadequate coping styles to deal with the disease [11,31,32].

Being informed of workplace risks has been shown to be a protective factor against non-traumatic shoulder diseases, with workers reporting a 0.2 times lower risk of shoulder injuries. Comparing this study with others conducted in primary health care is complicated, especially if the focus is on prevention with an occupational approach. Furthermore, many analyses are performed in specific population groups, belonging to specific labor sectors, or from other countries with different production and occupational systems, and studying several upper limb musculoskeletal disorders [33–35].

The authors have found a limited number of investigations that evaluate the effectiveness of educational or informative interventions for the prevention of shoulder diseases, with great heterogeneity among them, and mixed results. The findings presented in the paper show positive effects of preventive interventions in the same direction as many of the studies [13,25,26,33,34]. However, these results differ from some other research, where the ergonomic and/or educational interventions in the workplace environment were ineffective in reducing shoulder pain and disability associated with pain [35,36]. However, these differences should be interpreted with caution because there are important methodological differences between studies that limit their comparability. In addition, several reviews developed in recent years have found a low quality of evidence, suggesting that more workplace research is needed, with a higher quality and homogeneity of criteria, in order to confirm the existing findings about the preventive management of the occupational shoulder pain [2,13,36].

Preventive actions focused on information and communication activities can seek changes at different levels: the knowledge and attitudes; behaviors and new skills; physi-

cal and/or social environment to prevent risks or promote health; and the health system [37,38]. In addition, information on occupational health and safety is key to achieving an integrated management of prevention; it is multidisciplinary in nature and essentially transversal to other preventive activities [37].

The bibliographical review on the informative interventions in occupational risk prevention shows that limited evidence is available [36,37]. However, because of the multifactorial origin of the shoulder pathology and its health consequences (mostly partially preventable), preventive strategies are widely justified [25]. It is recommended to combine physical, psychological and organizational strategies [13,25,39,40]. Intervention focused on education/information can potentially reduce risk factors through changes in workers' behavior [25,41]. Furthermore, some studies point to the potential benefits of educational intervention focused on increasing workers' self-efficacy and empowerment, through inducing changes in their behaviors [25,26].

Awkward postures appear as an important risk factor according to the literature [9,25,42,43], and so do repetitive movements [17,42]. However, no evidence has been found detailing a dose-response relationship between specific tasks and the development of specific pathologies [25,44]. Regarding the variable possibility of temporary absence from the workplace without having to be replaced (aOR = 1.6 [1.1–2.5]), a possible limitation in the interpretation of the result is that, when asking, it was not specified whether the absences were for taking breaks, or to start other tasks due to the needs of the company. Exposure to monotonous work has been studied as a psychosocial risk factor [45]. Some authors have suggested how these factors could act in the appearance and perpetuation of upper limb pain. Poor psychosocial conditions could lead to physical overload (such as an increase in the frequencies and duration of the exposure). However, another possible explanation would be that high work demands lead to the development of stress symptoms and physical responses that involve musculoskeletal symptoms [46,47].

The fact that the use of a single arm and the requirement of physical force act as protective factors may seem at first sight an opposite result to what is expected, finding even some evidence to the contrary [42]. A possible explanation would be that the tasks where a single arm is used are those that generally require lower intensity both in terms of postures and load handling. Otherwise, the fact that physical force at work acts as a protective factor could be modulated by the use of tools or other mechanical aids to carry out the tasks associated with positions with higher requirements. However, more studies would be needed to confirm these findings.

As for the limitations of this study, they are typical of this type of design. The first limitation refers to the difficulty of forming an adequate control group. Although it has been obtained from the same population that visits the primary healthcare center for other reasons and during the same period of time, the authors had to assume that it formed an adequate group of comparison, but it could imply biases that are difficult to measure. Also, collecting information on the exposure retrospectively to the presence of the disease involves obtaining data reported by the participants based on their memory. This is difficult to validate, as well as influences the responses, in the sense of recalling the cases to a greater extent than the controls, although the degree of exposure could be the same. However, the mean response rate was close to 70%, i.e., higher than that obtained in other studies investigating musculoskeletal pathology of the upper limb through questionnaires [4,39]. Other limitations of the study are the possible diagnostic coding errors in the cases treated, as a result of which some relevant cases may have not been taken into account. There are also limitations inherent in the survey itself, as there have been no documented antecedents such as sports injuries/hobbies involving the use of shoulders, or housework, which could be directly related to the origin of shoulder pain independently of a work association.

CONCLUSIONS

In conclusion, this study shows that having information on both the ergonomic requirements and how to prevent the risks associated with workplace requirements is a useful tool for the prevention of non-traumatic shoulder diseases. Preventive policies that include intervention based on health education at the workplace could benefit from its cross-sectional action to the rest of preventive activities that could be developed.

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Appendix. Questionnaire used for data collection in the population assisted during 1 year in 1 primary healthcare center in Alicante, Spain

Case/control number:

Personal information:

Age .....
Gender
☐ male
☐ female

Education:
☐ no formal education
☐ primary
☐ secondary
☐ vocational
☐ higher education

Workplace:

Current position held
Economic activity
☐ construction
☐ agriculture
☐ livestock and fisheries
☐ trade and hospitality
☐ health and social services
☐ transport and warehouse
☐ cleaning
☐ services
☐ industry
☐ administration, banking and insurance
☐ teaching

Occupation
☐ masons
☐ drivers
☐ healthcare personnel
☐ teachers
☐ cleaners
☐ commercial
☐ administrative and managerial
☐ artisans, farmers and ranchers
☐ defense and security
☐ mechanics, welders, industrial assemblers
☐ computer science, engineers

How many hours do you work?
daily .....
weekly .....

Have you been informed of the risk associated with your job?
☐ yes
☐ no

Do you use personal protective equipment? (gloves, safety footwear, masks, work clothes etc.)
☐ yes specify .....
☐ no

Do you have an Occupational Risk Prevention Service?
☐ yes
☐ no

Is there an assessment of occupational risks?
☐ yes
☐ no

Is there a prevention plan?
☐ yes
☐ no

Have you done health surveillance in your work?
☐ yes
☐ no

Ergonomic requirements of the position:

Does your workplace require adopting awkward postures?
☐ yes
☐ no

What arm do you use in your work?
☐ right
☐ left
Dominant arm?
☐ right-handed
☐ left-handed
Is it necessary to raise the arms above the shoulder line?
☐ yes, the right
☐ yes, the left
☐ yes, both of them
☐ no
Do you use turning tools (drills, sanders…)?
☐ yes
☐ no
Do you strike surfaces in your work (hammer)?
☐ yes
☐ no
Do you work standing or sitting?
☐ seated
☐ stand
☐ switch
☐ squatting positions
Do you bend or twist your neck or spine in your work?
☐ yes, the neck
☐ yes, the spine
☐ yes, both of them
☐ none
Is it necessary to handle loads of > 15 kg at your workplace?
☐ yes
☐ no
Approximate weight: .....
Does it require the use of great physical force (screw, tighten with a metal key)?
☐ yes
☐ no
Do you perform repetitive movements? (cycles < 5 min)
☐ yes
☐ no
Do you think your work is monotonous?
☐ yes
☐ no
Is there a possibility of taking rest breaks during the workday?
☐ yes
☐ no
Number of breaks and duration .....
Is there a possibility of being temporarily absent from the position without being replaced?
☐ yes
☐ no