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Prevalence of musculoskeletal problems in laboratory technicians

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Prevalence of musculoskeletal problems in laboratory technicians

Mª Jesús López-González *, Silvia González and Eva González-Menéndez

Escuela Superior de Ingeniería y Tecnología (ESIT), Universidad Internacional de la Rioja (UNIR), España.

*Corresponding author: Mª Jesús López-González, mjesus.lopez@unir.net. https://orcid.org/0000-0002-1368-0549.

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The authors declare that they have no conflict of interest associated with this publication and they will not provide access to the study data. All authors contributed equally to the conception and design of the research, to the analysis of the data, and to the writing of the final version of the manuscript.

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Abstract

Purpose: The aim of this work was to analyze the prevalence of work-related musculoskeletal symptoms in laboratory technicians and their relation to personal and organizational factors, as well as the lack of specific training on work-related risks.

Methods: A Standardized Nordic Questionnaire made for the Spanish population and a survey of sociodemographic variables and organizational aspects were applied on a sample of 460 Spanish laboratory technicians. The statistical analysis was done through the R program.

Results: The 84.5% of the sample studied has presented some musculoskeletal discomfort, with a higher percentage in women. The probability of having discomforts was 8 times higher for those older than 46 years and the most affected part of the body was the neck. The variables that were associated more significantly with the probability to suffer discomfort in the most affected parts of the body (neck, right shoulder and right wrist) were: gender, education level, prevention knowledge and seniority.

Conclusions: Due to this, it is necessary to implement plans to train in the specific risks according to the activities done by these professionals.

Keywords: Laboratory technicians, musculoskeletal disorders, Standardized Nordic Musculoskeletal Questionnaire, prevalence, ergonomics

1. Introduction

Musculoskeletal disorders (MSDs) are the main health problem related to work that affects men just as much as women of any age all over the world and in all sectors of activity. Reasonable evidence exists that the risk factors associated with work-related MSDs are mainly: excessive repetition, awkward postures, and heavy lifting [1].

In Europe, the results of the *6ª European Working Conditions Survey* (6ª EWCS), indicated that 61% of the European workers find themselves exposed to repetitive hand- arm movements and 43% to painful and tiring positions [2]. On the other hand, the second European Survey of Enterprises on New and Emerging Risks

(ESENER-2), shows as the most frequent risk factors, in second and third place, awkward or exhausting postures (56%) and repetitive movements of hands and arms (52%), being the awkward postures, the main risk factor in the health sector (61%) and scientific technician services (64%) [3].

The national survey of work conditions in Spain, defined in the *6ª* EWCS [4], coincides in pointing out these as the principle risk factors and specifically, within the health sector, shows that 67% of the workers find themselves exposed to painful or tiresome postures for more than a quarter of a work day. In addition, the annual report of the Observatory of Occupational Diseases (CEPROSS) and of Illnesses caused or worsened by work (PANOTRATSS) indicates that 59% of the illnesses reported by professionals in Spain have been provoked by awkward postures, repetitive movements at work, and fatigue and inflammation of the tendon sheaths, peritoneum tissue, and insertion of muscles and tendons 31% relate with nerves paralysis due to the strain [5].

In the health field, there are many studies that prove the prevalence of work-related MSDs, and that show the most relevant parts of the body affected depending on the activity carried out [6,7]. While in physical therapists the lumbar zone is more prone to MSDs with a 44%, in hospital nurses, this situation is almost duplicated to 80-85%. Nevertheless, a study centred on sterilization personnel, shows that the neck is the part of the body most affected with 71.7% [8,9]. This, points out the necessity to perform specific studies in each sector of activity that could bring scientific evidence to adopt efficient preventive measures to overcome this type of risk. In regard to this, there are few studies that analyze the prevalence of MSDs in laboratory technician personnel and the preventive actions are based basically in studies of other health professionals. The work of a laboratory technician is largely associated with the adoption of awkward and static postures due to lack of space, inadequate adjustment of working areas,

microscope use, specific requirements of predetermined procedures in extraction cabins, cell counting, etc [10,11]. The repetitive movements are also present in the routine work of a laboratory technician such as the continuous use of pipets and a microtome, the opening, closing, and filling of test tubes, sample manipulation, etc. This being the main work-related factors that lead to the development of MSDs [12,13]. It should also be taken into account the number of daily hours spent working with screens that contribute to an increase in the exposure of these risks.

A study performed on laboratory technicians in India showed that 69.9% of the technicians had suffered from some sort of musculoskeletal pain in the last 12 months, the back being the most prevalent part of the body (44%) [14]. Another similar study established that the prevalence of work-related MSDs in medical laboratory personnel is 73.3% [15]. The same authors, through a revision of the already existing studies on this topic, concluded that few studies existed and with prevalence variable between 40 and 60%, which it makes necessary to continue discovering more on this topic.

The prevention of MSDs means a great benefit for all the workers and for the society in conjunction in terms of health, performance, and by-product costs, direct and indirect. In this sense, the 31/1995 law in Spain, which puts the European Directive 89/391/CEE [16], points out as a preventive key tool, indispensable and mandatory, the specific training of the risks that the workers are exposed to, in their work place. Nevertheless, there are many occasions in which these training processes, lack of important information that leads to less efficient prevention [17]. The experience has shown that to consolidate an authentic preventive culture, implies integrating the occupational safety and health (OSH) in the schools, adjusting the curriculum content of the education system, to the reality of the working environment [18]. In this context, the Spanish educational system has recently incorporated in its curriculum of the cycles of

the Professional Formation (PF) in the health system, contents related with the "Analysis of risks tied to the ergonomic and psychosocial conditions," within the Module of Labor Formation and Orientation (LFO) [19] .

However, it is complicated to evaluate the real impact and the adequacy of the training in occupational risk prevention (ORP) that has been carried out until now. A study done by the Community of Madrid, pointed to the importance of evaluating the training processes to be able to improve the future actions and the need to strengthen the practical character of the training to obtain the greatest awareness and changes in the culture that reinforces the objective attitudes towards the prevention [20].

In this context, the main objective of this work has been to carry out a study at a national level in Spain that analyzes the prevalence of work-related musculoskeletal symptoms in laboratory technicians and establish possible relations with personal factors as age, gender, education level, etc. and organizational such as seniority and weekly hours in the laboratory, etc.

The second objective was established to analyze the possible existing relationship between the lack of specific training in terms of ergonomics in these professionals, with the prevalence to suffer work-related musculoskeletal symptoms. It was not expected in this study to carry out a thorough analysis at the level of specific training of workers, but to analyze generally if there was a significant relationship, which would support further studies in this regard.

2. Materials and Methods

2.1 Sample

The study was applied to the group of laboratory technicians in the Spanish population belonging to different work environments, health, microbiology, clinical, chemical, etc.

The necessary minimum sample size was calculated to estimate the prevalence of discomfort in the population and to study the relation between suffering discomfort based on having received or not training in ORP. For that, a pilot sample of 30 was taken, the percentage of discomfort was measured as well as the correspondents of training and no training.

Considering a confidence level of 95%, a strength of 80%, and a loss adjustment of 10%, it was estimated that it was necessary to have 140 individuals in each group for the first case and 146 individuals for the second case. The maximum of the two calculations described above was taken as n.

The sample was obtained in two ways: from The Spanish Association of Laboratory Technicians (AETEL), reaching all technicians associated with it; and through contact with private companies. An exclusion criteria was applied to those technicians with musculoskeletal condition or with existing muscle ailments previous to their incorporation to their work as a laboratory technician; in order to do this, there was a question included in the questionnaire related to these criteria.

2.2 Questionnaire

A descriptive and transversal epidemiological study was conducted using the Nordic Standardized Questionnaire procedure [21], validated in the Spanish population, for the detection and analysis of musculoskeletal symptoms [22]. To characterize the sample and establish risk factors of the study, it was complemented with a questionnaire of 13 questions, which included on the one hand sociodemographic variables such as age, gender, weight, height, educational level, etc., and on the other hand, organizational aspects such as time of work, regular working position, level of specific training in ORP, seniority of the lab technicians, etc.

The prevalence of musculoskeletal discomforts was analyzed through the questions in the Nordic Standardized Questionnaire that covers different parts of the body: neck, shoulder, elbow, wrist, and dorsal zone. Also, information was obtained on the perception that workers have on the causes associated with said discomforts.

The complete questionnaire was created through an online platform for online surveys facilitating its distribution and completion. The procedure and objectives of the study were explained in detail to the participants via electronic mail, it provided the link to access the questionnaire and they were able to be complete it online with any electronic tool. The email addresses were managed only by AETEL or by the personnel in charge of the businesses, preserving the complete anonymity of the participants. The answers to the questionnaires were captured directly into the platform without access to any data that could identify the participant answering the questionnaire. Additionally, the first page of the platform contained the informed consent of the participants of this study.

2.3 Statistical Analysis

A descriptive analysis was carried out by providing absolute and relative frequency distributions. The relationship of the questions of "Characterization of the sample" with having discomfort was analyzed using a Chi Squared test of Pearson (χ^2) or the Fisher test, depending on the acceptance or rejection of the hypothesis on the expected frequencies.

A model of multiple binary logistic regression was built, including, predictable variables which had significance levels of less than 0.20 in the previous analysis. Thereafter, a selection algorithm was applied step by step for simplification of the model.

153 The statistical analysis was done through the R program (R Development Core
154 Team), version 3.4.3. (Foundation for Statistical Computing, Austria).

155 **3. Results**

156 ***3.1 Descriptive analysis***

157 A total of 460 laboratory technicians belonging to various sectors of the profession
158 participated in this study, of which we considered 362 to be valid cases (78.70%), after
159 eliminating those subjects who showed congenital muscular complaints or who had
160 suffered them before beginning their profession as laboratory technician.
161 The sample meets the initially required parameter of having a minimum number
162 of subjects, which allowed for the estimation of the prevalence of musculoskeletal
163 symptoms in the population of the study, and the relation of suffering from discomforts
164 depending on having received or not training in ORP.
165 The socio-demographic and organizational variables considered for the study are
166 shown in Table 1 and 2. The highest percentage of the technicians is represented by
167 people between the ages of 26 and 45 years (68.8%), non-smokers (82.6%), mainly the
168 female gender (81.8%) and with an educational level of Trade School (73.5%).
169 *[Table 1 here]*
170 *[Table 2 here]*
171 On the other hand, the majority of the technicians indicated to have been in the
172 profession for longer than 5 years (64.1%) and working more than 20 hours weekly in
173 the activities related to the laboratory (69.6%). Only 58.8% of the participants indicated
174 having received specific training in ORP related to the task of laboratory technician.
175 The analysis of the prevalence of musculoskeletal discomforts in the sample of
176 362 subjects had the following results: 84.5% of the participants showed some muscular

ache, 64.36% showed muscular discomforts in two or more regions of their body at the same time, as well as 35.08% in the neck and the right shoulder at the same time.

The most affected body parts in the last twelve months were neck (51.1%), dorsal-lumbar area (41.7%), right shoulder (33.40%), and wrist (29%).

The average score given by the participants was of 2.95±1.02 for neck pain, 2.97±1.10 for the dorsal-lumbar area, 2.81±1.11 for shoulder and 2.55±1.30 for wrist discomforts.

Figure 1 shows the percentage of people who show symptoms for each part of the body studied during different time periods, the neck being the most affected area in all cases.

[Figure 1 here]

3.2 Relationship between musculoskeletal symptoms and socio-demographic and organizational variables

Through χ^2 test or Fisher's exact test, the existing relation between "discomforts" and the socio-demographic and organizational variables considered for the characterization of our sample, were clearly shown.

There exists a significant relation with age, gender, height, dominant hand, ORP specific training and work seniority doing laboratory technician specific tasks (Table 3, shows the data according to the variables which have shown a significant association).

[Table 3 here]

As far as the variable of gender, 86.82% of women presented muscular symptoms, compared to 13.18% who did not suffer any; while the percentage of men with symptoms is lower at 74.24% compared to 25.76% who suffered no aches at all. In the same manner, data referring to the dominant hand show a major prevalence in people who are right handed as opposed to left handed. As far as age is concerned,

74.19% of the technicians younger than 25 years, showed musculoskeletal symptoms, when compared to 25.81% who showed no aches at all. On the other hand, it highlights the percentage of technicians who, even with specific training in OPR, present symptoms, 80.75%, compared to those who don't suffer from them, 19.25%.

3.3 Relationship between musculoskeletal symptoms by body parts and socio-demographic and organizational variables

All of the possible associations in the characterization of the sample variables were analyzed in the same manner, with the different discomforts by body part (neck, shoulders, wrists, elbows etc.) The most relevant associations were found in neck, shoulder and right wrist, as shown in Tables 4, 5 and 6. Although the dorsal-lumbar area showed a high prevalence of discomforts, no significant relationship was found with the study variables.

[Table 4 here]

Regarding neck discomforts, they presented a significant association with gender, educational level and seniority (Table 4). Women continue to show a higher level of prevalence than men, as do the people who have worked longer as laboratory technicians. The percentage of technicians who have suffered from discomforts for longer than three years was much higher than the percentage of technicians who suffer from no discomforts at all. On the other hand, people with an educational Trade School level, were found to be those who suffer from muscular symptoms the most (66.54% versus 33.46%).

The discomforts associated with the right shoulder were significantly associated with the gender variable, dominant hand, educational level, specific training in ORP, seniority and weekly work hours in the laboratory (Table 5).

[Table 5 here]

In this case, the percentage of technicians who had received specific training in ORP and suffered from muscular discomforts (34.74%) was much lower than the percentage of technicians who did not suffer any (65.26%).

Regarding the weekly hours of work in the laboratory, it was observed that the less hours of work, the lower the percentage of technicians who suffered from discomforts when compared to those who did not suffer them at all.

The dominant hand, educational level and specific training in ORP showed significant associations with right wrist discomforts (Table 6). The analysis of the contingency table pointed in the same direction as those described above.

[Table 6 here]

3.4 Multivariate model

To perform an analysis using the multiple binary logistic regression model, the upper categories of the age variable and the lower categories of the seniority variable were grouped together, and the variable for specific training in ORP was converted to binary (No versus Yes).

It was found that the four variables which are most significantly associated with the probability of suffering discomforts were: age, gender, the most usual work position and specific training in ORP.

Table 7 shows the significance of the Wald test, the exponential of the coefficients or odds ratio (*OR*), as well as the confidence intervals associated to 95%.

[Table 7 here]

The probability of having discomforts for those older than 46 years of age was significantly higher than for those younger than 25 years, specifically 8 times more likely (*OR* = 8.35), as deduced from Table 7.

Regarding gender, significant differences were observed, women being two times more likely to suffer discomforts than men (*OR* = 2.09). As for the ORP specific training, we have observed it as a protective factor (*OR* = 0.52 < 1), since the probability of having discomforts was reduced by half in those persons trained when compared to those who are not formally trained. Finally, the habitual position of work also influenced significantly, the sitting position being the one which increased the probability of having discomfort, almost double that of working while standing (*OR* = 1.97).

The same analysis focused only on neck symptoms, detected that the variables significantly related were gender, educational level and seniority, although work position remained in the final model for reaching a near significance in the significance levels (Table 7).

Once again, women had double the risk of suffering from neck discomforts when compared to men, and a sitting position increased the probability of having discomforts. Having an educational level of bachelor´s or master´s degree decreased in half the fact of having neck discomforts in respect to having a level of Trade School or Secondary School diploma. Lastly, differences were noticed between the higher categories of seniority and having worked as a laboratory technician for less than three years, doubling the risk of having discomforts for those with the most seniority.

In the case of discomforts in the right shoulder, the variables associated in a significant way were gender, educational level, specific training in ORP and seniority (Table 8).

[Table 8 here]

The values of *OR*, showed that the female gender and the seniority in the job increased the probability of suffering from discomforts in the right shoulder at double

the rate, while having an educational level of a bachelor´s or master´s degrees, or having specific training in ORP decreased the probability approximately by half.

Lastly, the variables which were associated in a significant way to the aches in the right wrist were once again, the educational level, the specific training in ORP and the seniority (Table 8), pointing in the same direction as the ones above.

4. Discussion

The objective of this study was to analyze the prevalence of work-related musculoskeletal symptoms in professionals who perform laboratory technician activities, and to analyze how certain personal and organizational factors have a significant influence.

Our results confirm that a great majority of the sample we analyzed had some kind of muscular discomfort (84.5%). It also indicates that 35.08% of the subjects in the study showed affections in the neck and right shoulder at the same time, which indicates the prevalence of musculoskeletal symptoms among the population of laboratory technicians in Spain is very high. The percentage is similar to the one found by Ramadan and Ferreira (86.7%) [23].

The most affected body part was the neck with a 51.1% of people with discomforts in the last twelve months, followed by the dorsal-lumbar area (41.7%), the right shoulder (33.4%) and the wrist (29%), with similar results to those found in a study done among users of microscopes [24], although a bit higher in shoulder and wrist complaints.

The main causes which workers associated with those discomforts were awkward postures and repetitive movements, mainly given to the tasks performed involving safety cabinets, the inefficient ergonomic design of working surfaces, the use

of micropipettes, microscopes, microtomes and the use of a computer [25]. The results were very much in accord with ones shown in Arora et al. [11] and Agrawal et al. [17].

The multivariate model showed that the personal and organizational variables which relate most significantly with the probability of suffering from musculoskeletal discomforts are gender, age, specific training in ORP and habitual work posture. However, when the study was focused on the parts of the body most affected, the educational level and the seniority at their job were shown to have a more significant relation, to the detriment of the age and habitual work posture.

As far as gender is concerned, women showed double the probability of suffering from musculoskeletal symptoms (*OR* = 2.09) in comparison with men, in a general way as much as in the neck (*OR* = 2.27) and the shoulder (*OR* = 2.11). These results can be influenced by the fact that the majority of the sample was represented by women. Many of the studies related to MSDs, have a high percentage of women, given the large presence of the gender in this profession. The percentage of women in our study was similar to the ones shown in the studies by Agrawal et al. [17] and Maulik et al. [15], and according to other publications which show the difference in gender in relation to the prevalence of suffering MSDs [26,27]. Regarding age, the probability of having discomforts was 8 times higher for those older than 46 years (*OR* = 8.35), however, there was no significant association with specific neck, right shoulder and right wrist symptoms. This result could be linked to the degenerative process due to aging, such as the wearing down of the intervertebral discs or the loss of muscular mass which contribute to the emergence of musculoskeletal discomforts [28]. Nevertheless, a significant association between age and discomforts was found, showing that 74.19% of the laboratory technicians who are younger than 25 years, showed musculoskeletal symptoms, against 25.81% who demonstrated not symptoms at all (Table 3). It could

be hypothesized that there is a relation between musculoskeletal discomforts and the specific job of younger technicians, independently of those effects mentioned above which are due to natural aging factors. This gives support to the results found by Fritzsche et al. [25] and Cromie et al. [29], which underscores the need to deepen the studies to associate these discomforts, not only to those who are older in age, but also to those who are younger.

If we focus on the variable: habitual work posture, the multivariate analysis suggests that the probability of having discomforts is almost double (*OR* = 1.97) when the worker is sitting instead of standing and the results are close to showing significant relationship between sitting posture and neck pain (Table 7). Although the most usual work position in the laboratory is standing (54.97% standing compared to 45.03% sitting), tasks most related to awkward and sustained postures and repetitive movements (safety cabinets, microscope, microtome, etc.) are mostly performed in a sitting position. This, together with the time they dedicate to working with PVD, is the main cause of the result obtained. In this sense, there are studies that show that physical demands involving awkward and sustained postures were most frequent and strongly associated with reported MSDs [15,30,31]. Other studies show evidence of the significant relationship between neck pain and sitting posture [32], which support the results obtained.

Having received specific training in ORP related to the specific tasks performed as a laboratory technician is not only significantly associated with the variable of having musculoskeletal discomforts in general but also to symptoms in the right shoulder and right wrist, representing in all cases a protective factor which lowers approximately by half, the probability of developing musculoskeletal discomforts. The results were very much in accordance with those stablished by Pedersen [33] and Shuai [34]. On the other

hand, there was also a significant association between age and specific training in ORP (data no included), showing that older technicians had received less training. This confirms the need to implement specific risk training plans in accordance with the specific tasks carried out by these professionals.

The educational level turned out to be another protective factor against suffering discomforts in the neck, right shoulder and right wrist (Tables 7, 8). In the previous analysis a significant association between the educational level and the weekly hours dedicated to laboratory work (data not included) was shown. People who had a higher educational level worked fewer hours in the laboratory than people who had a trade school level (85.14% of technicians who worked more than 30 weekly hours in the laboratory had a trade school level), that could contribute to a decrease in risk exposure and consequently being the cause for the less prevalence of muscular aches in people who had a higher educational level.

Lastly, the results showed a significant association with seniority, the chances of having discomforts increased as the time in the job also increased. This association coincides with the results of other studies [12], in which the probability increases by as much as five times starting with the year 11 of seniority in the job, which clearly evidences the important relation between the years in the job and the presence of discomforts.

The results obtained in the present study highlight the need to introduce preventive measures mainly oriented at organizational aspects and design of the workplace. The development of specific training plans in aspects related to the adoption of awkward postures and repetitive movements seems to be one of the key points to consider. Programs for establishing pauses and muscle exercises during the daily working period, can be important measures in the prevention of MSDs. Special

attention should be paid to those with a previous history of muscle pathologies because they are more sensitive to risk exposure as well as to those workers with a lower educational level since they spend the most time in the laboratory.

Regarding design aspects, we estimate, based on the responses of the participants, that the most critical jobs are those related with the use of microscope, safety cabinets, and computer and pipetting tasks, due to working heights, lack of support for arms or feet and use of inappropriate chairs. Figure 2 presents examples of awkward postures related to laboratory work.

[Figure 2 here]

Applying ergonomic modifications in the laboratory environment based in UNE-EN 14056: Laboratory furniture - Recommendations for design and installation [35], and UNE-EN 13150: Workbenches for laboratories. Dimensions, safety requirements and test methods, can significantly reduce ergonomic hazards [36].

The limitations of the present study are mainly related to the way the questionnaire was distributed to the participants. Using an online platform makes it impossible to know each workstation, which has prevented us from establishing more specific prevention measures, so only the general lines of action have been provided. In the same way, although the procedures and objectives of the study were explained in detail to the participants via electronic mail, the option of solving the doubts that arise at the moment of answering the questionnaire is null.

5. Conclusions

This study showed the high prevalence of musculoskeletal discomforts among laboratory technicians in the Spanish population and its relationship with personal and organizational variables. Not only was an increase in the occurrence of discomforts in

relation to variables such as: being a woman or seniority at the job found but also among younger technicians. The parts of the body most affected and which showed a significant relationship with the study variables were the neck and the right shoulder. The specific training in ORP and the educational level were shown as protective factors which lowered the prevalence of symptoms.

In this way the application of a validated Questionnaire of musculoskeletal symptoms, has made it possible to carry out an analysis of its presence in this specific sector, in an individual as well as in a collective level, so as to make it possible to take useful preventive actions.

It is necessary to deepen the study of the existing training programs to better the level of implementation and their effectiveness, as well as analyzing other factors (psychosocial and biomechanical) which allow to design specific preventive measures which lower the risks to which laboratory technicians are exposed.

Conflict of Interest

The authors declare that they have no conflict of interest associated with this publication and they will not provide access to the study data. All authors contributed equally to the conception and design of the research, to the analysis of the data, and to the writing of the final version of the manuscript.

Compliance with Ethical Standards

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Informed consent was obtained from all individual participants included in the study.

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549 **Figures**

550 Figure 1. Frequency of reported musculoskeletal disorders in different body parts
551 during: (a) rarely; (b) the 12 months prior to the study (grey bars) and the 7 prior days
552 (black bars). Note: MSDs = musculoskeletal disorders.

553 Figure 2: Examples of awkward postures: (a) while microscope and pipetting tasks; (b)
554 in safety cabinets.

555 **Tables**

556 Table 1. Socio-demographic characteristics of laboratory technicians.

557 Table 2. Occupational characteristics of laboratory technicians.

558 Table 3. Associations between socio-demographic and occupational variables and
559 reported musculoskeletal symptoms among the participants (N=362).

560 Table 4. Associations between socio-demographic and occupational variables and
561 reported musculoskeletal neck symptoms (N=362).

562 Table 5. Associations between socio-demographic and occupational variables and
563 reported musculoskeletal right shoulder symptoms (N=362).

564 Table 6. Associations between socio-demographic and occupational variables and
565 reported musculoskeletal right wrist symptoms (N=362).

566 Table 7. Multivariate analysis for musculoskeletal general and neck symptoms.

567 Table 8. Multivariate analysis for right shoulder and wrist symptoms.

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Table 1. Socio-demographic characteristics of laboratory technicians.

Variable	n	%
Age (years)		
≤ 25	31	8.6
26-35	147	40.6
36-45	102	28.2
46-55	64	17.7
≥ 56	18	5.0
Gender		
Male	66	18.2
Female	296	81.8
Weight (Kg)		
≤ 45	6	1.7
46-60	139	38.4
61-80	165	45.6
81-95	46	12.7
≥ 96	6	1.7
Height (cm)		
≤ 150	8	2.2
151-165	184	50.8
166-175	132	36.5
176-190	36	9.9
≥ 191	2	0.6
Dominant hand		
Right	324	89.5
Left	31	8.6
Both	7	1.9
Education level		
Secondary school	4	1.1
Trade School basic	5	1.4
Trade school advanced	266	73.5
Bachelor	68	18.8
Doctorate	19	5.2
Smoker (cigarettes/day)		
0	239	66.0
0 but ex-smoker	60	16.6
<10	43	11.9
10-20	18	5.0
>20	2	0.6
Muscular ailments congenital or previous		
Yes	98	21.30
No	362	78.70

Table 2. Occupational characteristics of laboratory technicians.

Variable	n	%
Workplace		
Private lab.	91	25.1
Hospital	170	47.0
Research	101	27.9
Other	33	9.1
Work experience (years)		
< 1	36	9.9
1-3	53	14.6
4-5	41	11.3
6-10	67	18.5
> 10	165	45.6
Lab. working hours (h/week)		
0	9	2.5
< 10	29	8.0
10-20	72	19.9
21-30	104	28.7
> 30	148	40.9
Computer working hours (h/week)		
0	4	1.1
< 10	154	42.5
10-20	156	43.1
21-30	28	7.7
> 30	20	5.5
Usual working posture		
Standing	199	55.0
Sitting	163	45.0
ORP specific training		
Yes	213	58.8
Not specific but general	127	35.1
No training at all	22	6.1

Note: Lab = laboratory; ORP = occupational risks prevention.

Table 3. Associations between socio-demographic and occupational variables and reported musculoskeletal symptoms among the participants (N=362).

	Musculoskeletal symptoms				
	Yes		No		
Variable	n	%	n	%	p
Age (years)					0.005
<25	23	74.19	8	25.81	
26-35	119	80.95	28	19.05	
36-45	85	83.33	17	16.67	
46-55	62	96.88	2	3.12	
>56	17	94.44	1	5.56	
Gender					0.018
Male	49	74.24	17	25.76	
Female	257	86.82	39	13.18	
Height (cm)					0.011
<150	5	62.50	3	37.50	
151-165	159	86.41	25	13.59	
166-175	116	87.88	16	12.12	
176-190	25	69.44	11	30.56	
>191	1	50.00	1	50.00	
Dominant hand					0.034
Both	6	85.71	1	14.29	
Right	279	86.11	45	13.89	
Left	21	67.74	10	32.26	
ORP specific training					0.002
Yes	172	80.75	41	19.25	
No, but in general, yes	118	92.91	9	7.09	
Neither	16	72.73	6	27.27	
Work experience (years)					0.009
<1	26	72.22	10	27.78	
1-3	40	75.47	13	24.53	
4-5	32	78.05	9	21.95	
6-10	60	89.55	7	10.45	
>10	148	89.70	17	10.30	

Note: ORP = occupational risks prevention.

Table 4. Associations between socio-demographic and occupational variables and reported musculoskeletal neck symptoms (N = 362).

	Musculoskeletal neck symptoms				
	Yes		No		
Variable	n	%	n	%	p
Gender					0.003
Male	30	45.45	36	54.55	
Female	195	65.88	101	34.12	
Education level					0.027
Secondary school	3	75	1	25	
Trade school basic	2	40	3	60	
Trade school advanced	177	66.54	89	33.46	
Bachelor	32	47.06	36	52.94	
Doctorate	11	57.89	8	42.11	
Work experience					0.003
<1	13	36.11	23	63.89	
1-3	28	52.83	25	47.17	
4-5	27	65.85	14	34.15	
6-10	47	70.15	20	29.85	
>10	110	66.67	55	33.33	

Table 5. Associations between socio-demographic and occupational variables and reported musculoskeletal right shoulder symptoms (N = 362).

	Musculoskeletal right shoulder symptoms				
	Yes		No		
Variable	n	%	n	%	p
Gender					0.01
Male	17	25.76	49	74.24	
Female	130	43.92	166	56.08	
Dominant hand					0.032
Both	3	42.86	4	57.14	
Right	138	42.59	186	57.41	
Left	6	19.35	25	80.65	
Education level					0.008
Secondary school	2	50	2	50	
Trade school basic	0	0	5	100	
Trade school advanced	121	45.49	145	54.51	
Bachelor	18	26.47	50	73.53	
Doctorate	6	31.58	13	68.42	
ORP specific training					0.023
Yes	74	34.74	139	65.26	
No, but in general, yes	63	49.61	64	50.39	
Neither	10	45.45	12	54.55	
Work experience					0.023
<1	6	16.67	30	83.33	
1-3	19	35.85	34	64.15	
4-5	17	41.46	24	58.54	
6-10	29	43.28	38	56.72	
>10	76	46.06	89	53.94	
Working hours in lab					0.047
0	3	33.33	6	66.67	
<10	7	24.14	22	75.86	
10-20	22	30.56	50	69.44	
21-30	50	48.08	54	51.92	
>30	65	43.92	83	56.08	

Note: lab = laboratory; ORP = occupational risks prevention.

Table 6. Associations between socio-demographic and occupational variables and reported musculoskeletal right wrist symptoms (N = 362).

	Musculoskeletal right wrist symptoms				
	Yes		No		
Variable	n	%	n	%	p
Dominant hand					0.001
Right	121	37.35	203	62.65	
Left	2	6.45	29	93.55	
Education level					0.041
Secondary school	3	75	1	25	
Trade school basic.	0	0.00	5	100	
Trade school advanced	98	36.84	168	63.16	
Bachelor	20	29.41	48	70.59	
Doctorate	3	15.79	16	84.21	
ORP specific training					0.028
Yes	63	29.58	150	70.42	
No, but in general, yes	55	43.31	72	56,69	
Neither	6	27.27	16	72.73	

Note: ORP = occupational risks prevention.

Table 7. Multivariate analysis for musculoskeletal general and neck symptoms.

	General Symptoms			Neck		
Risk Factor	*OR*	95% CI	*p*	*OR*	95% CI	*p*
Age				Non-significant association		
26-35	1.51	[0.57, 3.75]	0.383			
36-45	1.64	[0.59, 4.30]	0.325			
> 46	8.35	[2.16, 41.29]	0.004			
ORP specific training				Non-significant association		
Yes	0.52	[0.26, 0.97]	0.047			
Gender						
Female	2.09	[1.04, 4.07]	0.033	2.27	[1.28, 4.07]	0.005
Usual working Posture						
Sitting	1.97	[1.07, 3.73]	0.033	1.56	[0.99, 2.47]	0.057
Education level	Non-significant association					
Bachelor's - Masters				0.46	[0.26, 0.82]	0.008
Doctorate				0.84	[0.30, 2.38]	0.736
Work experience	Non-significant association					
3-5				2.29	[1.03, 5.27]	0.045
6-10				2.30	[1.16, 4.67]	0.018
> 10				1.92	[1.09, 2.37]	0.023

Note: CI = confidence interval; *OR* = odds ratio; ORP = occupational risks prevention. Reference for age = less than 25 years; gender = male; ORP specific training = no; education level = less than bachelor's degree; work experience = less than 3 years; usual working posture = standing.

Table 8. Multivariate analysis for musculoskeletal right shoulder and right wrist symptoms.

	Right Shoulder			Right Wrist		
Risk Factor	*OR*	95% CI	*p*	*OR*	95% CI	*p*
Education level						
Bachelor's - Masters	0.47	[0.25, 0.86]	0.017	0.83	[0.45, 1.49]	0.534
Doctorate	0.41	[0.13, 1.15]	0.102	0.35	[0.05, 0.76]	0.028
Work experience						
3-5	1.97	[0.86, 4.55]	0.109	1.16	[0.47, 2.73]	0.741
6-10	1.95	[0.97, 3.97]	0.064	2.09	[1.03, 4.26]	0.041
> 10	1.94	[1.08, 3.53]	0.028	2.04	[1.14, 3.72]	0.018
ORP specific training						
Yes	0.59	[0.37, 0.92]	0.022	0.57	[0,36, 0,91]	0,018
Gender				Non-significant association		
Female	2.11	[1.14, 4.04]	0.021			

Note: CI = confidence interval; *OR* = odds ratio; ORP = occupational risks prevention. Reference for gender = male; ORP specific training = no; education level = less than bachelor's degree; work experience = less than 3 years.

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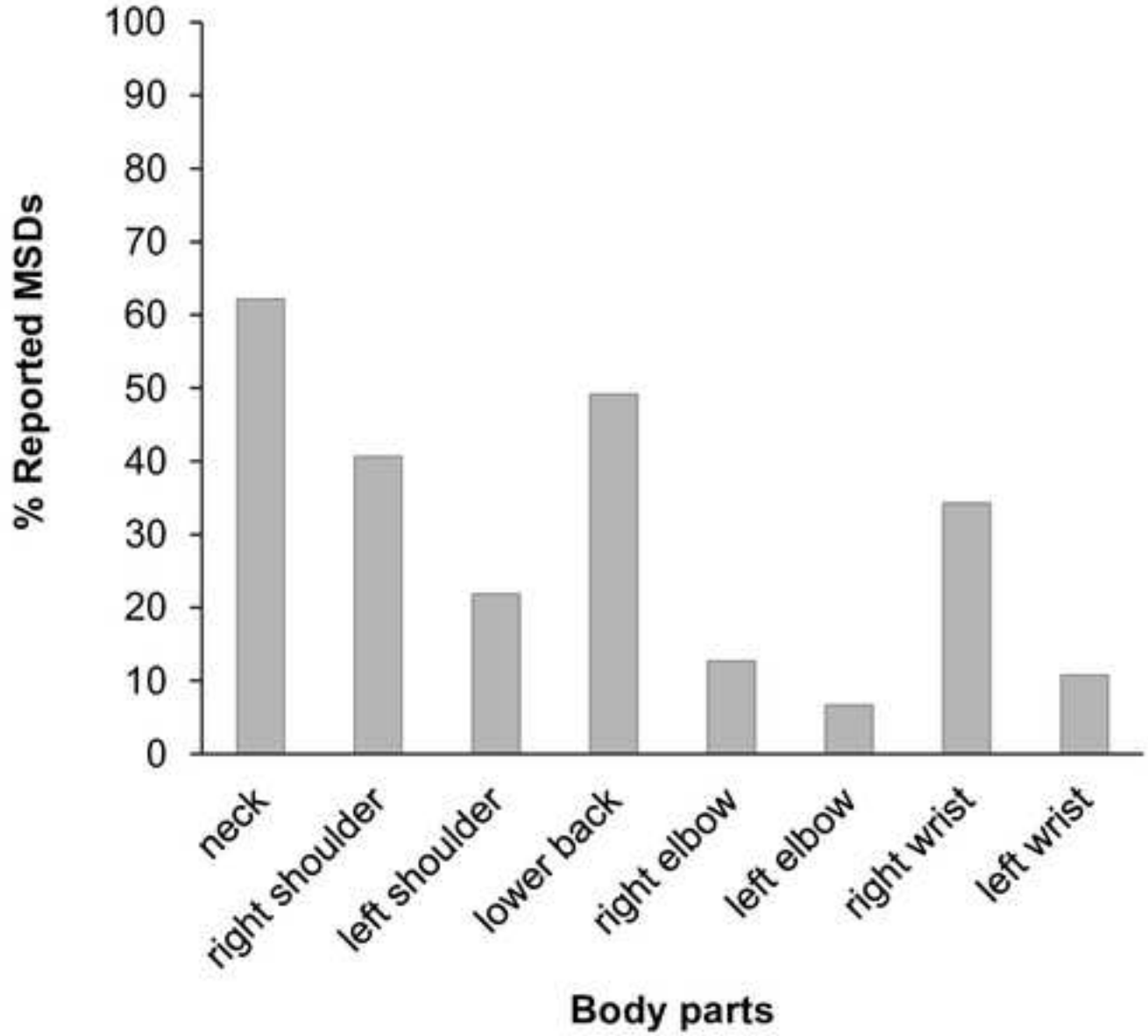

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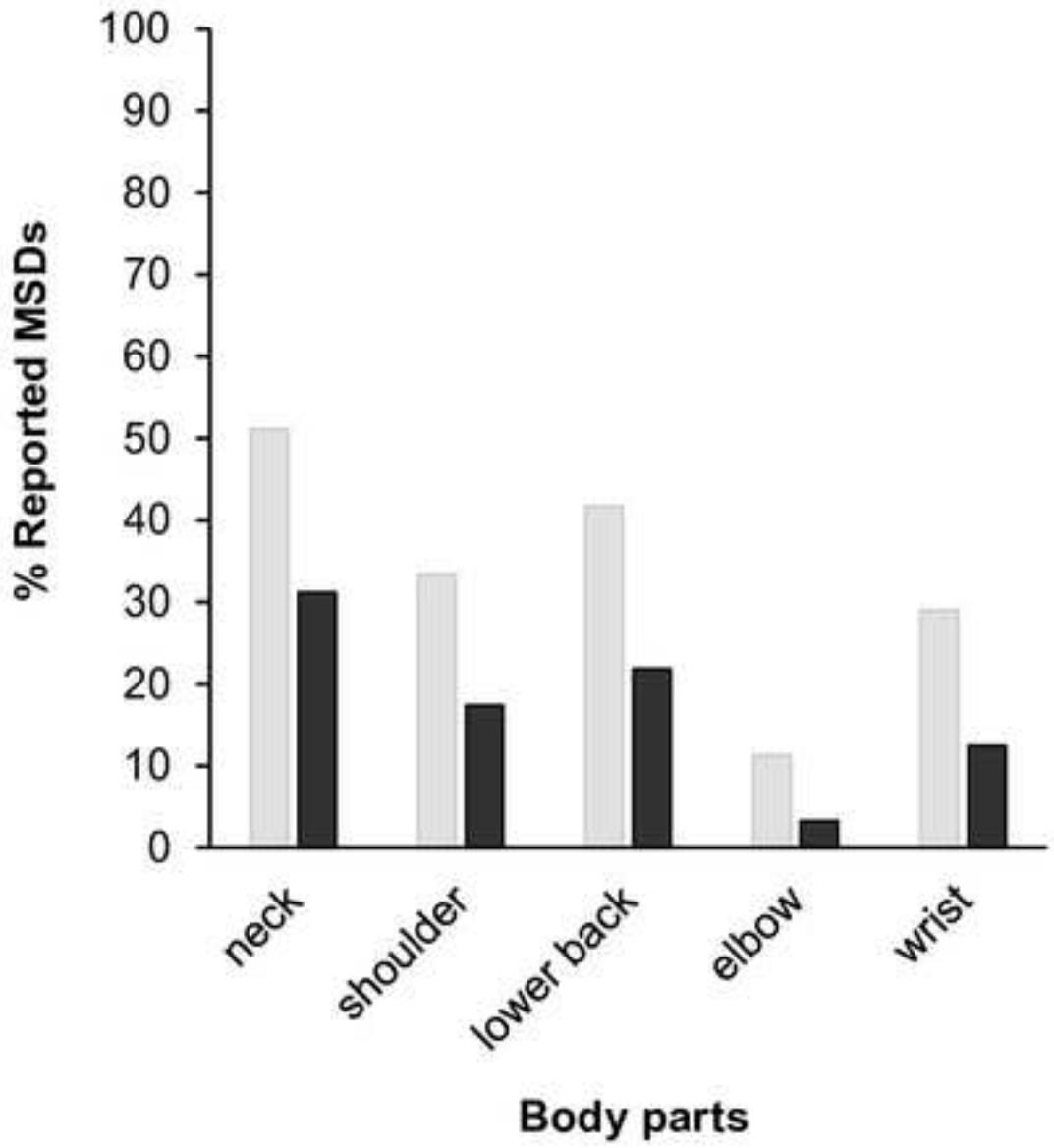

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