Risk Factors Associated with the Reporting of Musculoskeletal Symptoms in Workers at a Laboratory of Clinical Pathology

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Objective: This study was conducted with the participation of 120 workers at a laboratory of clinical pathology, with the objective of determining the association of demographic factors, clinical and occupational case histories, individual characteristics, work-related stress and ergonomic workplace analysis with the following outcomes: musculoskeletal symptoms and absences from work associated with these symptoms reported by a questionnaire.

Methods: Interviews were carried out in order to obtain demographic data, occupational case history and risk factors in workplaces. Data related to musculoskeletal symptoms and absences from work have been registered by means of an adaptation of the Nordic Questionnaire. The variables related to stress at work were based on the questionnaire of the European Foundation for the Improvement of Life and Work Conditions. According to the model prepared by the Finnish Institute of Occupational Health, 120 workers’ workstations have been submitted for ergonomic analysis of work.

Results: By means of multiple logistic regression, the results showed that the symptoms have been significantly associated with the previous history of rheumatic or orthopaedic disease (OR = 15.4; 95% CI, 1.7–135.7) and with movements and postures at work (OR = 13.5; 95% CI, 3.8–47.9). Absences from work due to musculoskeletal symptoms have been significantly associated with the low level of education (OR = 32.3; 95% CI, 4.9–211.8) and marital status (OR = 37.1; 95% CI, 2.3–593.9).

Conclusions: The symptoms have been significantly associated with a previous history of rheumatic or orthopaedic disease and with inadequate movements and postures at work. Absences from work due to musculoskeletal symptoms have been significantly associated with the workers' low level of education and marital status.

Keywords: absences from work; ergonomics; musculoskeletal symptoms; workers at laboratories

INTRODUCTION

Several work-related risk factors which may be associated with the occurrence of musculoskeletal disorders have been significantly described in different studies, such as long work-shifts, the lack of a work-rest schedule during work, repetitive movements, the combination of strain and repetitiveness, poor postures, vibrations, static muscular constraints, movements requiring extreme hand and arm postures, strained hand and arm movements, sudden muscular effort, short work cycles, task invariability, short deadlines, high cognitive demand, lack of autonomy over work, low temperatures in the work environment, exposure to vibrations, mechanical compression on tissues, negative psychosocial situations and individual susceptibility (Maeda, 1977; Silverstein et al., 1986, 1991; Hagberg, 1996; Buckle, 1997; Viikari-Juntura, 1998; Mani et al., 2000).

Psychosocial factors (increase of workload, time pressure, little autonomy over work, monotonous work and the lack of support from colleagues and chiefs) and their interaction with biomechanical factors (high repetitiveness, vibrations, static muscular constraints and poor postures) have also been considered in different studies (Hollmann et al., 2001; Devereux et al., 2002).
As for workers at laboratories of clinical pathology, most studies focus on specific tasks: Wieslander et al. (1996) carried out a study to verify the relation between exposure to cold temperatures in work performed using microtomes with the signs and symptoms of peripheral neuropathy and the Raynaud phenomenon. Signs of peripheral neuropathy were found in workers who performed this kind of task.

Other authors described the connection of risk factors associated with musculoskeletal complaints and the use of pipettes: there was an increase in the number of complaints concerning hands and shoulders associated with the use of pipettes for over 300 h a year (Björksten et al., 1994); an increase of pain in the thumb associated with the time spent on work with automatic pipettes (Fredriksson, 1995); a higher number of complaints concerning hands and elbows (David and Buckle, 1997); while Lee and Jiang (1999) emphasized the importance of the ergonomic design of these instruments in order to reduce the muscular strain.

The activities performed in laboratories of clinical pathology are carried out by professionals from different areas and educational levels and involve activities and tasks requiring high levels of concentration, attention, repetitive movements and the maintenance of static postures for long periods (Kilroy and Dockrell, 2000). However, there are few studies available in the pertinent literature concerning the association of these risk factors with musculoskeletal symptoms in workers at laboratories of clinical pathology.

**STUDIED POPULATION AND METHODS**

The Central Laboratory Division (CLD) belongs to the ‘Hospital das Clínicas’, which is an integral part of the University of São Paulo School of Medicine, the biggest public hospital in São Paulo, Brazil. The CLD comprises a 5000 m² area where biological material is collected, analytical procedures are developed and reports are issued.

In 2001, there were 343 workers at the CLD and 201 of them agreed to participate in the study. A hundred and twenty workers chosen at random out of the 201 who had agreed to participate in the study were interviewed so that demographic data could be obtained [gender, age, marital status, weight, height, educational level], the occupational history (daily work-shift, time of employment in the institution, the time of employment in the present occupation, the previous performance of the same activity in a different institution, the performance of a second job or overtime work, as well as the individual data: a previous diagnosis of work-related musculoskeletal disorders (WRMD), a previous diagnosis of rheumatic or orthopaedic diseases not related to work, the time spent taking care of children <5 years old, the regular practice of physical exercise or sports and the performance of housekeeping tasks].

The data associated with muscular complaints and absences from work were recorded by a questionnaire based on the Nordic Questionnaire for the Analysis of Musculoskeletal Symptoms (Kuorinka et al., 1987). In the previous studies carried out in Brazil (Souza, 1999; Pinheiro et al., 2002), the questions were translated from English into Portuguese and, as these questions were very simple and objective, there was no need for semantic adaptation in the translations. In the present study, the adapted questionnaire retained the original structure of the Nordic questionnaire and included the following items: a space for the worker’s identification; the first item referred to the presence of any pain or discomfort symptom in any segment of the body, the anatomic segment involved (neck, shoulders, arms, elbows, forearms, wrists, hands, fingers, upper back and lumbar region, considering the right and left sides of the body) and the type of presented symptom.

If the answer to the first item was yes, the worker was instructed to fill in the other ten items (2–11), which included the side of the body where the problem appeared (right or left), when the problem started, the frequency, duration and intensity of the symptom over the previous year, whether the symptom occurred in the preceding 30 days, in the preceding 7 days, whether the worker had ever received medical treatment on account of the symptoms in the previous year and the number of days he was absent from work because of the symptoms (absences from work), and finally, if any strategy had been adopted to alleviate the symptoms.

The study and the identification of risk factors and stress at work were carried out using the Questionnaire of the European Foundation for the Improvement of Life and Work Conditions (Kompier and Levi, 1995). This questionnaire consisted of 38 yes/no questions divided into 5 modules. Each module represented a variable: work requirements (nine questions), decision making authority (eight questions), task discrimination (six questions), job conditions (seven questions) and support from chiefs and colleagues (eight questions) The points (0 or 1) attributed to each answer resulted in a score for each of the five studied variables in a way that the higher the score, the higher stress risk represented by the variable. The questionnaires were answered during working hours and the workers could clarify doubts, if any, with the assessor when they handed them in.

The ergonomic workplace analysis was carried out in the 120 workstations using the guidelines based on the model elaborated by the Finnish Institute of Occupational Health (Ahonen et al., 1989), which seemed the most suitable one, considering the intention to make the study demonstrate the preliminary associations of a wide range of risk factors with the
symptoms and absences from work. The scores were awarded at each workstation while the workers were performing their activities and included the dimensional measures, drawings in scale and photographs of the workstations as well as the record of the thermal environment, the measurement of the work cycle duration and the observation of the activities performed by each worker in order to analyse the other items as recommended by the guidelines.

The references used by the assessor to award the scores were those described in the tables of the original guidelines. According to the original guidelines, each of the 14 items is assessed on a scale of 1–4 for the items work site, general physical activity, attentiveness, lighting, or 1–5 for the items lifting, work postures and movements, accident risk, job content, job restrictiveness, work communication and personal contacts, decision making, repetitiveness of the work, thermal environment and noise. In this scale, score 1 represents the ideal work conditions, (optimum level or generally accepted recommendations) while scores 4 or 5 stand for the poorest conditions. For worker assessment, the scores ranged from 1 to 4 for all items: score 1 represented the best condition and score 4 represented the poorest condition.

For the univariate statistical analysis, the assessor scores were rearranged as ‘best work conditions’ (scores 1 or 2) or ‘poorest conditions’ (scores 3, 4, or 5). The present study considered as outcomes:

i. The occurrence or non-occurrence of musculoskeletal symptoms in the previous year referred to as ‘symptoms’;

ii. The occurrence of absences from work (at least one day in the previous year) associated with these symptoms referred to as ‘absences’.

The demographic factors, occupational history, individual history, workplace stress-related risk variables as well as those resulting from the ergonomic workplace analysis were used as independent variables or predictors.

The statistical analysis was done according to the SPSS 10.0 statistical programme and the level of significance was set up at $P < 0.05$. In the first stage, univariate analysis was implemented so that the possible associations with the dependent variables ‘symptoms’ and ‘absences’ could be verified. For univariate statistical analysis, Pearson’s chi-square test or Fisher’s exact test were used and the Student’s $t$-test for continuous quantitative independent variables.

Subsequently, models of multivariate analysis by logistic regression were used (Kleinbaum, 1992). In this phase, the independent variables that showed a level of significance up to 0.10 ($P < 0.10$) in the univariate analysis were included in the logistic regression models through the stepwise forward technique. Only variables with $P < 0.05$ were retained in the final model.

**RESULTS**

The characteristics of the population represented by demographic parameters, occupational and individual histories are described in Table 1.

The positions of laboratory technicians, biologists, maintenance technicians, service assistants, nursing assistants and computer operators corresponded to 65.8% of the studied population ($N = 120$). The other occupations involved in the study (34.2%)

<table>
<thead>
<tr>
<th>Table 1. Independent variables represented by demographic variables, occupational and individual history ($N = 120$)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age in years—M ± SD</strong></td>
</tr>
<tr>
<td>40.8 ± 8.7</td>
</tr>
<tr>
<td><strong>Body mass index in kg/m²—M ± SD</strong></td>
</tr>
<tr>
<td>24.2 ± 5.1</td>
</tr>
<tr>
<td><strong>Time of employment in the institution (years)—M ± SD</strong></td>
</tr>
<tr>
<td><strong>Time in the present occupation (years)—M ± SD</strong></td>
</tr>
<tr>
<td><strong>Gender</strong></td>
</tr>
<tr>
<td><strong>Marital status</strong></td>
</tr>
<tr>
<td><strong>Educational level</strong></td>
</tr>
<tr>
<td><strong>Daily work-shift</strong></td>
</tr>
<tr>
<td><strong>Previous performance of the same activity in a different institution</strong></td>
</tr>
<tr>
<td><strong>Has a second job</strong></td>
</tr>
<tr>
<td><strong>Overtime work</strong></td>
</tr>
<tr>
<td><strong>Previous diagnosis of rheumatic or orthopaedic disease</strong></td>
</tr>
<tr>
<td><strong>Previous diagnosis of WRMD</strong></td>
</tr>
<tr>
<td><strong>Looks after children &lt; 5 years old</strong></td>
</tr>
<tr>
<td><strong>Practises physical activity regularly</strong></td>
</tr>
<tr>
<td><strong>Does housework daily</strong></td>
</tr>
</tbody>
</table>

*M ± SD = mean ± standard deviation.

†Orthopaedic or rheumatic disease history.

‡Work related musculoskeletal disorders history.
were administrative staff and clerks, heads of sectors, supervisors, doctors, nurses, pharmacists and the director. Among the participants, 79.8% reported musculoskeletal symptoms in the preceding 30 days and 70.2% reported musculoskeletal symptoms in the preceding 7 days.

Concerning the occurrence of symptoms in the last year, 86.7% presented symptoms in at least one of the anatomic segments, and among them, 21.2% reported at least one absence from work due to the symptoms. Besides, among the workers who reported symptoms, 51% received some sort of medical treatment in the previous year and, within this group, 90.1% reported being absent from work at least 1 day in the previous year.

After the ergonomic analysis was completed, the activities performed by the 120 workers taking part in the study were preliminarily divided into two groups according to the positions and type of predominant activity:

i. Tasks involving several types of manual work or operational activities, such as the use of microscopes and/or pipettes, the collection of biological material; manual activities performed at counters, such as the sorting of material, labelling of pipe tubes to identify samples and sowing of cultures, typing of data at computer terminals, cleaning, recovery and transport of material in the different sectors, and equipment maintenance.

ii. Administrative activities like management or supervision (non-operational activities).

The percentages resulting from the reporting of musculoskeletal symptoms in at least one anatomic segment corresponded to 72.1% for the group performing operational activities and to 27.9% for the group performing non-operational activities (Table 2), and the difference between the two groups was statistically significant ($P < 0.0001$).

All the workers who had only completed primary school performed operational activities involving the recovery, cleaning, and transport of material and maintenance work.

Univariate statistical analysis

The statistically significant results of the univariate analysis described in Table 3. The analysis of the ‘symptoms’ in relation to the demographic factors, occupational history, individual history, work-related stress and ergonomic analysis of the workplace are described in Table 3.

The analysis of the ‘symptoms’ in relation to the demographic variables, variables represented by occupational history, variables represented by individual history and variables related to the risk of stress in the workplace presented only a few statistically significant results. In the ergonomic workplace analysis, the final score obtained in the postures and movements item has as reference the poorest assessments recorded in the following body segments: neck–shoulder, elbow–wrist, hips–legs, and back. In our assessments, the poorest scores corresponded to the neck–shoulder, elbow–wrist and back segments in all the analyses; therefore, these scores determined the final score. Conversely, the hips–legs segment never got the poorest assessment in any of the analyses; hence, it did not decide the final score of the posture and movements item.

The statistically significant results of the univariate analysis concerning the association between the ‘absences’ and the independent variables are described in Table 4.

No statistically significant association between ‘absences’ and the other variables resulting from the ergonomic analysis of the workplace or to the variables recorded by the stress in the workplace questionnaire were observed.

Table 3. Significant results of the univariate analysis of the relationship between the ‘symptoms’ and the independent variables related to demographic factors, occupational history, individual history, work-related stress and ergonomic analysis of the workplace

<table>
<thead>
<tr>
<th>Predictors</th>
<th>Symptoms</th>
<th>$P$</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Previous diagnosis of rheumatic or orthopaedic disease$^a$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>18.8%</td>
<td>81.2%</td>
</tr>
<tr>
<td>Yes</td>
<td>2.5%</td>
<td>97.5%</td>
</tr>
<tr>
<td>Work postures and movements$^b$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>38.5%</td>
<td>61.5%</td>
</tr>
<tr>
<td>Yes</td>
<td>6.4%</td>
<td>93.6%</td>
</tr>
<tr>
<td>Job content$^a$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>18.3%</td>
<td>81.7%</td>
</tr>
<tr>
<td>Yes</td>
<td>2.6%</td>
<td>97.4%</td>
</tr>
<tr>
<td>Job restrictiveness$^b$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>28.1%</td>
<td>71.9%</td>
</tr>
<tr>
<td>Yes</td>
<td>8.0%</td>
<td>92.0%</td>
</tr>
<tr>
<td>Repetitiveness$^a$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>19.5%</td>
<td>80.5%</td>
</tr>
<tr>
<td>Yes</td>
<td>2.3%</td>
<td>97.7%</td>
</tr>
<tr>
<td>Noise$^b$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>50.0%</td>
<td>50.0%</td>
</tr>
<tr>
<td>Yes</td>
<td>11.4%</td>
<td>88.6%</td>
</tr>
</tbody>
</table>

No other variable presented a level of significance $<0.05$.

$^a$Statistics generated by chi-square test.

$^b$Statistics generated by Fisher’s exact test.

Table 2. Reporting of musculoskeletal symptoms in at least one anatomic segment in the past year associated with the predominant work activity ($N = 120$)$^b$

| Reporting of | Type of predominant work activity | $P$ |
| musculoskeletal | Non-operational | Operational |
| symptoms | (12) 75.0% | (4) 25.0% |
| No (N)$^b$ | | |
| Yes (N) | (29) 27.9% | (75) 72.1% |

$^a$Statistics generated by chi-square test.

$^b$Statistics generated by Fisher’s exact test.
Multivariate statistical analysis by the logistic regression technique

The variables that showed association with ‘symptoms’ in the univariate analysis ($P < 0.10$) were applied to multivariate statistical models. The step-wise forward method, which retains only the variables with statistical significance, ($P < 0.05$) was used. The results of the logistic regression final model are presented in Table 5.

For the ‘absences’ variable (Table 6), the step-wise forward method, which only retains the statistically significant variables ($P < 0.05$) in the final model, was also used.

**DISCUSSION**

It is known that the transversal design used in the present study does not allow us to establish cause-effect relations because both the exposure to risk factors and its effects, (in this case, the occurrence of musculoskeletal symptoms and absences from work) are registered simultaneously (Hviid Andersen et al., 2002). However, it enables the analysis of possible associations between the occurrence of symptoms and absences and the variables obtained through interviews, questionnaires and the occupational analysis.

Our preliminary analysis, which considered the type of predominant work activity (Table 2), showed a higher percentage of musculoskeletal symptoms reported by workers performing manual or operational activities (72.1%) when compared to workers whose activities did not demand continuous manual work or non-operational activities (27.9%). The operational activities include the tasks most commonly performed at laboratories of clinical pathology. On the other hand, the non-operational activities involve administrative and management tasks, which are typical of other work environments. Consequently, such a result may suggest differences between these two groups of workers concerning risk exposure in this work environment.

In our study, the global reference to musculoskeletal symptoms in at least one anatomic segment was 86.7% in the last 12 months, 79.8% in the last 30 days and 70.2% in the last 7 days, regardless of the type of activity performed by the worker.

Björkstén et al. (1994) used the Nordic Questionnaire, obtaining 58% of prevalence of symptoms in the shoulders and 44% concerning the cervical region, wrists and hands in a group of workers using pipettes. The scores of 59% for symptoms in hands and wrists and 23% for symptoms involving elbows are registered in another study, which was also geared to workers using pipettes (David and Buckle, 1997).

In the study carried out by Kilroy and Dockrell (2000), other activities performed in laboratories were considered besides those associated with the use of pipettes. They used the Nordic Questionnaire with two supplementary questions: whether the symptom was caused or whether the symptom was aggravated by work. In that study concerning the global reporting of musculoskeletal symptoms, a prevalence of 79% was found in the preceding 3 months in a group of 14 female workers.
In the present study, the percentage of symptoms reported in at least one anatomic segment in the previous year was high when these results were compared to those obtained by other authors. However, among the studies focusing on laboratory workers, only Kilroy and Dockrell (2000) described the global prevalence of symptoms, but they considered the period of the preceding 3 months.

Moreover, they added questions about work conditions, as a cause or aggravating factor of the symptoms. In the present study, the instructions to fill in the questionnaire were given in such a way that any references or suggestions of a possible relation between work and musculoskeletal symptoms were avoided. In view of this, it is more plausible to consider that the population of the present study referred to musculoskeletal symptoms generically and not necessarily to those caused or aggravated by work.

After the calculations made in the multivariate analysis by logistic regression concerning the occurrence of musculoskeletal symptoms in the last year (‘symptoms’), the present or previous history of rheumatic or orthopaedic diseases and the work postures and movements during the performance of work were the two significant predictors.

Despite the fact that the factors associated with age, gender, marital status, educational level as well as the individual factors, including the possible exposure to musculoskeletal strain outside the work environment, and occupational history have been considered as important variables (Hagberg, 1996; Buckle, 1997; Pope et al., 1997; Coury et al., 2002; Rocha and Debert-Ribeiro, 2001; Santos Filho and Barreto, 2001); in the present study, there was no statistically significant association between these factors and the occurrence of ‘symptoms’.

The association between ‘symptoms’ and the previous history of rheumatic or orthopaedic diseases can be explained by the fact that the symptoms related to other musculoskeletal diseases were also revealed by the questionnaire on musculoskeletal symptoms as there was no specific instruction to exclude the symptoms which were not related to work. This association shows the importance of diseases that are not related to work as predisposing factors.

As for the results obtained through the ergonomic workplace analysis, there was a predominant association between the occurrence of musculoskeletal symptoms and the postures and movements required by the work, which association had already been highlighted in previous studies (Björkstén et al., 1994; Fredrikson, 1995; Kilroy and Dockrell, 2000; Kreczy et al., 1999), where the constrained postures described by workers using automatic pipettes, microscopes, and the rising edges of working counters are similar to some of the risk factors found in our study group. Besides, the variable postures and movements might reflect factors indirectly related to work organization, such as, job content, restrictions and repetitiveness (Table 3).

In the second model, in which the outcome is represented by occurrence of absences from work due to the symptoms, the variables concerning the educational level (elementary school) and marital status (single) remain.

The ‘absences’ from work were registered only by the workers who reported missing work at least 1 day due to musculoskeletal symptoms in the previous year. Among the workers who reported musculoskeletal symptoms, 21.2% reported having been absent from work at least 1 day.

Concerning the demographic variables, single workers presented a higher rate of absences from work (35.0%) when compared to married workers (13.5%) and those who were separated or widowed (8.3%). A possible interpretation of this result would be the fact that single workers might not be as committed to family duties as married workers, considering that their degree of responsibility concerning dependants might not be so high. In other words, they might be more inclined to be absent from work when they present symptoms than the married workers not only because of the lower degree of family commitment but also due to the lack of family support under such conditions. Conversely, it is also possible that owing to their responsibility relating to dependants, the married, widowed and separated workers tended to go to work even when they presented symptoms. However, neither of these interpretations is supported by the studies in which there was a control for the marital status variable.

The educational level (complete or incomplete elementary school) also presented a statistically significant association with ‘absences’. This variable may represent a social factor because, in general, low educational level also indicates the lack of basic conditions that guarantee good social support to the worker, mainly in what concerns access to information and even to health facilities, which is a factor occurring very frequent in Brazil. Regarding the studied population, we could infer that a low educational level, as well as other unfavourable social conditions, are predominantly associated with work activities involving a lower degree of autonomy, a poorer content, a higher level of physical strain and a higher exposure to risks due to the heavier workload and to the lack of information or the difficulty to access health prevention information (Santana et al., 2003).

The work performed at laboratories of clinical pathology and the WRMD—related risk factors in these environments are still a very little explored universe considering the available literature. On the one hand, this can make the introduction of preventive measures difficult. On the other hand, it can also stimulate further search.
In view of the variables considered and the results obtained in the present study, the involvement of professionals from different areas seems to be necessary for the elaboration of preventive programmes. The introduction of wider measures oriented to the physical work environment as well as to the work organization would fundamentally require the involvement of the workers as also the participation of managers, supervisors, technicians and engineers. Preventive guidance including scheduled breaks during the work-shift, as well as stretch and relaxing exercises for the muscles may be important measures in WRMD prevention.

Providing information about WRMD prevention to the workers and carrying out periodical exams paying special attention to the workers with a previous history of rheumatic or orthopaedic disease and to those with a lower educational level whose tasks may involve a higher exposure to the risk factors studied here would be important tools.

CONCLUSION

Among the workers of the CLD, 86.7% referred to musculoskeletal symptoms in at least one anatomic segment in the preceding year. The prevalence in relation to the reporting of absences from work due to these symptoms was 21.2% among the workers who reported musculoskeletal symptoms in the previous year. The multivariate analysis revealed that the present occurrence or a previous history of rheumatic or orthopaedic disease not related to work and the postures and movements required by work were associated with the reporting of musculoskeletal symptoms in the previous year. As for the absences from work, the main risk factors associated were represented by the low educational level and single marital status.

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