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Differences in ergonomic and workstation factors between computer office workers with and without reported musculoskeletal pain

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Abstract.
BACKGROUND: Some studies have suggested a causal relationship between computer work and the development of musculoskeletal disorders. However, studies considering the use of specific tools to assess workplace ergonomics and psychosocial factors in computer office workers with and without reported musculoskeletal pain are scarce.
OBJECTIVE: The aim of this study was to compare the ergonomic, physical, and psychosocial factors in computer office workers with and without reported musculoskeletal pain (MSP).
METHODS: Thirty-five computer office workers (aged 18–55 years) participated in the study. The following evaluations were completed: Rapid Upper Limb Assessment (RULA), Rapid Office Strain Assessment (ROSA), and Maastricht Upper Extremity Questionnaire revised Brazilian Portuguese version (MUEQ-Br revised). Student *t*-tests were used to make comparisons between groups.
RESULTS: The computer office workers were divided into two groups: workers with reported MSP (WMSP, $n = 17$) and workers without positive report (WOMSP, $n = 18$). Those in the WMSP group showed significantly greater mean values in the total ROSA score (WMSP: 6.71 [CI 95%:6.20–7.21] and WOMSP: 5.88 [CI 95%:5.37–6.39], $p = 0.01$). The WMSP group also showed higher scores in the chair section of the ROSA, workstation of MUEQ-Br revised, and in the upper limb RULA score. The chair height and armrest sections from ROSA showed the higher mean values in workers WMSP compared to workers WOMSP. A positive moderate correlation was observed between ROSA and RULA total scores ($R = 0.63$, $p < 0.001$).
CONCLUSION: Our results demonstrated that computer office workers who reported MSP had worse ergonomics indexes for chair workstation and worse physical risk related to upper limb (RULA upper limb section) than workers without pain. However, there were no observed differences in workers with and without MSP regarding work-related psychosocial factors. The results suggest that inadequate workstation conditions, specifically the chair height, arm and back rest, are linked to improper upper limb postures and that these factors are contributing to MSP in computer office workers.

Keywords: Ergonomics, checklist, questionnaire

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1. Introduction

Scientific advances bring to the workplace new communication and information technologies, leading to changes in workers' professional practice and workstyle [1]. The increase in computer usage during work represents one of these changes [2]. Several previous reviews have indicated a possible causal relationship between computer work and musculoskeletal complaints [3].

The main musculoskeletal disorders (MSDs) associated with prolonged computer use in the workplace are upper limb and neck pain complaints [1, 4]. However, a number of papers assessed only for complaints of the arms, neck, and shoulders (CANS) [5]. Associations between computer work and MSDs have been demonstrated in several studies with reported 12-month prevalence rates of MSDs in the neck, back, and upper extremities of 55–69%, 31–54%, and 15–52%, respectively [6–9].

Some studies have suggested a causal relationship between computer work and the development of MSDs [9, 10] while others have reported moderate or no evidence for such associations in the upper extremities [11, 12]. Work-related MSDs could be influenced by a number of factors including medical conditions, biomechanical exposure, work organizational factors, work demands, and individual psychosocial variables [13]. Multiple factors could be linked to MSD development and determine its course and prognosis, such as the computer; time spent using a mouse and keyboard; workstation design; and psychosocial factors such as poor support, job strain, and high demand [11].

A recent systematic review described many tools available for use in assessing ergonomic risk factors [14]. Observational methods, such as checklists or other instruments applied directly by a field expert, are the most common approach to evaluating physical workload at work and monitoring the effects of ergonomic changes [14]. Rapid Upper Limb Assessment (RULA) is one of the tools that has demonstrated low-moderate validity and moderate-good inter-rater reliability [15]. The RULA ergonomic assessment tool considers biomechanical and postural load requirements of job tasks/demands on the neck, trunk, and upper extremities. In this way, it is focused on worker postures adopted [15]. However, it is not possible to assess specific constructs such as psychosocial factors or workstyle [14] through observational methods.

Specifically, for computer workers, there are instruments available to assess biomechanical and ergonomic factors, such as the Rapid Office Strain Assessment checklist (ROSA) [16], and to assess mixed ergonomic and psychosocial factors, such as the Maastricht Upper Extremity Questionnaire (MUEQ) [5], which is a self-report instrument. Differently from RULA, ROSA is more focused on workplace organization and arrangement rather than postures adopted. In this way, a better approach could be a mixed design that includes both self-report and observational assessments to capture workplace factors.

The literature includes studies examining the association between MSD, work ability, and computer usage [10, 16–19]. Most are based solely on self-report assessment [10, 17, 19] or applied observational methods [16, 20], rarely both. However, to the best of our knowledge, studies considering the use of specific tools to assess computer workplace ergonomics along with physical and work-related psychosocial factors in workers with and without reported musculoskeletal pain (MSP) are scarce. Additionally, the identification of differences in ergonomic, physical and work-related psychosocial factors in computer office workers with and without MSP could contribute to the development of specific strategies towards primary or secondary preventive intervention.

To this end, this study aimed to compare the ergonomic, physical, and psychosocial factors in computer office workers with and without a report of MSP. The hypothesis of this study is that workers complaining of MSP will demonstrate worse ergonomic, physical and work-related psychosocial indexes, by the use of ROSA, MUEQ and RULA tools, than workers without MSP.

2. Methods

2.1. Sample

All the 64 computer office workers (aged 18–55 years) were invited to participate in the present study. However, only 38 workers met the eligibility criteria and accepted to participate. The sample consisted of male and female employees who had been in the same job position for at least 12 months and who used a desktop computer for a minimum of four of their daily working hours [16]. To obtain this information the MUEQ-Br revised was completed first [21]. Three volunteers were excluded due to the impossibility to adequately assess and analyze the video recordings. In this way, the final sample size involved in this study was 35 computer officer workers divided into two subgroups: workers with MSP [(WMSP; $n = 17$) and without MSP report (WOMSP; $n = 18$)]. The eligibility criteria for the group WMSP were: self-reported MSP (complaint section of the MUEQ-Br revised [21]) and chronic MSP [22] – at least 3-month duration of pain symptoms [22, 23]. Only workers who did not report any MSP in the last three months were included in the WOMSP group.

According to *post hoc* power analyses and considering ROSA total scores comparing both groups (5.88, SD:0.99 vs. 6.71, SD:0.99 – independent student *t*-test), the sample size assessed in this study achieved 80% power and an effect size of 0.85 (GPower version 3.0.10, University of Kiel, Germany). All employees were informed of the study procedures. The exclusion criteria were as follows: illiteracy or functional illiteracy, insufficient time in the current work position, an age of 60 years or older, acute MSP not directly related to work, degenerative or systemic rheumatic MSDs, and neurological disorders or neurological sequelae. This project was reviewed and approved by the Human Research Ethics Committee of the University Hospital at Ribeirão Preto Medical School, University of São Paulo (Process HCRP Nº 4527/2013). All participants signed a free and informed consent form.

2.2. Measures

Video recordings, questionnaire and checklists were used to collect data from all computer workers.

2.3. Rapid Office Strain Assessment—ROSA

The ROSA [16] allows to quickly quantify risk factors related to computer workstation considering workplace posture and equipment assessment. In this study, the Brazilian Portuguese version of ROSA was used [24]. Construct validity of the original tool demonstrated a significant correlation of ROSA final scores with reported discomfort, with a proposed action level score of 5 or greater indicating an increased risk of discomfort [16]. Users are provided with a final risk ROSA score ranging from 1 to 10. The English version of the instrument can be accessed clicking on following link: http://ergo.human.cornell.edu/ahROSA.html. Also, original on-site interrater reliability testing was shown to be high [16].

All postures that were described as ideal or neutral were given a score of 1 and became the minimum score for each area within the sub-sections of the tool. Deviations from the neutral postures were scored in a linearly increasing manner with values from 1 to 3.

Risk factors were grouped into the following areas/sections: chair, monitor and telephone, keyboard and mouse. The scoring charts were developed by matching two office subsections with each other to get a complete score for that area. The maximum scores from each of the sections were used as the horizontal and vertical axes for the sub-section scores (which were subsequently used to obtain the ROSA final score). Section A provides the chair score (2–9 points). Section B is composed by telephone and monitor resulting in the monitor (1–7 points) and telephone scores (1–6 points). And section C provides the keyboard (1–7 points) and mouse (1–7 points) scores. The scores from the monitor and telephone and keyboard and mouse are then compared in another chart to receive the peripheral score. The ROSA final score (1–10 points) is derived by comparing the peripheral chart against the chair score.

For each ROSA subsection, a value of +1 is added when the workstation equipment is not-adjustable.

A value of +1 is also added to the subsection if a worker uses a piece of equipment for more than 1 h continuously or for 4 h per day. If the worker uses the equipment for between 30 min and 1 h continuously or between 1 and 4 h per day, then the duration score will be given a value of zero. For less than 30 min of continuous work or 1 h of total work per day, the duration score is given a value of –1 [16]. In this way, the final score of each session is chair (2–9 points), monitor and telephone (1–9 points), keyboard and mouse (1–9 points).

2.4. Rapid Upper Limb Assessment—RULA

The RULA is a checklist-based method to assess work posture that focuses on the upper body but includes the lower body [15]. Group A section consists of the upper arm, lower arm, and wrist (upper limb score, 1–9 points), and group B section consists of the neck, trunk, and legs (lower limb score, 1–9 points). The scores for group A and group B postures and the scores for static muscle work and force are added as appropriate to give an upper limb score and a lower limb score. Both scores are then combined in a table to give a Grand Score (1–7 points). The English version of the instrument can be accessed clicking on following link: http://www.rula.co.uk

The Grand Score is used to assign the observed posture into an Action Level that indicates the required intervention. The four levels are a) level 1 – scores between 1 and 2: posture is acceptable if not maintained; b) level 2 – scores between 3 to 4: further investigation needed; c) level 3 – scores between 5 to 6: further investigation and changes needed soon; and d) level 4 – scores greater than 7: investigation and changes required immediately. The RULA was developed as a screening tool for exposure to risk factors for work-related upper limb disorders and takes into account the static movements and forces that may be required for a task. The intra- and inter-rater reliability of RULA scores have been found to be acceptable [15, 25, 26].

2.5. Maastricht Upper Extremity Questionnaire Brazilian Portuguese version—MUEQ-Br revised

MUEQ is a self-administered questionnaire used to assess the occurrence, nature and possible work-related physical and psychological factors associated to CANS among computer users [21]. The MUEQ-Br revised is composed of six domains (workstation – 6 questions, 0 to 6 points; body posture during work – 6 questions, 0 to18 points; job control – 0 to 27 points, 9 questions; job demands – 0 to 21 points, 7 questions; quality of break time – 0 to 18 points, 6 questions and social support – 0 to 21 points, 7 questions). The tool consists of 41 multiple choice questions (the revised version), with Yes (0)/No (1 point) answers for the workstation domain. For the other domains, the responses are "always" (0), "often" (0), "sometimes" (1), "seldom" (2), and "never" (3) with a score ranging from 0 to 111. Greater the sum score, greater the perception of the worker about the interference of psychosocial and ergonomics aspects on work context. The MUEQ-Br revised demonstrated good levels of internal consistency and reliability, and cross-validation provided evidence of lack redundancy [21]. The MUEQ-Br revised was completed by the computer office workers prior to the video recordings in order to determine if the worker was eligible for the study. The workers were always addressed in their office by the same examiner not involved in the video recording analysis.

2.6. Procedure

Two cameras (Canon EOS 60-D marks) were placed on two tripods in each worker office. The equipment was positioned to allow recording of all the items of the workstation and the worker postures: leg position, feet, lower back support, and head. One camera was positioned in the sagittal perspective concerning to worker's office position [27]. To guarantee that the entire worker body would be visualized, the center of the camera lens was fixed to correspond to the midpoint of the worker height in the sitting position [28]. The second camera was positioned in a diagonal position in relation to the worker and workplace to enable broad registration of the workplace organization (phone position, arm movements using the keyboard and mouse, and head position in relation to the monitor). Frontal plane recordings could not be captured due to the presence of the monitor in front of the worker.

The individual was asked to perform his or her habitual work functions. All recordings were performed for one hour without sound in full HD format. The cameras were positioned, and the researcher left the room to avoid leading the worker to adopt an unnatural position.

The entire 60-minute video, from both cameras, were edited into a five-minute video to reduce the length of the assessment and to secure the visualization of all the workstation components necessary to full fill the ROSA and RULA checklists (i.e., in which it was possible to visualize the employee performing keyboard activities, answering the phone, using the mouse, during sitting position, adopting different trunk, arm and leg postures). Camtasia Studio program version 8.4 (Okemos, Michigan: TechSmith Inc., 2014) was used to edit the videos. The same researcher edited all of the videos. The researcher was trained and blinded to the presence or not of MSP report, and codes were attributed to videos and checklists to allow for comparisons.

2.7. Statistical analysis

A Shapiro–Wilk test was used to check for normality of data distribution. The data showed normal distribution. Independent Student *t*-tests was used to make comparisons between groups (with and without reported MSP) regarding scores on the tools (ROSA, RULA, and MUEQ-Br revised) ($p < 0.05$). Intra and interrater reliability were checked by Intraclass Correlation Coefficient (ICC) [29]. Weak reliability was considered when ICC<0.40, moderate reliability when 0.40<ICC<0.7 and strong reliability when ICC >0.75 [29]. To investigate correlations between ROSA and RULA total scores, the Pearson Correlation Coefficient was used. The magnitude of correlation was graded as follows: $R < 0.30$ = weak; $0.4 < R < 0.6$ = moderate; $R > 0.70$ = strong [30]. IBM SPSS Statistics for Windows, version 22.0 (Armonk, NY: IBM Corp, 2013) was used to perform the statistical analysis and the significance level was established at 0.05.

3. Results

A total of 35 computer office workers participated in this study. No significant differences were observed for anthropometric data and work practices between the groups with and without MSP (Table 1).

For reliability analysis, two examiners independently assessed 35 videos on two occasions (one week apart). The ICC for intra-rater and interrater reliability for the total ROSA score were 0.77 (95%CI: 0.33–0.93) and 0.72 (95%CI: 0.47–0.89) respectively, showing excellent and moderate levels.

Of the total 17 workers complaining of chronic MSP, 29% ($n = 5$) reported low back pain (LBP), 29% ($n = 5$) reported headaches, 24% ($n = 4$) reported pain in the upper limbs, 6% ($n = 1$) reported neck pain and 12% ($n = 2$) reported both LBP and upper limb pain. Computer office workers with MSP showed significantly greater mean values in the total score and chair section of the ROSA than those without pain. The sections chair height and armrest showed the higher mean values in computer office workers with MSP compared to workers without MSP (Table 2).

Significantly greater mean values were also observed for workstation domain score of the MUEQ-Br revised and in the upper limb RULA score. The mean score for backrest in the MUEQ-Br revised was significantly higher in computer office workers with MSP compared to workers without MSP (Table 2).

A moderate positive correlation between ROSA and RULA total scores was observed ($R = 0.63$, $p < 0.001$).

4. Discussion

The main hypothesis of this study was that workers complaining of chronic MSP demonstrated worse physical and psychosocial indexes than workers without reported MSP. The hypothesis was partially confirmed by the results, since computer workers with MSP showed worse ergonomic indexes for total ROSA score, ROSA chair score and workstation domain of the MUEQ-Br revised, as well as, worse physical risk related to upper limb (RULA upper limb section) compared to workers without MSP. However, there were no observed differences in workers with and without MSP regarding work-related psychosocial factors.

We found that workers with MSP had significantly higher mean scores than those without pain on the chair section of the ROSA, specifically for subsections chair height and armrest from ROSA, and the workstation domain of the MUEQ-Br revised, specifically the question about inadequate backrest. Supporting our findings, previous studies [31–33] showed a reduction of musculoskeletal symptoms in computer office workers after ergonomic intervention based on chair modification. A systematic review showed moderate evidence for chair-based intervention [34]. Also, there are reports about the association between prolonged sitting and LBP [35] and the high

Table 1

Mean values and standard deviations (in parentheses) of anthropometric data and work characterization of computer office workers with ($n = 18$) and without musculoskeletal pain report ($n = 17$)

Sample Characterization	Without Musculoskeletal Pain ($n = 18$)	With Musculoskeletal Pain* ($n = 17$)	t(df), p-value
Age (years)	39.9 (10.59)	39.2 (9.75)	*–0.23 (33), p = 0.83*
Sex (female/male)	6/12	5/12	
Height (m)	1.73 (0.10)	1.75 (0.10)	*–0.47 (33), p = 0.63*
Weight (kg)	77.06 (13.33)	78.59 (19.66)	*–0.26 (33), p = 0.79*
Time in the current work position (years)	9.5 (8.34)	6.41 (6.33)	*1.29 (33), p = 0.23*
Number hours working per day	8.0 (0.69)	8.0 (0)	*0.16 (33), p = 0.85*
Number hours working with a computer per day	7.1 (0.83)	7.00 (1.17)	*0.32 (33), p = 0.75*
Number hours working using telephone per day	1.6 (1.15)	2.1 (1.31)	*–0.68 (33), p = 0.50*
Number hours working in a sitting position	6.94 (0.66)	6.59 (1.12)	*0.97 (33), p = 0.34*

Student t-test ($p < 0.05$). *At least three months of pain duration. df: degree of freedom.

Table 2
Mean values and 95% confidence intervals (in parentheses) of domain and total scores on the Rapid Office Strain Assessment (ROSA Br), Rapid Upper Limb Assessment (RULA), and Maastrichit Upper Extremity Questionnaire revised (MUEQ-Br revised) of computer office workers with ($n = 17$) and without musculoskeletal pain ($n = 18$)

Scores	Without Musculoskeletal Pain ($n = 18$)	With Musculoskeletal Pain ($n = 17$)	t(df), p-value
ROSA – Chair section (2–9)	5.35 (4.67–6.03)	6.41 (5.78–7.04)	*–2.63 (33), p = 0.01**
Chair height (1–5)	2 (1.58–3.58)	2.88 (2.35–5.24)	*–2.58 (33), p = 0.02**
Pan depth (1–3)	1.5 (1.10–2.60)	2 (0.47–2.47)	–1.59 (33), $p = 0.12$
Armrest (1–5)	3.11 (2.59–5.70)	3.82 (0.87–4.69)	*–2.07 (33), p = 0.05**
Backrest (1–4)	1.89 (1.54–3.43)	2.41 (2.00–4.41)	–1.90 (33), $p = 0.07$
ROSA- Monitor (1–7)/telephone section (1–6)	5.06 (4.39–5.73)	4.94 (4.18–5.70)	0.25 (33), $p = 0.81$
ROSA – Mouse (1–7)/keyboard (1–7)	4.71 (4.11–5.30)	5.35 (4.56–6.14)	–1.51 (33), $p = 0.14$
ROSA – Total score (1–10)	5.88 (5.37–6.39)	6.71 (6.20–7.21)	*–2.62 (33), p = 0.01**
MUEQ – Total score (0–111)	20.12 (15.75–24.49)	23.29 (18.90–27.69)	–1.04 (33), $p = 0.31$
MUEQ – Workstation (0–6)	0.47 (0.02–0.92)	1.12 (0.68–1.56)	*–1.20 (33), p = 0.03**
Chair height	0.12 (–0.03–0.26)	0.18 (0–0.36)	0.54 (33), $p = 0.59$
Non-adjustable chair	0	0.12 (–0.04–0.27)	1.50 (33), $p = 0.14$
Backrest	0.06 (–0.05–0.16)	0.47 (0.23–0.71)	*3.10 (33), p < 0.01**
Inadequate Keyboard position	0.11 (–0.03–0.26)	0.06 (–0.05–0.17)	–0.54 (33), $p = 0.59$
Inadequate Screen position	0.11 (–0.03–0.26)	0.12 (–0.04–0.27)	0.06 (33), $p = 0.95$
Not enough space in the office	0.45 (0.34–0.56)	0.94 (0.74–1.14)	1.11 (33), $p = 0.27$
MUEQ – Body posture during work (0–18)	4.53 (3.20–5.85)	5.53 (4.09–6.97)	–1.20 (33), $p = 0.24$
MUEQ – Job control (0–27)	4.24 (2.30–6.17)	4.71 (3.30–6.11)	–0.34 (33), $p = 0.74$
MUEQ – Job demands (0–21)	4.88 (3.24–6.53)	5.35 (3.24–7.46)	0.38 (33), $p = 0.71$
MUEQ – Break time (0–18)	3.47 (2.03–4.91)	4.29 (2.87–5.72)	–0.91 (33), $p = 0.37$
MUEQ – Social support (0–21)	2.53 (0.82–4.24)	2.29 (1.02–3.56)	0.48 (33), $p = 0.63$
RULA – Grand Score (1–7)	5.41 (4.78–6.04)	5.59 (4.91–6.27)	–2.82 (33), $p = 0.56$
RULA – Upper limb section (1–7)	4.53 (4.12–5.94)	5.35 (4.84–5.87)	*0.57 (33), p = 0.01**
RULA – Lower limb section (1–9)	5.18 (4.38–5.97)	4.82 (4.07–5.58)	–0.59 (33), $p = 0.57$

*$p < 0.05$, Student t-test ($p < 0.05$). df: degree of freedom.

prevalence of LBP in office workers [7, 36]. One can argue that the time spent in sitting position was the central aspect in the development of musculoskeletal symptoms. Although, in our study, we have not controlled for "the real time" spent in the sitting position (by accelerometry), workers with and without MSP did not differ about the time reported in the sitting position at work (Table 1).

The higher mean scores on items about the absence of adjustments in chair height, arm and backrest in workers with MSP could help explain our results. In this way, we can suppose that poor adjustability of the workstation components, particularly the chair, could be an important contributor factor to the musculoskeletal report in computer office work. Groenesteijn et al. [37] reported that computer office workers showed higher backrest comfort and mobility awareness using a chair with seat pan not fixed but able to move freely in all directions (external rotation point in forward/backward/sideward directions and intermediate directions). On the other hand, the literature advocates the importance of providing ergonomic training, and not only the replacement by ergonomic chairs, to decrease ergonomic risk [34]. Results from a randomized clinical trial showed a reduction in intensity, frequency, and duration of work-related musculoskeletal symptoms associated with ergonomic intervention without chair replacement [38]. Future studies should be conducted to verify if ergonomic training with or without the replacement of the chair is effective to reduce ergonomic and postural risk indexes.

A significantly greater mean score on the upper limb section of the RULA was observed in workers with MSP in our study, suggesting a link between improper upper limb postures adoption during computer work and MSP report. In line with our findings, Dennerlein and Johnson [39], when evaluating the different computer tasks that can contribute to biomechanical risk for MSDs development found that task-intensive keyboard use was associated with less neutral postures of the wrist and increased the activity of the forearm muscles. This increased activity could contribute to the development of upper limb pain. In addition, we can suppose that the improper position of the chair can be associated with the adoption of inadequate postures of the upper limbs in order to reach the keyboard and mouse, contributing to reports of musculoskeletal complaints not only in the upper limb but also in low back and neck. However, it is speculative, and further future research should be conducted to investigate the assumption.

To the best of our knowledge, studies have not been found using the ROSA checklist to check for differences between workers with and without MSP complaints. The ROSA checklist has the advantage of considering workstation aspects that other available checklists do not consider. Levanon et al. [40] adapted RULA items for the assessment of computer workers; however, the authors did not report differences in the scores on the instrument between workers with and without musculoskeletal complaints.

Our results showed a moderate and positive correlation between RULA and ROSA total scores. In this way, this moderate correlation suggests that working posture is linked to workstation equipment/organization ergonomic risk and both assessed by an observational method. However, it does not exclude the need to consider both constructs. Ultimately, we recommended the use of checklists focused on both worker postures (RULA) and workplace equipment organization and characteristics (ROSA). Kaliniene et al. [1] reported that workers with musculoskeletal complaints had higher risk scores on the RULA checklist than did workers without complaints ($U = 26877.0$, $p = 0.05$). A logistic regression analysis showed that a one-unit increase in the risk score increased the likelihood of complaints 1.22 times (CI 95%: 1.15–1.51). Considering that the authors assessed only the worker postures, future studies should be conducted to understand the association between workplace ergonomics, worker posture, and MSP.

The results obtained from ROSA tool in our study were endorsed by results from MUEQ-Br revised, since only workstation domain from MUEQ-Br revised showed significantly greater scores in workers with MSP. In contrast to our findings, a recent report showed that workers with MSP evaluated their workstations more negatively than subjects without MSP, while the expert analysis found no difference between workers with and without MSP [41]. Poor ergonomic knowledge could be an explanation for this result, since the study included workers from the industrial sector. The availability of ergonomic information about office workstations is more widely disseminated than work sites in the industrial sector.

Low back pain (29%), headache (29%), and pain in the upper limbs (24%) were the MSP most reported in our study. Similarly, Quemelo et al. [20] in a sample of workers in the administrative sector, [19] also found that LBP and pain in the upper limb to be the most common, although the prevalence rates were considerably higher (81% and 70%, respectively). In contrast, some studies found a higher prevalence rate for complaints in the neck and shoulders [5] or only in the neck pain [1, 42]. Oha et al. [19] reported that the most common complaints have been in the neck (51%), LBP (42%), hand (35%), and shoulder (30%). However, most studies assessed only complaints in the neck, arm, and shoulders (CANS) [5]. Several occupational factors could be related to the development of pain in different anatomical sites. The time spent using a computer mouse and keyboard is found to be related to forearm and shoulder complaints [43], and LBP seems to be related to prolonged sitting or sustained lumbar flexion, which has been found to reduce the ability of the spine to resist force acting upon it [44]. One of the few studies found in the literature about the association between headache and computer use, reported high levels of screen time exposure to be associated with migraine in young adults [45].

In our study, no differences were observed in work-related psychosocial factors between workers with and without reported MSP. In a systematic review on the risk factors associated with the onset of LBP in computer office workers, it was not found evidence for the predictive value of social support, and job demands for the development of LBP [44]. In disagreement with our results, Johnston et al. [46] reported that low supervisor support was the only psychosocial variable that had a main effect on neck pain disability. However, several factors could explain the difference in their results compared to ours: 1) the authors included only female office workers and in our study we included both genders, in this way, we can suppose a possible gender-effect on psychosocial variables; 2) the association reported was noted only for one of the five psychosocial variables considered. It is possible that only a weak association was observed, however, we could not confirm its magnitude assessing the report; and 3) the study investigated the associations between neck disability and work-related psychosocial variables and not differences in psychosocial factors in workers with and without MSP. In line with our results, a recent cohort study failed to identify a causal relationship between neck pain onset and work-related psychosocial factors [47]. However, the authors did not rule out the role of the psychosocial factors on the development of MSP, since only work-related psychosocial factors were controlled. Future research should clarify the role of psychosocial factors (work-related or not) in computer office workers with and without MSP.

One can argue that work-related experience could contribute to MSP development, since in our study workers without MSP reported 9.4 years working in the current position at work against 6.5 years reported by workers with pain. However, there were not found statistical differences between groups and our data does not exclude the possibility that workers may have other previous office jobs using computers, considering that the question only queried about "time in the current work position". Future studies may investigate such aspects.

This study has some limitations. Firstly, a small sample size was considered in spite of the higher power obtained by sample size calculation. Additional studies with greater sample sizes should be conducted to confirm (or not) our findings. Secondly, the method of analysis of video recording should be further investigated since we could not confirm that 60 minutes of recordings were representative enough of daily working posture during computer work. Thirdly, it was not possible to verify differences in the subgroups divided according to the subtypes of MSP (e.g.: low back pain, upper limb disorders) due to our limited sample size. And consequently, future studies with greater sample sizes could help understand the ergonomic, postural and psychosocial factors implicated in the development of MSP subtypes in computer office workers.

5. Conclusion

Our results demonstrated that computer office workers who reported musculoskeletal pain had worse ergonomic indexes for total ROSA score, ROSA chair score and workstation domain of the MUEQ-Br revised, as well as, worse physical risk related to upper limb (RULA upper limb section) than workers without pain. It was also showed a correlation between workstation ergonomics score (ROSA) and working posture risk (RULA). However, it was not observed differences in workers with and without musculoskeletal pain regarding work-related psychosocial factors.

The results suggest that inadequate workstation conditions, specifically the chair height, arm and back rest, are linked to improper upper limb postures and that these factors are contributing to musculoskeletal pain in computer office workers.

Conflict of interest

None to report.

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