

Risk factors associated with musculoskeletal symptoms in footwear sewing workers

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ABSTRACT: Beyond the lack of studies on this issue, particularly in Portugal, the relationship between the prevalence of musculoskeletal symptoms and many work-related risk factors is still very unclear. Therefore, in order to contribute to a better understanding of WMSD risk factors, this study aims to analyze the association between the prevalence of musculoskeletal symptoms in sewing workers of the footwear industry and some of the work-related risk factors for the development of WMSD. Both direct observation and a questionnaire survey were performed, and SPSS was used in statistical data analysis. Some of the individual, occupational, environmental and organizational/psychosocial risk factors were found to be associated with the reported symptoms, but those were distinct in the two companies under study. The results emphasize the multifactorial nature of WMSD and the need for the implementation of new and more effective ergonomic prevention programs, more centered on the identified risk factors.

1 INTRODUCTION

Due to the present socio-economic context and globalization, the increasing workload and quality demands are threatening workers' health and leading to high productivity losses and tremendous financial costs for both individuals and society. Particularly the impact on workers' musculoskeletal health seems to be even more concerning.

The growing importance of this issue has led institutions and organizations such as European Commission (EC, 2010) to consistently identify Musculoskeletal Disorders (MSD) as a priority in the prevention of safety and health at the companies level.

In fact, according to the statistical data from the Bureau of Labour Statistics (2012), in 2011, MSD were responsible for 33% of all accidents and illnesses related to labour absenteeism in the United States of America (USA). Meanwhile, in Europe, according to Health and Safety Executive (2012), countries like Austria, Germany and France show a high number of lost working days due to Work-related Musculoskeletal Disorders (WMSD). The same source refers that WMSD are one of the most common causes of work absenteeism due to illness in the United Kingdom while in France, according to the European Agency for Safety and Health at Work (EU-OSHA, 2010) in the year 2006, WMSD led to 7 millions of lost working days, which

represents a cost of 710 million Euro for the companies. Likewise, Woolf & Pflieger (2003) referred that the expenses with the productivity and wages losses due to WMSD correspond to 2.4% and 1.3% of the gross domestic product of Canada and USA, respectively. The socio-economic impact also seems clear in the manufacturing industry (EC, 2010). In Portugal, the footwear industry represents an important part of the manufacturing industry and is responsible for a growing amount of the national exports. However, the traditional taylorist organization system, which is characterized by risk factors recognized in several studies as predominant for the onset of WMSD, is still adopted by most companies (Todd *et al.*, 2008). The sewing sector is referred to as one of the sectors where the workplaces are at a higher risk (Aghili *et al.*, 2012; Roquelaure *et al.*, 2004).

In this context, this study aims to check if there are statistically significant associations between the prevalence of Musculoskeletal Symptoms (MSS) reported by the workers of the footwear industry sewing sector and the studied risk factors. The study of the MSS arises as a predictor of subsequent MSD in the studied populations, therefore constituting an important step towards the WMSD prevention (Smith *et al.*, 2009).

In the last decades, physical factors for WMSD have been widely studied in the literature. On the contrary, psychosocial factors have been neglected

and there is still a lot to explore. For that reason, they were privileged in this study while, although have been registered, some of the physical factors were not subjected to a specific analysis in this investigation.

2 MATERIALS AND METHODS

2.1 Subjects

This study was conducted in the sewing sector of two companies (A and B) of the footwear industry, placed in the municipality of Felgueiras. From a global population of 130 female workers, samples (34 in company A and 32 in company B) were selected through pre-established inclusion and exclusion criteria. The inclusion criterion was: individuals who had been performing duties in the company for at least one year, who were present on the day of the companies' visit and who agreed to participate in the study. All the identified individuals who did not fulfil the inclusion criterion as well as those presenting musculoskeletal problems, which were not related to the job, were excluded. All the participants were informed about the objectives of the study and that all information collected would be treated as strictly confidential and anonymous.

2.2 Methods

For the characterization of the activity carried out by the workers of the sewing sector, the guide for the ergonomic analysis of workstations by the Finnish Institute of Occupational Health (FIOH), translated and adapted into Portuguese by University of Minho (Gomes da Costa, 2004), was used. For data collection on the musculoskeletal symptoms reported by the workers as well as on the potential risk factors, a questionnaire was built up based on 3 validated questionnaires: Nordic Musculoskeletal Questionnaire in its translated and validated version for the Portuguese population (Mesquita *et al.*, 2010) to evaluate health aspects; Dutch Musculoskeletal Questionnaire—extended version (Hildebrandt *et al.*, 2001) to evaluate socio-demographic and work aspects and Copenhagen Psychosocial Questionnaire—medium size version (Kristensen *et al.*, 2005) to evaluate psychosocial aspects.

Work-related MSS were evaluated in terms of pain perception or discomfort of the respondents, whenever they were present in the last 12 months for at least a week (Sluiter *et al.*, 2001), in the following body regions: neck, thoracic region, lumbar region, hips/thighs, knees, ankles/feet, shoulders, elbows and wrists/hands.

SPSS® v.21.0 software was used in data statistical analysis. The Chi-Square independence test was performed to look for statistically significant associations between the prevalence of the reported MSS and the observed risk factors. For those associations, the Relative Risk (RR) was performed whenever possible, while Odds Ratio (OR) was used in the remaining cases. The corresponding 95% confidence intervals (95% CI) were also estimated.

2.3 Procedures

In December 2012 the activity of sewing workers was characterized through direct observation and the support of the FIOH ergonomic analysis guide.

Subsequently, a pre-test of the constructed questionnaire was conducted in 10 of the study participants. Then, during January 2013, the questionnaire was applied to all the selected workers by means of a structured interview. The duration of each interview was approximately 8 minutes.

3 RESULTS AND DISCUSSION

Herein, are presented and discussed the statistically significant results found in the study of the association between the prevalence of MSS (presented in the paper entitled “Prevalence of WMSD in the sewing sector of two companies of the footwear industry”) and the studied work-related socio-demographic (section 3.1), occupational (section 3.2), environmental (section 3.3) and organizational/psychosocial (section 3.4) risk factors.

3.1 Socio-demographic factors

The final sample consisted of 34 workers from company A and 32 from company B, which mean response rates of 80% and 38%, respectively.

The workers are aged between 22 and 55 years old and, in average, they are 38 ± 8 years old (39 ± 8 for company A and 38 ± 8 for company B).

Table 1 shows the statistically significant associations between the prevalence of MSS and the socio-demographic factors.

In company A, the number of workers under 40 years old reporting shoulders symptoms is significantly greater than expected (OR = 5.000; CI 95%: 1.030–24.279). This result seems to contradict the results of other studies which found an association between the prevalence of MSS and the increase in age of the sewing workers (Aghili *et al.*, 2012; Wang *et al.*, 2009). On the other hand, others have found a higher prevalence of

Table 1. Association between the prevalence of MSS and socio-demographic factors.

Risk factor	Region of the body	p
<i>Company A</i>		
Age	Shoulders	0.038*
Marital status	MSS 12 months	0.048**
	Lower back	0.046**
<i>Company B</i>		
Education level	Ankles/feet	0.024**

*Chi-square independence test; **Fisher's exact test.

MSS on shoulders and neck in younger workers (Roquelaure *et al.*, 2012). This situation may be explained by the workers' inexperience (Roquelaure *et al.*, 2012), though it is worth noting that the percentage of workers with less than 20 years of experience is the same in both companies and that, in company B, the prevalence of MSS was not associated with age. Another likely reason is the so called “healthy worker effect”, that is, the possible bias on results that may be due to the fact that the healthier workers remain employed longer (Benavides *et al.*, 2006). Although the literature refers a cause and effect relationship between workers' age and MSS, this relationship is not linear, which suggests that there may be other factors involved (Guo *et al.*, 2004).

Despite the fact that the majority of the participants are married, it can be observed that in company A, the risk of the single or widow workers ($p = 0.048$; RR = 4.348; CI 95%: 1.366–13.889) reporting symptoms in the last 12 months is more than four times that found for those who are married or who live together. Similar conclusion was made by Kaergaard & Andersen (2000), who found a higher risk of neck and shoulders symptoms in single seamstresses. On the contrary, in company B, the risk of workers with an education level up to the 4th grade ($p = 0.048$; RR = 8.800; CI 95%: 1.122–69.036) reporting ankles/feet symptoms is almost nine times the risk of those with a higher education level. These data seem to confirm the findings of Ozturk & Esin (2011), who reported a higher prevalence of MSS in workers with low education levels. This is likely due either to the increased difficulty of workers with low education levels to understand working instructions (Costa *et al.*, 2009) or to the unclear transmission of information to the workers. However, the type of pedal used in company B may also have influenced the development of the symptoms in those regions, since the pedal of the machine is actuated with only one foot, while in company A, the pedal is actuated with both feet simultaneously, thus eliminating the static load on one foot.

3.2 Occupation related factors

Statistically significant associations between the perceived MSS and the occupational risk factors were only found in company A (Table 2), where the risk of reporting elbows symptoms is higher in workers with experience up to 20 years ($p = 0.017$; RR = 1.800; CI 95%: 1.045–3.101) than in more experienced workers. Also Roquelaure *et al.* (2012) found that longer job experience was associated with a lower MSS prevalence rate. On the contrary, Zhang *et al.* (2011) referred that the higher the number of years of experience, the higher the probability of developing MSS.

The results of these studies seem to indicate that workers with less years of work in the same job may have more difficulties in performing their work, which may lead to inadequate postures while carrying out their activities. However, a work experience up to 20 years may not necessarily imply little experience. This situation in company A may have been worsened by the lack of a elbows support, which, unlike company B, was not provided to the workers.

In what concerns the employment contract type, data indicate that the risk of workers with a fixed-term contract reporting MSS in the last 12 months is 5.6 times ($p = 0.021$; RR = 5.618; CI 95%: 1.923–16.393) that found for permanent workers. The results of the current study seem to support the findings of other authors (Benavides *et al.*, 2006; Roquelaure *et al.*, 2012), which reported a higher prevalence of MSS in the wrists/hands region of temporary workers when compared to the permanent workers. This fact is possibly due to the fear that the operators with a fixed-term contract have of becoming unemployed (Benavides *et al.*, 2006). Besides that, workers with less professional experience are more frequently exposed to time constraints (Roquelaure *et al.*, 2012). In company A, the prevalence of neck MSS is also statistically associated with the duration of the working rest breaks ($p = 0.020$), and the percentage of workers reporting neck MSS was higher in those enjoying rest breaks lower than 10 minutes than in those having longer rest breaks. In fact,

Table 2. Association between the prevalence of MSS and occupation related factors.

Risk factor	Region of the body	p**
<i>Company A</i>		
Work experience	Elbows	0.017
Contract type	MSS 12 months	0.021
Rest breaks	Neck	0.020

**Fisher's exact test.

the insufficient rest breaks during work are being pointed out as a risk factor for the development of MSS in sewing workers, mainly in the neck and shoulders (Wang *et al.*, 2007; Zhang *et al.*, 2011). This situation may indicate that, in company A, the duration of rest breaks may not be enough for workers to recover from the effort of the used muscles.

3.3 Environmental factors

In company A, the risk of workers reporting MSS in the lumbar region ($p = 0.052$; RR = 2.160; CI 95%: 1.152–4.051), in neck ($p = 0.006$; RR = 2.778; CI 95%: 1.500–5.145), and in shoulders ($p = 0.033$; RR = 3.333; CI 95%: 1.342–8.281) is higher for those who perceive to be exposed to extreme temperatures. In fact, during the observation of the working environment in both companies, the room temperature seemed to be relatively higher in company A than in company B. In this context, it is likely that the symptoms reported by the workers in those body regions may be explained by a significant increase of temperature while carrying out their tasks. Similar results were found by Gold *et al.* (2009), which referred that the exposure to extreme temperatures was associated with the prevalence of MSS. However, furthermore, the seat used in company A is not adjustable, forcing workers to perform the activity in an uncomfortable position which may explain a higher prevalence of symptoms in those regions (Rempel *et al.*, 2007; Wang *et al.*, 2008). On the other hand, the workers of company B who consider to be exposed to poor lighting conditions show a risk of reporting MSS in the neck region of 6.5 times ($p = 0.034$; RR = 6.500; CI 95%: 1.375–30.731), and in the lumbar region of 13 times ($p = 0.015$; RR = 13.000; CI 95%: 1.621–104.247) the risk of those who do not consider to be exposed to that risk factor. In fact, Parimalam *et al.* (2007) referred that the prevalence of back pain in sewing workers might be associated with inadequate positions due to poor lighting. It is important to highlight that the sewing activity is a precision work; therefore, when the lighting is inadequate, the workers' visual fatigue may predispose to inadequate positions, such as the flexion of the neck and back (Institut National de Recherche et de Sécurité, 2011). In this context, it was observed that, although there was a greater amount of natural light in company B, the artificial lighting levels could be lower, especially due to the fact that the luminaire support was too high, forcing workers to lean forward to improve their vision of the work plane and, thus, contributing to the development of MSS in the referred regions.

3.4 Organizational and psychosocial factors

Table 3 shows the statistically significant associations between the prevalence of MSS and the psychosocial factors.

In company A, the workers who perceive a low leadership recognition and support show a risk of reporting symptoms in the last 12 months 2.4 times the risk of those who do not perceive that risk factor ($p = 0.001$; RR = 2.396; CI 95%: 1.116–5.142). Similar results were found by Kaergaard & Andersen (2000) for the regions of the neck and shoulders of sewing workers. In addition, Canjuga *et al.* (2010) referred that the high social support by the managers was also associated with less absences from work in the short run. Besides that, the workers who perceive not being able to easily express their opinions and feelings at work show a risk of reporting symptoms in the last 12 months ($p = 0.028$; RR = 1.579; CI 95%: 1.031–2.419) that is 1.6 times the risk of those who perceive to be able to do it. In fact, Wang *et al.* (2005) observed a statistically significant association between the low work control and the prevalence of MSS in the sewing sector. By their side, in a study conducted in office workers, Van den Heuvel *et al.* (2005) found an association between the development of the carpal tunnel syndrome and low work control.

In company B, the prevalence of MSS in the last 12 months is associated with the workers' perception of working very fast ($p = 0.023$). Moreover, the workers who consider themselves exposed to a very fast work pace have a chance of reporting wrists/hands symptoms ($p = 0.041$; OR = 9.800; CI 95%: 1.036–92.696) that is 9.8 times that of those who do not consider to be exposed to that risk factor. These results corroborate what was found by other authors in studies conducted in sewing operators, which found that the prevalence of MSS in the wrists is associated to the fast work

Table 3. Association between the prevalence of MSS and organizational/psychosocial factors.

Risk factor	Region of the body	p
<i>Company A</i>		
Low leadership recognition	MSS 12 months	0.001**
Difficulty of expression at work	MSS 12 months	0.028*
<i>Company B</i>		
Very fast work pace	MSS 12 months	0.023**
	Wrists/hands	0.041**

*Chi-square independence test; **Fisher's exact test.

pace (Ozturk & Esin, 2011; Wang *et al.*, 2009). This situation may also have been aggravated by the fact that the sewing workers make many repetitive movements with wrists/hands (Sarder *et al.*, 2006; Sealetsa & Thatcher, 2011).

4 CONCLUSIONS

The risk factors associated with the reported MSS were distinct in the two companies, which seems to indicate the multifactorial nature of WMSD. This situation demonstrates that, in general, the prevalence of MSS in both companies is due to the adoption of the taylorist production system, which continues to prevail in the Portuguese footwear industry, as well as other important individual and psychosocial work aspects. However, despite the interesting conclusions made, the results must be carefully interpreted because of the reduced sample size.

This exploratory study seems to point out to the need for the implementation of a prevention ergonomic program focused on the identified risk factors, as well as for more research about the influence of each risk factor individually on the prevalence of MSS. In this context, it would be interesting to carry out an extensive study, including a large sample of companies and including also workers from the remaining sectors of this particular economic activity in order to be able to extrapolate the results with greater reliability to the studied populations.

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