

Musculoskeletal pain in women of the clothing industry: analysis through the perspective of the demand-control model*

Dor musculoesquelética em mulheres da indústria do vestuário: análise na perspectiva do modelo demanda-controle

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ABSTRACT: The objective of the study was to describe the occurrence of musculoskeletal pain (MEP) in workers of the clothing industry and to analyze the relationship between MEP and different forms of operationalizing the variable “high psychosocial strain”. Three hundred and six workers from 40 companies were evaluated for MEP, through a self-report on the presence or absence of symptoms. For evaluating the psychosocial factors, we used the Job Content Questionnaire (JCQ). Through the JCQ scores, the “high psychosocial strain” variable was operationalized in the forms: *quadrant, ratio, logarithm of the ratio and subtraction*. We tested the Poisson regression models, considering every form of calculation of the exposure variable and having MEP as the outcome. Of the workers evaluated, 54.3% had MEP. The probability of MEP occurrence in the presence of high strain at work in this study ranged from 1.2% to 75%, according to the operationalization of this variable. With the results obtained, we concluded that work situations with high psychosocial strain are associated with musculoskeletal pain in workers of the clothing industry. However, the form of definition and operationalization of the exposure variable (high strain) interfere in the values of probability of pain occurring.

KEYWORDS: Musculoskeletal pain; Occupational exposure; Textile industry.

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RESUMO: O objetivo do estudo foi descrever a ocorrência de dor musculoesquelética (DME) em trabalhadoras da indústria do vestuário e analisar a relação entre DME e diferentes formas de operacionalizar a variável “alta exigência psicossocial”. Trezentas e seis trabalhadoras de 40 empresas foram avaliadas em relação à DME, através do auto-relato sobre a presença ou não do sintoma. Para avaliação dos fatores psicossociais adotou-se o *Job Content Questionnaire* (JCQ). A partir dos escores do JCQ, a variável “alta exigência psicossocial” foi operacionalizada nas formas: *quadrante, razão, logaritmo da razão e subtração*. Foram testados os modelos de regressão de Poisson, considerando cada forma de cálculo da variável exposição e tendo como desfecho a DME. Das trabalhadoras avaliadas, 54,3% apresentavam DME. A probabilidade de ocorrência de DME na presença de alta exigência no trabalho variou de 1,2% a 75%, de acordo com a operacionalização desta variável. A partir dos resultados obtidos, pode-se concluir que situações de trabalho com alta exigência psicossocial estão associadas com dores musculoesqueléticas em trabalhadoras da indústria do vestuário. Entretanto, a forma de definição e operacionalização da variável exposição (alta exigência) interfere nos valores de probabilidade de ocorrência de dor.

DESCRIPTORES: Dor musculoesquelética; Exposição ocupacional; Indústria têxtil.

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INTRODUCTION

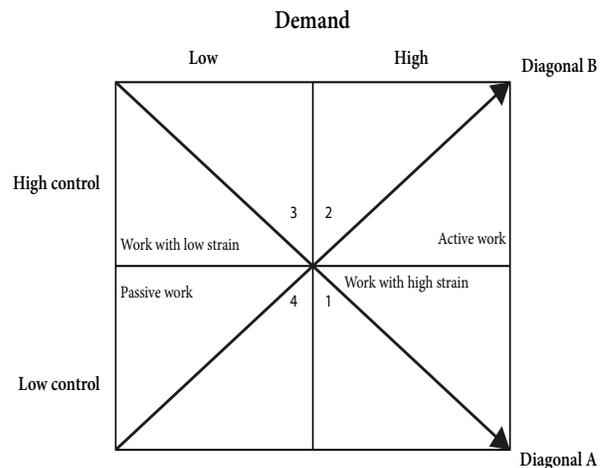
Musculoskeletal pain poses a serious problem for workers, who feel too weakened to perform their tasks, and for companies, which suffer the consequences of the decline in productivity and the costs of licenses and absences^{1,2}. Social Security data indicate that musculoskeletal pain represents the third cause of absences from work in Brazil, which has led to a growing demand for medical services and rehabilitation³.

Medical and social costs that originate from this problem have grown in recent years, significantly impacting the public health budget and referring to the need to identify the causal factors, so that prevention strategies for these problems can be created⁴.

The relationship between musculoskeletal pain and psychosocial work factors have been studied in various professional categories, although the measurement of these factors also represent a challenge for researchers^{2,4,5}. These factors include aspects such as extra tasks, pressure of time and repeatability; as well as monotony, low demand and lack of creativity. Psychosocial aspects are also considered, as well as the workers' decision-making about their work, interpersonal conflicts and lack of social support⁴.

Psychosocial factors are investigated using some theoretical models, like the one proposed by Karasek et al.⁶ in 1979, known as the Demand-Control Model (DC). This model was developed in a historical context in which the emerging trend in Europe and the United States was to emphasize the power and workers' control in the workplace. Thus, the demand-control model conceives two dimensions covering specific aspects of the work process⁶. The DC model is anchored on the premise that an imbalance in the relationship between psychological demands at work and the worker's effective ability in facing these demands can create occupational stress⁷.

In this model, psychological demands refer to what is excessive and difficult to perform, as well as the amount of conflicts in labor relationships. On the other hand, control is defined as the amplitude or decision margin the worker has regarding two aspects: autonomy to make decisions about their own work and the ability to be creative and to acquire new knowledge⁷. The main assumption of the DC model is that the condition of greater exposure to illness is present in workers that undergo high psychosocial strain⁸ (Figure 1).



Source: Karasek; Theorell⁶

Figure 1 – Graphical representation of the Demand-Control model

Evidence has shown that jobs with high psychosocial strains are more likely to have a negative effect on health^{8,9}. However, there is no consensus regarding the best way to define and operationalize this construct. A systematic review of the empirical use of the DC Model showed that the heterogeneity in the operationalization of the high psychosocial strain variable and the parameters used to define high strain, may be contributing to such different results found in the studies that analyzed the relationship between occupational stress and other health outcomes¹⁰.

In adult life, the social determinants of health are mostly connected with life at work¹¹. Moreover, these determinants are unequally distributed between occupational classes and between men and women^{12,13}. Women are the majority in occupational classes of lower income and, oftentimes, occupational stress is linked to jobs traditionally considered female such as education, caring the sick and sewing¹⁴. Gender differences related to employment conditions have an impact on occupational health and safety and should not be ignored.

Clothing sector workers are affected by various health conditions such as arterial hypertension, mental, visual and hearing disorders and problems of musculoskeletal origin¹³. Although many symptoms are associated with musculoskeletal disorders linked to work, one of the most prevalent complaints is pain¹². Musculoskeletal pain is described as a common health outcome among teachers¹³, nurses¹² and workers of the clothing industry¹⁵.

Considered a center of the clothing industry, the city of Divinópolis, located in the midwestern region of the state of Minas Gerais, Brazil, shows a predominance of micro and small companies, coupled with a low-skilled workforce. This scenario contributes to the exploitation and discrimination of women, who represent about 90% of the workers of this industry¹⁵. Thus, to investigate the occurrence of musculoskeletal pain in the workers of the clothing industry and test their association with psychosocial factors may help define preventive strategies and health promotion strategies. In addition, considering the importance of the DC Model for worker health and its use in Brazil, it is necessary to analyze the different forms of operationalizing the high strain construct at work.

Therefore, regarding the DC Model, the objectives of this study were to describe the occurrence of musculoskeletal pain in workers of the clothing industry and to analyze the relationship between different forms of operationalizing high strain at work and musculoskeletal pain in this population.

METHODS

This is a cross-sectional observational study, whose data are part of the project entitled “Interaction of psychosocial factors and the ability to work in workers of the clothing industry”. This data was collected from January to December 2011, with the participation of 306 workers from 40 micro and small clothing industry companies of the city of Divinópolis, Minas Gerais. The study was approved by the Ethics Committee of the Federal University of Minas Gerais (UFMG), under ETIC 0196.0.203.000-10. The sample was selected by convenience. The initial contact with the companies was made by telephone and after the signing of the consent form by the companies, we began collecting data. A single researcher collected data, following a previously established schedule, within the industry itself. All workers were invited to participate in the study, though only those who agreed and signed the consent form remained. The data collection lasted about 20 minutes for each worker.

For a description of the sample, we used an evaluation protocol containing demographic questions (age, education, marital status, number of children) and issues related to work, such as industry sector, time and working hours in the company. These data were part of an evaluation protocol developed by the authors, containing only closed questions.

For the evaluation of psychosocial factors, we adopted the Job Content Questionnaire (JCQ), developed

from the DC Model⁶. Araújo and Karasak¹⁶ performed the validity and reliability of the Brazilian Portuguese version of the questionnaire. The JCQ is a tool for the evaluation of work stress based on the relationship between psychological strain and control in the labor process. The tool contains 49 questions. For each question, there is a scale ranging from 1 to 4 points (1 = strongly disagree, 2 = disagree, 3 = agree, 4 = strongly agree). Using this score, we can separately calculate the scores for psychological strain and control at work. These scores can be used in a continuous form or dividing it into quantiles (tertile and quartile). The definition of the independent variable “high psychosocial strain” variable can be accomplished in various ways, using these scores. In this study, we opted for the ways most used in the literature, as pointed out in the systematic review by Alves et al.¹⁷. They are: *quadrant ratio* (continuous tertile and quartile), *logarithm of the ratio* (continuous tertile and quartile) and *subtraction* (continuous tertile and quartile).

For the operationalization in the *quadrant* form, initially, the continuous variables – psychological strain and control – were categorized, taking into consideration the median cutoff (below median = low; above the median = high), which resulted in quadrants as described: low strain (high control and low demand), high strain (high demand and low control), active work (high control and high demand), passive work (low control and low demand).

For other forms of operationalization, we calculated the continuous values of the *ratio* (ratio between demand and control), the *logarithm of the ratio*, and finally the *subtraction* form (difference between demand and control). These three forms were also categorized into high strain when the values were higher than the 2nd tertile – percentile 66 (*ratio*, *logarithm of the ratio* and *tertile subtraction*); or above the 3rd quartile – 75 percentile (*ratio*, *logarithm of the ratio* and *quartile subtraction*).

Musculoskeletal pain was assessed by the worker’s self-report on its presence or absence. If the pain was present, the employee then had to report its location.

The descriptive analysis of the different forms of operationalizing high strain was performed and then the Poisson regression models with robust variance were tested, considering each calculation form of the exposure variable and having as an outcome the occurrence of musculoskeletal pain. These models are shown in cross-sectional studies with binary outcomes (e.g. occurrence of pain), and the association between exposure and outcome is estimated by the prevalence ratio (PR). For each model, in this study, the prevalence ratio values were estimated

(PR) with their respective 95% confidence intervals (95%CI).

All analyses were performed with the STATA software version 10.0, considering a 5% significance level.

RESULTS

Descriptive data

The study included 306 workers with a mean age of 36.02 years (SD = 11.07). Considering education, 22.6% had not completed elementary school, 37.6% had completed the full primary or had incomplete secondary education and 39.8% had completed high school or more.

Regarding marital status and the number of children, we found that just over half of the sample (58.2%) lived with a partner and 60.5% had children, with 46.0% of these women having up to two children. The 306 workers were thus distributed in the productive sectors: 62.5% in the sewing sector, 27.6% in the ironing sector and 9.9% in the finish sector. In all companies, the workday was of nine hours a day (from 7 to 17h15), with an hour break for lunch and 15 minutes for coffee, Monday through Thursday. On Friday, working hours were from 7 to 16h to complete 44 hours per week. It is noteworthy that 31.7% of workers worked overtime. Working time in the industry ranged from one to 324 months with a median of 33 months or 2.75 years.

Among the workers evaluated, 166 (54.3%) had musculoskeletal pain. The most affected body regions were: column (21.9%), arms/shoulders (12.0%), knees/legs (8.5%), hands (4.7%), head (4.3%) and other places (2.9%).

JCQ data

The isolated analysis of the JCQ items relating to the psychological demands and control dimensions at work, allowed us to observe that: regarding the variable control, the work requires a high level of skill for most workers (87.6%), though they have opportunity to learn new things (81%). Still on work control, decisions on the tasks were less frequent (28.8%) (Table 1).

The characteristics that stood out in relation to high psychosocial demand were the strain for long periods of concentration on tasks (85.6%), followed by repetitive work (84.0%) (Table 1).

Table 1 – Description of the characteristics of the psychological Control and Demand dimensions for workers of the clothing industry. Divinópolis, Minas Gerais, Brazil, 2011 (N = 306)

Control characteristics	No		Yes	
	N	%	N	%
Learning new things	58	19.0	248	81.0
Requiring creativity	124	40.6	182	59.4
Demands a high level of skill	38	12.4	268	87.6
In charge of different tasks	138	45.1	168	54.9
Opportunity of developing special tasks	95	31.0	211	69.0
Making decision for tasks	218	71.2	88	28.8
Little liberty of decision	140	45.7	166	54.3
Demand characteristics				
Repetitive work	49	16.0	257	84.0
Accelerated rhythm	113	40.0	193	60.0
I don't have excessive volume of work	130	42.4	176	57.6
Requires long periods of focus for the tasks	44	14.4	262	85.6
Tasks are interrupted	120	39.2	186	60.8
Work is hectic	210	68.7	96	31.3
Waiting for the work of others makes work slower	148	48.4	158	51.6
Time to accomplish the task is sufficient	42	13.8	264	86.2
Free of conflicting demands	150	49.1	156	50.9

After analyzing the “high strain at work” variable in the forms described in the methodology of this study, we observe in Table 2 that the prevalence of high strain ranged from 24.8% (quadrant shape) to 36.9% (form of tertile subtraction) (Table 2).

Table 2 – Prevalence of high strain, according to the forms of operationalization of the variable – Clothing industry workers, Divinópolis, Minas Gerais, Brazil, 2011 (N = 306)

Forms of operationalization	Frequency	Percentage
Quadrant		
Low strain	92	30.1
High strain	76	24.8
Active work	87	28.4
Passive Work	51	16.7
Tertile Ratio		
Low strain	196	64.1
High strain	110	35.9
Quartile Ratio		
Low strain	230	75.2
High strain	76	24.8

Continues...

Table 2 – Prevalence of high strain, according to the forms of operationalization of the variable – Clothing industry workers, Divinópolis, Minas Gerais, Brazil, 2011 (N = 306)

Forms of operationalization	Frequency	Percentage
Logarithm of Tertile Ratio		
Low strain	196	64.1
High strain	110	35.9
Logarithm of Quartile Ratio		
Low strain	230	75.2
High strain	76	24.8
Tertile Subtraction		
Low strain	193	63.1
High strain	113	36.9
Quartile Subtraction		
Low strain	222	72.5
High strain	84	27.5

Poisson regression analysis

The association analysis between high strain at work and musculoskeletal pain using the Poisson model indicated that an individual with high strain at work, according to the operation in the quadrant form, has an increased 44% probability of having musculoskeletal pain over those exposed to low strain (p = 0.013).

The results showed associations between variables when using the operationalization in the *continuous ratio* form (p = 0.010) and the *quartile ratio* (p = 0.037). In the case of *continuous ratio*, the increase of one unit in the high strain value increased 75% the probability of pain. For the *quartile ratio*, an individual with high strain at work, has 25% more probability of having musculoskeletal pain compared to those with low strain.

There was also an association between high strain and musculoskeletal pain for the forms *logarithm of continuous ratio* and *logarithm of the quartile ratio* (p = 0.014 and 0.037, respectively). In the case of *logarithm of the continuous ratio*, the increase of a unit for the high strain increased by 53% the probability of pain. For the *logarithm of the quartile ratio*, an individual subjected to high strain at work has a 25% greater probability of pain than those with low strain.

The form of *subtraction* showed an association between high psychosocial strain and the presence of musculoskeletal pain only for the *continuous subtraction* variable (p = 0.01). The one-unit increase in the value of *continuous subtraction* increased by 1.2% the probability of occurrence of musculoskeletal pain (Table 3).

Table 3 – Poisson distribution with robust variance, considering different ways of operationalization of the independent variable (high psychosocial strain) and the presence of Musculoskeletal Pain as an outcome for workers of the clothing industry. Divinópolis, Minas Gerais, Brazil, 2011 (N = 306)

Operationalization	p-value	PR	95%CI
Quadrant			
Low strain	-	1.00	
High strain	0.013	1.44	[1.08; 1.91]
Active work	0.100	1.28	[0.95; 1.71]
Passive work	0.328	1.19	[0.84; 1.68]
Continuous ratio			
	0.010	1.75	[1.14; 2.67]
Tertile ratio			
High strain	0.350	1.10	[0.90; 1.36]
Quartile ratio			
High strain	0.037	1.25	[1.01; 1.55]
Logarithm of Continuous Ratio			
	0.014	1.53	[1.09; 2.14]
Logarithm of Tertile Ratio			
High strain	0.350	1.11	[0.90; 1.36]
Logarithm of Quartile Ratio			
High strain	0.037	1.25	[1.01; 1.55]
Continuous subtraction			
	0.010	1.012	[1.002; 1.021]
Tertile subtraction			
High strain	0.308	1.11	[0.91; 1.37]
Quartile subtraction			
High strain	0.059	1.23	[0.99; 1.51]

RP = Prevalence Ratio 95%CI = 95% Confidence Interval

DISCUSSION

The results of this study showed that the probability of occurrence of musculoskeletal pain in the presence of high strain at work varied according to the form of operationalization of this variable. The highest probability ratio was found in the form of *continuous ratio* (75%) and the less likely in the form of *subtraction* (1.2%). According to Alves et al.¹⁷, the *ratio* form does not seem to be adequate since it is possible to obtain the same result through the division of numbers in different situations. In other words, different numbers may express similar ratios, although the demand and control situations are different. Country to this argument, Campos¹⁸, using salivary

cortisol analysis of nursing workers, considered the form of *subtraction* as the most suitable for discriminating high and low strain at work.

In this study, musculoskeletal pain was associated with all forms used for operationalization of the high psychosocial high psychosocial strain variable. The evidences currently available are still insufficient to conclude whether one of these forms is superior to the others¹⁹, though it is important to note that the way to compute this variable can influence its interpretation. The *ratio*, *logarithm* and *subtraction* approaches allow us to identify a job that has high psychosocial strain even in work situations with low demand and high control, unlike the *quadrant* approach, which considers this situation as a low strain job. On the other hand, the assumption of the DC Model, in the operationalization of the *quadrant*, is that high demand and high control work should be considered as active jobs, i.e. jobs that provide opportunities for learning and skills enhancement. Thus, what determines whether the job is stressful or not, is the worker's level of control over the activities performed⁷. However, from the point of view of the workers' health, this becomes dangerous, because there may be situations of overload, with negative consequences for health, due to excessive demand, even in the presence of high control. This issue has already been mentioned in other studies using the Karasek Model and obtained evidence showed that high job control was not effective in reducing the effects of high psychological strain for worker's health^{16,20}.

The sample of this study was made up mostly of young women, whose working time in the company showed great variability, with a median of about three years. These aspects should contribute to a reduced number of musculoskeletal pain and stress due to the low age and short exposure time to the task. Despite the short time working in the company, more than half of the workers in this study had musculoskeletal pain in different body regions, being more frequent, complaints in the spinal region. This result corroborates the study of Anderson et al.²¹, who reported that the prevalence of musculoskeletal pain in more than one anatomical region is common in activities with repetitive and accelerated movements and among those who work, most of the time, sitting down. The analysis of the work process performed by Augusto et al.¹⁵ showed that workers remain fixed in their jobs throughout the day, whether sitting, in the sewing and finish sector, or standing, in the cut and ironing sectors. Also, to obtain a better view while performing the tasks, the workers evaluated by the researchers maintained a

position of flexion of the cervical spine and often adopted an inclined and rotated body posture.

Maintaining a sitting posture during long working hours contributes to the development of disorders associated with the vascular and musculoskeletal systems^{22,23}. The sitting position generates compression of blood vessels, causing pain in the lower limbs, swelling in the feet and a feeling of fatigue in the legs²². The sitting posture, especially if the body is anteriorly inclined and kept in a static position, is also associated with musculoskeletal pain, especially in the lumbar spine region²³.

Beyond the biomechanical factors, the ergonomic and psychosocial aspects are also associated with musculoskeletal pain^{1,2}. In this study, the analysis of the JCQ items relating to the psychological demands and control at work dimensions showed classic characteristics of the scientific organization of work. This form of organization expropriated the laborer knowledge and turned into repetitive, monotonous and discouraging activities, as well as requiring maximum physical and mental capacity for the workers. The workers of this study are subjected to repetitive, fast-paced work, and require high concentration in their tasks. These characteristics represent a working process with high strain, which together with a low power of decision on the tasks and especially regarding company policies, lead the workers to stress exposure.

Since this is a cross-sectional study, it is not possible to infer causality. In other words, we cannot say that the job characteristics were causes of the musculoskeletal pain. However, it was possible to demonstrate association between these variables, regardless of the form of operationalization of the independent variable (high strain). These results provide further evidence that a stressful job can be a source of physical and psychological illness²⁴.

A limitation of this study is the possible "healthy worker" effect, i.e. it is possible that the study has only evaluated the healthiest workers, who were present in the company at the time of the research, since it is not known how many workers may be away from work due to illness. It is also possible that only companies where working conditions are less unfavorable to health have been chosen, since the selection of the companies was for convenience. So, we may have underestimated both the outcome variable and the exposure variable.

Despite the limitations mentioned, this study contributes to the understanding of the precariousness of the work for women in the clothing industry. The presence of biomechanical and psychosocial risks indicates the need for educational and preventive measures such as postural orientation, position changes and adequacy

of work security. The introduction of breaks, rotation functions, greater power to decide on the tasks and the pace of work may also help in adjusting the working conditions and reducing musculoskeletal pain. The adoption of preventive measures brings, not only direct benefits for workers, but also saves money for the pension system by avoiding sick leave and early retirement.

CONCLUSION

This study contributed to the understanding that work situations with high psychosocial strains are associated with musculoskeletal pain in workers of the clothing industry and the form of definition and implementation of the exposure variable (high strain) interferes with the likelihood of pain. In this study, the highest probability of pain occurrence was found in the form of continuous ratio and the lower probability was found in the form of subtraction operationalization of the

“high strain” variable, with a wide variability between these values (1.2% to the form of subtraction and 75% for the form of continuous ratio). Future research using more objective assessments of stress in workers can help defining the parameters to operationalize the high psychosocial strains at work, facilitating the comparison of results between studies and the understanding of how this characteristic of the workers may be associated with negative health outcomes.

The results highlight the need for reflecting on the impact of working conditions, organizational rigidity and loss of control over labor activity, concerning the health of workers in the clothing industry. Thus, the empowerment of these women, through workshops and continuing educational processes, can favor their ability to take control in the face of working conditions and can also facilitate the adoption of preventive measures to reduce musculoskeletal pain, preventing sick leave and early retirement in this sector.

Authors' contribution: V. G. Augusto – participated in the conception, data collection and writing the final manuscript; C. F. Aquino – participated in the data analysis and writing the final manuscript; D. S. P. Gontijo – participated in the data analysis and writing the final manuscript; R. F. Sampaio - participated in the conception and the writing the final manuscript.

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