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ORIGINAL

Health risk level and prediction of musculoskeletal pain in workers under telework conditions: A matrix approach

Nivel de riesgo para la salud y predicción del dolor musculo-esquelético en trabajadores en condiciones de teletrabajo: Un enfoque matricial

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ABSTRACT

Objective: evaluate the level of ergonomic risk and discomfort among musculoskeletal workers in teleworking conditions, and determine the potential risk to health of the development of musculoskeletal disorders.
Methods: a descriptive and cross-sectional study was carried out. In a sample of 212 workers (87,2 % of the population). A questionnaire under the Google Forms application was used, in addition, video calls were made to evaluate the work station. Together, the ROSA method was used. Data analysis was performed with SPSS Version 26.
Results: (61,8 %) of the participants were male with a mean age of 45,86 ± 9,0 years, with a job history of 10,72 ± 8,8 years and a computer use time of 7,33 ± 3,0 hours. (41,9 %) of the workers had a high level of dysergonomic risk. Likewise, 42,9 % of the personnel who teleworked did not present a high level of musculoskeletal pain. The health risk was (83 %), with a range of moderate to high and very high level. There is a strong-positive correlation between health risk and CMDQ total scores, given by rho = 0,896, likewise a strong-positive correlation between health risk and ROSA scores, given by rho = 0,869. With 95 % confidence and p <0,05.
Conclusions: it was evidenced that teleworkers carry out tasks under inadequate conditions and environment, not adapted to their anthropometry; In addition, they are exposed for a long time to biomechanical risk, generating musculoskeletal discomfort.

Keywords: Health Indicators; Musculoskeletal Pain; Workers; Telecommuting.

RESUMEN

Objetivo: evaluar el nivel de riesgo ergonómico y malestar entre musculo-esqueléticos de los trabajadores en condición de teletrabajo, y determinar el riesgo potencial para la salud del desarrollo de trastornos musculo esqueléticos.
Métodos: se realizó un estudio descriptivo y trasversal. En una muestra de 212 trabajadores (87,2 % de la población). Se utilizó un cuestionario bajo la aplicación Google Forms, además se realizó vídeo-llamadas, para evaluar la estación de trabajo. Conjuntamente, se utilizó el método ROSA. El análisis de datos se realizó con SPSS Versión 26.
Resultados: el (61,8 %) de los participantes eran masculinos con edad media de 45,86±9,0 años, con una antigüedad laboral 10,72±8,8 años y un tiempo de uso de computadora de 7,33±3,0 horas. El (41,9 %) de los trabajadores tuvieron un nivel alto de riesgo disergonómico. Así mismo, el 42,9 % del personal que teletrabajaba no presentaba un nivel de dolor músculo-esquelético alto. El riesgo para la salud fue del (83 %), con un rango de moderado a alto y muy alto nivel. Existe una correlación fuerte-positiva entre el riesgo

para la salud y las puntuaciones totales del CMDQ, dado por un rho = 0,896, de igual forma una correlación fuerte-positiva entre el riesgo para la salud y las puntuaciones ROSA, dado por un rho = 0,869. Con el 95 % de confianza y p <0,05.
Conclusiones: se evidenció que los teletrabajadores desarrollan tareas bajo condiciones y medio ambiente inadecuados, no adaptados a su antropometría; además, están expuestos por largo tiempo a riesgo biomecánico, generando molestias músculo esqueléticas.

Palabras claves: Indicadores de Salud; Dolor Musculoesquelético; Trabajadores; Teletrabajo.

INTRODUCTION

As a result of technological transformations, new forms of work organization such as teleworking and the increasing aging of workers, occupational health must face new challenges in order to guarantee workers the necessary protection from occupational health and safety to avoid damage to their health, taking into consideration the increase in the incidence rate of work-related musculoskeletal disorders.[1]

The National Institute of Occupational Safety and Healt[1] in the last report issued regarding occupational diseases has shown a significant increase in the last decade of musculoskeletal injuries (MSI), which is considered the main occupational health problem in the world. Fandiño et al.[2] estimated that the MSI to which teleworkers are exposed are mainly related to inadequate postures, maintained by long working hours and inadequate conditions and environment, in addition to the lack or adequacy of the workstation.

Herrera et al.[3] expressed that one of the main problems in which occupational health must act is that workers are unaware that teleworking brings occupational hazards that can affect their health, the main risks being dysergonomic health problems in this group of workers. The authors consider that the lack of training of these workers, together with the fact that they do not have adequate working space, since they lack space, structure and ergonomic tools, such as chairs, desks, accessories such as keyboard, mouse, adjustable elevator adapted to their anthropometry; all these elements lead to the development of musculoskeletal injuries in the short term.

In this sense, the workers, who abruptly changed their work in the office for teleworking, did not have adequate equipment and working conditions in their homes, and instead organized offices with inadequate furniture and equipment.[4]

INSST[5] proposes that among the main skeletal muscle disorders presented by teleworkers are carpal tunnel syndrome, Quervain's tenosynovitis, epicondylitis, cervical pain, back pain and low back pain. It is necessary to point out that the dysergonomic risks related to the new technologies associated with teleworking are different from the traditional risks, nowadays included within the new and emerging occupational risks; this is due to the changes in the working conditions and environment, by the adoption of different postures to the traditional ones, leading to a shift in the typology of musculoskeletal disorders; there is no control of the environmental conditions of the work environment, product of physically relocating the worker.

In short, these teleworkers tend to be exposed for longer periods of time to dysergonomic risks, since there is no control over the time of performance of work tasks. In addition, these teleworkers tend to be more sedentary than the rest of the workers, favoring or aggravating the appearance of musculoskeletal discomfort, and may generate, in time, musculoskeletal disorders, which can lead to the deterioration of performance in their work activities.[5]

According to the previously stated, the objective of the study is to evaluate the level of ergonomic risk and musculoskeletal discomfort of teleworking workers, and to determine the potential health risk of the development of musculoskeletal disorders.

MATERIALS AND METHODS

A quantitative, descriptive, cross-sectional study was carried out. The population consisted of 243 workers of the managerial team, at national level, of a Venezuelan food company, which at the time of the research were in teleworking mode. The type of sampling was intentional, where the sample consisted of 212 workers (87,2 % of the population), including all workers who used the computer for a period of time of 3 or more hours a day, for the execution of their activities and willing to participate in the study. In addition, all workers who had suffered any type of chronic musculoskeletal pain in the last 3 months were excluded.

The research was conducted in two phases. Hedge et al.[6] in phase 1 collected data in the period between September 2021 and January 2022, through a questionnaire developed under the Google Forms® application, where the musculoskeletal symptomatology of the participants was collected through the Cornell Musculoskeletal Pain or Discomfort Questionnaire (CMDQ); for sedentary workers in its male and female version. In phase 2 of the research, video calls were made to the participants to evaluate the workstation. Initially, participants were

asked to show their workstations in detail; they were also asked to locate a measuring instrument such as a tape measure or ruler to take measurements in some spaces and distances between work elements. They were then asked to place the camera at the side of the workstation at table height for approximately 10 minutes while working.[7]

The postural assessment was performed using the ROSA (Rapid Office Strain Assessment) method.[8] Which was designed to quickly quantify the risks associated with computer work through an observational assessment and has acceptable levels of reliability, accuracy and validity for both face-to-face and workstation imaging assessments.[9] The ROSA method allowed observers to quickly quantify risk factors grouped into the following three sections: chair (section A), monitor and telephone (section B) and keyboard and mouse (section C). Section A has four subsections: seat height, seat depth, armrests and backrest. Risk factors were diagrammed and coded as increasing scores from 1 to 3. Final ROSA scores ranged in magnitude from 1 to 10, and each successive score represented an increased risk factor presence. The ROSA research established a final score of 5 as the cut-off value for the recommended ergonomic intervention.

The final score of the ROSA method was classified according to levels proposed by Chaiklienga et al.[10] as follows:

1 = low (score 1-2)
2 = moderate (score 3-4)
3 = high (score 5-7)
4 = very high (score 8-10)

Similarly, final CMDQ scores were derived and ranked the level of discomfort/pain in office workers as follows:

0 = no discomfort (score 0)
1 = mild (score 1,5 to 4,5)
2 = moderate (score 5 to 14)
3 = severe (score 15 to 45)
4 = very severe (score ≥ 45)

All data analysis was performed with SPSS Version 26. Descriptive statistics were used to summarize personal factors, dysergonomic health risks and levels of musculoskeletal complaints. The risk matrix (table 1) proposed by Chaiklienga et al.[10] was used, which combines objective assessments of ergonomic risks with subjective assessments of self-reported discomfort. It classifies individuals into different levels of health risk based on the probability of exposure to ergonomic hazards (measured by the ROSA method) and the severity of perceived discomfort (measured by the Cornell Musculoskeletal Discomfort Questionnaires). The matrix assigns scores to each level of risk, ranging from low to very high, which allows prediction of musculoskeletal pain.

By taking into account both ergonomic risks and self-reported discomfort, the matrix provides a comprehensive approach to assessing and managing the health risks associated with musculoskeletal pain in this group of workers.

Table 1. Health risk score on the Cornell Musculoskeletal Pain or Discomfort Questionnaire (CMDQ) matrix by ROSA method

		Risk level (ROSA)			
Health risk		1	2	3	4
Musculoskeletal pain level	4	4	8	12	16
	3	3	6	9	12
	2	2	4	6	8
	1	1	2	3	4
	0	0	0	1*	2*

Source: Chaiklienga et al.[10]

Note: Results of 1* and 2* in the table are presented when there are levels of 0 for musculoskeletal discomfort (CMDQ) and levels 3 or 4 for ergonomic risk (ROSA). The researchers believed that, even if the office staff rated discomfort as zero (0), if the ergonomic risk assessment indicated a high to very high risk, this could trigger at least low-level health risk in the long term. The color code for the level of health risk is as follows; gray = no risk, green = low risk, yellow = moderate risk, orange = high risk, red = very high risk.[10]

The categories adopted for health risk were as follows:
No risk = score 0
Low risk = scores 1-2

Moderate risk = scores 3-5
High risk = scores 6-8
Very high risk = scores 9-16

Similarly, Spearman's Rank Correlation Coefficient was used to determine the relationship of ROSA total scores and Cornell questionnaire musculoskeletal pain total scores with health risk. Data were analyzed using SPSS version 26 and p<0,05 was considered as significant correlation.

RESULTS

The majority of the participants were male (61,8 %), with a mean age of 45,86±9,0 years, with a work seniority 10,72±8,8 years and a daily computer usage time of 7,33±3,0 hours.

For the majority of office workers (41,9 %) the dysergonomic risk was at a high level; for 29,7 % the risk was moderate; for 19,8 % the risk was low and for 8,5 % of the participants the risk was very high, as shown in table 2. Likewise, the results show that 42,9 % of the personnel working under teleworking conditions did not present a high level of musculoskeletal pain, for 37,3 % of the sample the level of discomfort was medium and 14,2 % of the workers surveyed did not manifest musculoskeletal pain during the investigation.

Table 2. Risk matrix applied to workers in the management team, at the national level, of a Venezuelan food company

		Risk level (ROSA) *f* (%)				Total
Health risk		1	2	3	4	
Musculoskeletal pain level	4	0 (0)	14 (6,6)	59 (27,8)	18 (8,5)	91(42,9)
	3	26 (12,3)	30 (14,2)	23 (10,8)	0 (0)	79 (37,3)
	2	4(1,9)	3 (1,4)	3 (1,4)	0 (0)	10 (4,7)
	1	0 (0)	2(0,9)	0 (0)	0 (0)	2 (0,9)
	0	12 (5,7)	14 (6,6)	4 (1,9)	0 (0)	30 (14,2)
Total		42 (19,8)	63 (29,7)	89 (41,9)	18 (8,5)	212 (100)

The risk analysis was performed using the risk matrix (table 1) and the results are shown in table 3. For 14 % of the workers in teleworking conditions the health risk was moderate, and for 69 % the risks were high (22 %) to very high (47 %). The overall health risk for office staff was 83 %, ranging from moderate to high and very high.

Table 3. Level of health risks for workers in the management team, at the national level, of a Venezuelan food company

Level of health risk	Frequency (%)
No risk	26 (12)
Low	10 (5)
Moderate	29 (14)
High	47 (22)
Very High	100 (47)

As for the correlations between health risk scores and ergonomic risks and levels of musculoskeletal pain or discomfort, there is a strong-positive correlation between health risk and CMDQ total scores, given by a rho = 0,896 and likewise a strong-positive correlation between health risk and ROSA scores given by a rho = 0,869. With 95 % reliability and p<0,05, a statistically significant, positive and directly proportional linear correlation was found among the variables studied (see table 4).

Table 4. Correlation coefficient between the values of health risk and the ROSA method score and the score of the level of health risk with musculoskeletal pain of workers in the management team, at the national level, of a Venezuelan food company

	Correlation coefficient	Sig. (bilateral)
Level of discomfort CMDQ	,896**	0,000
Dysergonomic risk level ROSA	,869**	0,000
**The correlation is significant at the 0,01 level. (bilateral)		

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DISCUSSION

Santillán[11] reports that many organizations, in both the public and private sectors, have implemented new forms of work organization, such as teleworking and the use of information and telecommunication technology (ICT) platforms, in order to solve the global economic crisis. There are many advantages that this type of work can generate, not only for the organizations but also at an environmental level, and it has even been an opportunity to promote inclusive work. This modality is characterized by the provision of services outside the organization's facilities, making use mainly of ICTs.

Besides the advantages, this way of working has brought with it problems in the health of these teleworkers; as it has been mainly the injuries of the locomotive apparatus; García et al.[12] affirms that it is the pathology that more affects the teleworkers and according to the World Health Organization[13] is the first cause of disability worldwide.

Based on the results of this research, it could be observed that 42,9 % of these teleworkers presented high intensity musculoskeletal pain; for this group of teleworkers a high risk was estimated in 69 % to very high in 47 % of the respondents. In the case of office personnel, the risk was 83 % in the moderate high and very high range. Chaiklieng et al.[10] states that a high proportion of office workers were exposed to work-related dysergonomic risk. In this study, the health risk assessment showed that 51,1 % of the workers were exposed to a moderate, high or very high risk of musculoskeletal pain.

Similarly, these results coincide with Chaiklieng et al.[14] where the study revealed that workers in teleworking conditions presented a moderate to high level of ergonomic risk according to the application of the ROSA method. In addition, there was a significant correlation between levels of discomfort and health risk scores for developing musculoskeletal disorders.

The levels of health risks reported in the present study are in agreement with the research conducted by Chaiklieng et al.[15] where 216 call center workers participated and it was revealed that most of them presented a moderate to high health risk of suffering from neck, shoulder and back pain. The health risk assessment matrix showed that most workers had a moderate level of risk for these musculoskeletal disorders. Similarly, there was a significant positive correlation between health risk scores and self-reported distress scores, indicating that the higher the health risk, the more distress workers experienced.

CONCLUSION

It is concluded that the health risk assessment matrix can be used to predict and control musculoskeletal pain in teleworking workers as a function of their exposure to ergonomic risk factors. Overall, the study highlights the importance of addressing ergonomic factors and implementing preventive measures to reduce the risk of musculoskeletal disorders in teleworking workers.

Through these lines of research it is evident that teleworkers, unlike office workers, develop their tasks under inadequate conditions and environment, not adapted to their anthropometry; in addition, they are exposed for a long time to biomechanical risk, generating musculoskeletal discomfort; among other factors is the lack of knowledge by these teleworkers about the correct postures that they should adopt in front of the computer. Therefore, it is necessary for occupational health and safety services to carry out interventions where health promotion and prevention of occupational diseases prevail, through educational talks.

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