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HEALTH IN THE WORKPLACE: POSTURE, ERGONOMICS AND MUSCULOSKELETAL DISORDERS

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ABSTRACT

Objective: The aim of this study was to map the epidemiological profile of chronic musculoskeletal disorders and the ergonomic risks of body posture in the office environment. Methods: Data were collected using an electronic form composed of sociodemographic questions and adapted versions of the Nordic Musculoskeletal Symptoms and Rapid Office Strain Assessment questionnaires. Results: The average age of the 73 participants in the extension project was 25.3 years and most of them had higher education. Of these, 86.3% had experienced pain, numbness, or tingling in the past 12 months and of these, 90.5% had more than one body part affected by symptoms. Of the thirteen body postures evaluated (sitting, leaning, knee position, feet, elbows, forearms and head), all were identified as ergonomically inadequate, especially those related to the chair used. Conclusion: There is an evident need for immediate health care actions for this population, since the office environments were not ergonomically adequate and the workers were already ill. Ergonomic intervention actions and health education are essential to guide the risks of this environment and propose behavioral changes to reduce/prevent musculoskeletal disorders. One limitation of the study may be that the sample was affected by the effect of healthy workers, i.e., those who were already affected by chronic musculoskeletal disorders were interested in participating in the project.

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INTRODUCTION

In recent decades, there have been changes in ergonomic work standards on a global scale, where millions of people have started to perform their occupational activities in a computerized environment (Radulović *et al*., 2021). These technological advances and digital culture have been major drivers for increasingly sedentary work (Deery *et al.*, 2024).

Changes in lifestyle resulting from the emergence of new technologies, continuous innovation of processes and mechanization of work have led to the transformation of society's life habits, as a result of a new population profile, predominantly hypokinetic, dominated by prolonged maintenance of the sitting posture, insufficient supply of dynamic muscle activity, low postural and activity variation (Schranz *et al.,* 2016; Hyeda and Costa, 2017).

The reduction in movement and commuting patterns, the increase in the average daily sitting time, exposure to screens - television, tablet, computer, smartphone (McDowell *et al*, 2020*)* and levels of physical inactivity (Botero *et al*, 2021) associated with sedentary behavior in daily life and in the nature of the work performed, corroborates the increase in illness in the population (Tersa-Miralles *et al*, 2020), mortality related to oncological and cardiometabolic diseases (Radulović *et al*., 2021) and the manifestation of work-related musculoskeletal disorders (Baker *et al*., 2018).

Work-related musculoskeletal disorders are one of the most serious public health problems around the world (Lopes *et al.*, 2021) and is related to hypokinetic posture, the excessive use of certain muscle groups, and physiological, biomechanical, psychosocial, organizational, and ergonomic factors (El Kadri,, de Lucca, 2022; Santos *et al.*, 2021). The high prevalence of these disorders generates negative impacts for the individual with loss of quality of life, occupational leave, and early retirement, as well as for society, due to loss of productivity, increased spending on the health and social security systems (Radulović *et al*., 2021; Tersa-Miralles *et al*, 2020).

Associated with this, after the COVID 19 pandemic, remote work remained a functional reality. In this new concept, workers began to perform work activities in a domestic environment, generating difficulties in adaptation, mainly related to the adequacy of the environment, work instruments and the establishment of routines (Buomprisco *et al.*, 2021). In addition, employment organizations offered little or almost nothing in terms of infrastructure and technological resources that would promote adequate working conditions (Santos *et al.*, 2021).

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Considering that political, organizational, structural and personal issues can trigger or aggravate musculoskeletal disorders, the Study Group on Workers' Health (GEST), linked to a Department of Medicine in a federal institution of higher education (IFES), aimed to map the epidemiological profile of chronic musculoskeletal disorders and identify the ergonomic risks of body posture in the office environment of in order to propose more appropriate ergonomic interventions.

METHOD

This is an exploratory and descriptive study, based on data collected by extension projects called: "Ergonomic interventions and occupational health", developed in 2021 and 2022, duly registered with the Dean of Extension of IFES.

After following the internal procedures for approval by the Extension Council, the projects were widely disseminated on internal and external channels of the University, invitation through social networks, messaging application (WhatsApp) and *IFES email* list .

73 office workers participated in the project. The admission criteria were to be over 18 years old and to spend at least 20 hours/week in an environment with computers; the exclusion was being pregnant.

Data collection was based on an electronic form composed of questions related to sociodemographic characteristics (gender, age and education), one of the questions of the Nordic Musculoskeletal Disorders Questionnaire (QNSM) referring to symptoms in the last 12 months and the *Rapid Office Strain Assessment* – ROSA.

The QNSM, according to Alves (2017), is a translated, validated, and widely used instrument to identify, through reporting, the presence of musculoskeletal disorders in nine body regions (neck, upper back, shoulders, elbows, wrists/hands, lower back, hips, knees, ankles/feet).

ROSA, validated by Rodrigues *et al*. (2019), is used to guide the evaluation of the physical conditions of the work environment based on the complaints presented by individuals.

The data were organized in *Microsoft Excel spreadsheets* and later the answers were coded in numbers, in order to maintain the privacy of the respondents' data and facilitate use in *the Statistical Package for the Social Sciences – SPSS 20.*

Data analysis was performed based on the total, percentage, mean, maximum and minimum value calculations.

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The results of each participant, regarding the presence of signs and symptoms of musculoskeletal disorders and ergonomic inadequacies, were sent by e-mail, along with health and environmental organization guidelines. The final report with the information encompassing all participants was sent to the IFES Extension Dean's Office.

RESULTS

Table 1 shows the sociodemographic characteristics of the participants.

Table 1 - Sociodemographic characterization of the participants.

Features	Participants total [n(%)] 73 (100.0)
Sex Male Female	 35 (47.9) 38 (52.1)
Age (in years) Average Minimum value Maximum value	 25.3 18 68
Schooling Middle school Graduation Postgraduate studies	 27 (37.0) 32 (43.8) 14 (19.2)

Of the 73 participants, 63 (86.3%) reported feeling pain, discomfort, or tingling in one of the nine body regions.

Table 2 shows the affected body region with symptoms of musculoskeletal disorders in the last 12 months. It is worth noting that each participant could mark more than one region.

Table 2 – Number of people with chronic musculoskeletal disorders in each body region.

Affected body region	Participants with symptom 63 (100.0)
Neck	35 (55.6)
Upper back	32 (50.8)
Shoulders	33 (52.4)
Elbows	11 (17.5)
Wrists/hands	30 (47.6)
Lower back	37 (58.7)
Hip	14 (22.2)
Knees	17 (27.0)
Ankles/feet	15 (23.8)

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Table 3 shows the presence of chronic signs and symptoms of musculoskeletal disorders in one or more body regions.

Table 3 – Number of body regions affected by musculoskeletal disorders.

Number of body parts with chronic symptoms	Participants with symptoms [n(%)] 63 (100.0)
A region	6 (9.5)
Two regions	21 (33.3)
More than two regions	36 (57.2)

When evaluating the workstations, 73 participants reported their perceptions about their habitual body positioning and the positioning of objects in the work environment (Table 4). Except for the question about the position of the knees, all the other questions allowed only one alternative. As a way of guiding the reader, an asterisk was inserted in front of the expected answer as adequate.

Table 4 – Report on the perception of body positioning in the office environment.

Self-reported body positions	Participants [n(%)] 73 (100.0)
Seat allows hip to be fully supported	
No	20 (27.4)
Yes	53 (72.6)*
Position of the glutes on the seat	
In the middle and/or in front	29 (39.7)
On the back	43 (60.3)*
Knee position	
In the same direction as the hip	32 (43.8)*
Above hip line	9 (12.3)
Below the hip line	21 (28.8)
Real estate	5 (6.8)
More than one option	6 (8.2)
Foot position	
Suspended or supported on the toe	17 (23.3)
Fully in contact with the ground	42 (57.5)*
Resting on the feet of the chair	14 (19.2)
Distance between the popliteal region and the seat	
Smaller than a fist	25 (34.2)
About one fist	32 (43.8)*
Larger than a fist	16 (21.9)
Position of the upper back relative to the back of the chair	
Totally distant	11 (15.1)
Slightly distant	41 (56.2)
Fully supported	21 (28.8)*
Proximity of the elbows to the torso	
Distant	41 (56.2)
Next	32 (43.8)
Body part resting on the table	
No	4 (5.5)
Fists	21 (28.8)
Forearms	48 (65.7)*
Direction of the elbows in relation to the table	
Above the top	17 (23.3)

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In the same direction as the top	33 (45.2)*
Below the top	23 (31.5)
Distance from the torso to the screen	
Fingertips push the screen	25 (34.2)
Fingertips lightly touch the screen	32 (43.8)*
Fingertips are far from the screen	16 (21.9)
Neck position relative to the screen	
Tilted down	38 (52.1)
Tilted up	4 (5.5)
Not tilted, keeping it straight	31 (42.5)*
Position of the keyboard and mouse in relation to the body	
Keyboard and mouse aligned with the body	64 (87.7)*
Keyboard and mouse not aligned with the body	9 (12.3)
Direct light on the screen	
Yes	15 (19.2)
No	58 (80.2)*

Legend: * desired response

DISCUSSION

Decent work is the focus of the eight goals outlined for the 2030 agenda by the United Nations for sustainable development. The achievement of decent work is supported by four pillars: job creation, social protection, workers' rights and social dialogue (Schulte *et al.*, 2022). In this sense, the work environment needs to be in line with these pillars to ensure quality of life, safety, health and respect for the physical and mental integrity of workers in the exercise of their occupational activity (Spindler; Nascimento, 2024).

In order for the goals of integral safety to be achieved among office workers, ergonomics plays a fundamental role in health care, allowing the involvement and training of individuals in the solution of ergonomic and organizational problems, as well as promoting healthy habits and attitudes (Hyeda; Costa, 2017).

In this way, workers are key factors in this process, along with the organizational changes of companies and government policies. Recognizing one's own illness and having elements that make one understand possible reasons for it can be triggers for the search for personal help, as well as an alert to the needs for structural and organizational changes.

Thus, the project participants, when in possession of the individualized and collective feedback, had the possibility to recognize aspects of their own health and the environment in which they remained throughout the journey, as well as access to the portrait of the severity of the illness and ergonomic inadequacy.

The fact that the majority (86.3%) of the participants were sick and still affected in multiple body regions (90.5%) points to the harmful combination of prolonged sitting and prolonged screen time (Meyer *et al*., 2020; Arundell *et al*., 2020), repetitive movements, long hours without rest, inadequate postures, continuous and excessive use of finger force

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(Ardahan; Simsek, 2016; Soares *et al.*, 2019; Kayabinar *et al.*, 2021; Dzakpasu *et al*, 2021).

It is worth noting that long hours in front of screens is associated with negative feelings such as anxiety and depression in office workers, as pointed out in the study by Andrade, Stefane, Sato (2019).

Epidemiologically, these musculoskeletal disorders are considered the main factor in the increase in work-related injuries and the second cause of sick leave among Brazilian workers (Brasil, 2019).

This situation of illness triggers an alert to public health, and according to the data found, with a new particularity: the presence of these disorders among very young people - 25 years old and with a high level of education; differently from what the literature of people over 45 years of age points out (Cardoso *et al.*, 2022) and with low education (Assunção *et al.*, 2012; Mattos, 2023),

In addition to early onset, the data found on the body regions affected by chronic symptoms are in line with studies (Ardahan; Simsek, 2016; Soares *et al.*, 2019; Kayabinar *et al.*,2021; Dzakpasu *et al*, 2021), where regions located in the upper part of the hip are most strongly affected.

This illness is related to several factors, but the precariousness of the working conditions, such as those found in this study, is directly associated with the appearance and worsening of musculoskeletal disorders (Besharati *et al.*, 2020), especially low back pain (Channak, Klinsophon, Janwantanakul, 2022) and cervical pain (Cardoso *et al.*, 2022).

The ROSA questionnaire allowed the identification of the participants' perceptions about their body positioning and it signaled the inadequacy of posture and furniture. Regarding the ergonomic issues evaluated, the main problems found, either in terms of posture or equipment, were in relation to the chair, as 27.4% reported that the seat did not allow the hips to be comfortably accommodated; 39.7% positioned the glutes inappropriately in the seat; 47.9% did not keep their knees in the same line as their hips; 42.5% inadequately supported their feet on the ground; 56.1% did not maintain the distance of one fist from the popliteal region of the seat and 71.3% did not support their back on the backrest.

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According to NR17 (Brazil, 2021) the ideal is that the chair should have padded padding of adequate density, rounded front edge, backrest with a shape adapted to the body to protect the lumbar region, with adjustments for height, inclination and depth of the backrest, adjustments for seat and arm height. In addition, the width of the seat should be compatible with the size of the hip.

A study by Chen, Chan, Zhang (2021) focuses on poor chair posture being associated with the presence of musculoskeletal symptoms. In this sense, it is important to consider the posture adopted as well as new chair models to reduce the fatigue and discomfort often associated with sitting postures.

A literature review presented by Channak, Klinsophon, Janwantanakul (2022) shows very low to low quality evidence for the effect of chair intervention on reducing pain and discomfort, as well as health benefits derived from any type of chair. In short, the problem is beyond the furniture.

In this sense, NR17 (Brazil, 2021) brings to light the need to research chairs with adjustable seats and to review the concept of immutable sitting posture throughout the journey. Perhaps it would also be interesting to reflect on the fact that the adoption of inappropriate postures is related to the presence of previous pain, which is aggravated by inadequate furniture.

The inadequacy of the furniture and perhaps the lack of knowledge about physical ergonomics, most of the participants had inadequate body postures in terms of not having their elbows close to the torso (56.2%), did not support their forearms on the table (52.2%), did not have their elbows aligned with the table top (54.8%); standing with inadequate distance between the trunk and the screen (56.1%) and did not keep the neck aligned with the spine when sitting (57.6%). In this sense, NR17 (Brazil, 2021) establishes parameters for the protection of workers' health regarding furniture, emphasizing that the adjustments allow adaptation to anthropometric characteristics, as well as providing elements to evaluate the quality of the material.

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As for posture, NR17 (Brazil, 2021) suggests alternating positions; however, it is worth noting that the recommendations are for the elbows to remain close to the torso and aligned at 90° with the table, the fingertips lightly touching the screen and the neck aligned with the spine; these positions make the musculature, Especially the upper torso stay relaxed. After the 90° adjustment of the elbows with the table top, the feet should be completely against the floor and if not, the use of a footrest is indicated. Never rest your feet on the "feet" of the chair. The hip should remain fully supported on the seat, at a 90° angle with the knees and popliteal region one palm away from the seat (Barbieri *et al*., 2020; WorkSafe, 2020)element.

Despite the limitation of ROSA in not evaluating the use of laptops, the use of the laptop was identified and thus it is suggested to use a support so that the screen is at the height of the upper third of the vision and that a mouse and external keyboard are placed (WorkSafe, 2020).

Efforts should be made to identify whether the standing *desk proposal* (Finch; Tomiyama; Ward, 2017) is effective in Brazilian contexts, as well as in research and interventions on the table (Barbieri *et al*., 2020; Brusaca *et al*., 2021), chair (Frey; Barrett; De Carvalho, 2021; De Carvalho; Callaghan, 2022), monitors and screens (WorkSafe, 2020) in the face of Brazilian anthropometric characteristics.

In relation to the other ergonomic aspects evaluated, it is expected that the table top is free of grooves and with space for accommodating the keyboard, mouse and forearms; that the keyboard and mouse remain aligned with the body; that the gaze is in the upper third of the screen; that the letters on the screen are in a size that produces visual comfort and that the ambient light is not falling directly on the screen (WorkSafe, 2020).

In view of the above, the office environment is a space with a potential risk of developing musculoskeletal disorders, which are aggravated by the non-ergonomic physical environment. However, it is relevant to consider the other factors that affect the health of the office worker, such as the organizational climate, behaviors throughout the workday, and lifestyle habits (Schranz *et al.,* 2016; Schulte *et al.*, 2022).

It is noteworthy that organizational conditions such as those related to intensity, length of the workday and satisfaction with what it produces also interfere in the presence of this type of illness, given its association with levels of anxiety, depression, sleep quality and fatigue (Baek; Kim; Yi, 2015).

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Considering the seriousness of this problem among office workers, Rujiret *et al.*(2023) suggests a periodic self-assessment instrument, as a way to prevent health problems and their consequences.

Associated with this surveillance, the implementation of projects that seek to map health and ergonomic conditions are a tool capable of effectively corroborating the protection and promotion of health and safety measures in the reduction of occupational risks and thus collaborate with the implementation of the decent work agenda among office workers.

Adjustments to the environment and workflows, as well as information on body positioning, adoption of active break routines throughout the workday, insertion of physical activity throughout the week, increased patterns of interaction between individuals and behaviors against time in front of screens are healthy habits that can make up the scope of personal and institutional actions.

That said, it is hoped that this report will help advance discussions on the education of teleworkers and on the necessary ergonomic changes (Ingram *et al.*, 2021).

It is also worth noting that extension projects such as this enable an interdisciplinary, political-educational, cultural, scientific and technological process, since they provide a transformative interaction between the higher education institution and the various sectors of society, through the generation and application of knowledge and articulation with teaching and research (CNE/CES Resolution No. 7/2018, National Education Plan, 2014). At the same time, they guarantee students an education that goes beyond the classroom, integrating practice and theory, thus training professionals who are more sensitive to demands, with a humanized posture and capable of dealing with the challenges of society (Sampaio, 2024).

In short, this extension activity was able to integrate academic knowledge with the demands of society, leading to the exchange of knowledge between the university community and civil society.

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CONCLUSION

Most participants reported feeling symptoms related to musculoskeletal disorders in two or more body regions at a young age, and this may be related to issues involving rigid norms, inflexible hierarchy, inefficient communication and centralization of power; as well as, as already pointed out in the literature in the area, the deleterious effects of a physical environment that is not ergonomically adjusted. Thus, this study lights up a warning sign by portraying young people who are sick and working in precarious conditions.

In view of this, the action of intervention and education in health proved to be fundamental for the workers in the office to recognize their own health and the environment in which they remained throughout the day, and thus, they were alerted about the importance of developing self-care actions, either with the change of behaviors or with the search for help from a health professional, or with the adjustments of ergonomically inadequate stitches; as well as fighting for better organizational and public policy conditions. This, therefore, would strengthen attention to the prevention of disorders and the adoption of health recovery/maintenance strategies that ensure quality of life and decent work.

As an identified need, it is suggested the development of new equipment and technologies that enable better ergonomics, as well as studies on postures and movements that can mitigate or remedy the deleterious effects involved in the office environment.

Among the limitations of the projects are the non-monitoring of the implementation of the suggested ergonomic actions and the adoption of healthy habits; as well as having the possibility of having a sample affected by the effect of the healthy worker, that is, those who were already affected by chronic musculoskeletal disorders were interested in participating in the project.

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