



ASSESSMENT OF THE ERGONOMIC AND ENVIRONMENTAL CONDITIONS OF ADMINISTRATIVE WORKPLACES AT A FEDERAL EDUCATIONAL INSTITUTION

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Summary

A qualitative and quantitative descriptive applied research was carried out, with the objective of verifying the ergonomic conditions of the workstations of technical-administrative employees in the administrative area of the Federal Institute of Education, Science and Technology of Maranhão, at the São Luís Monte Castelo Campus. Adopting theoretical and methodological foundations for the ergonomic assessment of workplace conditions, with a view to improving the health and safety of public servants through the prevention and control of ergonomic risks. As a research technique, field observations, safety inspections were carried out, application of an electronic questionnaire to the individual electronic addresses of technical-administrative employees in regular work activity and measurement of environmental comfort conditions (noise, luminosity, relative humidity, effective temperature, air speed). The results highlighted aspects favorable to workers' health, such as the autonomy of public servants in managing their work, but also highlighted the need to adopt corrective measures in the work environment.

Keywords: Ergonomics; Physical ergonomics; Organizational ergonomics; Work conditions; Public server.

Abstract

A qualitative and quantitative descriptive applied research was carried out, with the objective of verifying the ergonomic conditions of the workstations of administrative-technicians servants in the administrative area of the Federal Institute of Education, Science and Technology of Maranhão, on the São Luís Monte Castelo Campus. Adopting theoretical and methodological foundations for the ergonomic assessment of workplace conditions, with a view to improving the health and safety of public servants through the prevention and control of ergonomic risks. As a research technique, field observations, safety inspections, application of an electronic questionnaire to the individual electronic addresses of administrative-technical employees in regular work activity and measurement of environmental comfort conditions (noise, luminosity, relative humidity, effective temperature, air speed). The results highlighted aspects favorable to workers' health, such as the autonomy of public servants in managing their work, but also highlighted the need to adopt corrective measures in the work environment.

Keywords: Ergonomics; Physical ergonomics; Organizational ergonomics; work conditions ; Civil servants .

1. INTRODUCTION

Work is essential in man's life as a social being, as it is a human activity that directly influences his living conditions. Ergonomics is the science that studies the individual's interaction with all the elements that are part of the execution of their activities in their work environment. It is a user-centered science, that is, it focuses on the subject performing their



function, aiming to promote maximum comfort, health, safety, well-being and efficiency of the environment, adapting it through a set of knowledge interdisciplinary according to their psychophysiological and anthropometric characteristics, considering the function and activity carried out in the organizational environment (Moraes et al., 2012; Brasil, 2022).

There are several administrative activities carried out in public institutions, related to people management, accounting, purchasing, bidding, asset control, contract inspection, information technology service center, among others, depending on the main activity of the body. For Guimarães et.al (2011), individuals who carry out administrative activities are subject to environmental conditions (noise, air temperature, relative air humidity, air speed and light level) in the work environment, which may represent a risk to their health. health, with the lack of ergonomics in these environments being one of the main agents causing illness-absenteeism, due to the nature of the activity performed regularly.

The administrative worker remains throughout the working day carrying out intellectual activities, predominantly in a sitting position in front of the computer, with limited movements. The conditions of jobs, the postures assumed and the pace of work can be influential on health at work (Lahoz , 2018). To prevent health problems related to ergonomic non-conformities, it is necessary to adapt the physical arrangement and work organization to the individual characteristics of the worker (Andrade & Tonin, 2024).

In view of the above, considering the value of people, as well as the commitment to legal determinations to protect worker health and safety, applied research was developed, with the objective of evaluating the ergonomic conditions of the workplaces of technical-administrative employees in the area administration of the Federal Institute of Education, Science and Technology of Maranhão, São Luís Monte Castelo campus (IFMA-MTC), with a view to developing an ergonomic action plan (PAE) to enhance the health of employees.

2. THEORETICAL REFERENCE

According to the International Ergonomics Association — IEA (2021), Ergonomics is the scientific discipline concerned with understanding the interactions between humans and other elements of a system. Ergonomists apply theory, principles, data and methods to design in order to optimize human well-being and overall system performance. They contribute to the design and evaluation of tasks, jobs, products, environments and systems, in order to make them compatible with people's needs, abilities and limitations.



In the literature review carried out by Pinto et al. (2018), the authors researched highlighted the importance of ergonomics in organizations, with the insertion of health practices in the work environment, actions to value workers, respect for individual characteristics, with results in Quality of Life at Work.

A case study, developed by Lahoz (2018), to identify the perception of different social actors in relation to indicators of working conditions (physical, organizational or social and psychological or cognitive conditions), found that “postures at work” and “work rhythm”, both with a percentage of 90% corresponding to the operators’ perception. Still in the perception of these workers, around 97% of those interviewed also identified jobs as factors that influence health.

An ergonomic analysis of work carried out at a Federal Institution of Higher Education (IFES), the ergonomic conditions of workplaces were analyzed in the context of face-to-face work and teleworking in order to compare them. The focus of the study was not only the physical conditions of the unit and the execution of activities, but also on the cognitive and organizational aspects that involve work dynamics. Complaints of discomfort were frequently identified among employees who carry out administrative activities to meet the demands of academic routines, who maintain a sitting posture and use computers. Furthermore, thermal discomfort, problems with equipment and furniture were observed, with the chairs “considered inadequate and uncomfortable by 75% of the unit’s employees” (Andrade & Tonin, 2024).

psychocognitive discomfort, according to the findings, is not associated with the volume of demands, but rather with face-to-face work. The complaints collected (stress, tension, anxiety and lack of autonomy) were directly associated with face-to-face work at IFES.

In this context, it is beneficial to know and evaluate the work situations of administrative technicians in the administrative area of IFMA-MTC, adopting ergonomics as a reference, from the perspective of valuing the worker and also complying with labor legislation, as provided for in the Regulatory Standard (NR) no. 1 – Occupational Risk Arrangements and Management. This standard has the following prerogative: “The organization must develop actions on the occupational health of workers integrated with other prevention measures, Occupational Health and Safety — OSH, according to the risks generated ” (Brazil, 2022).



3. METHODOLOGY

An applied research was developed, with a qualitative and quantitative descriptive approach. ⁷The population of the research area of interest was 70 (seventy) administrative technical employees performing their duties, from the 16 (sixteen) sectors of the administrative area of the IFMA campus São Luís Monte Castelo 8, being:

- ARQ - Archive;
- CAP - Coordination of Pedagogical Activities;
- CCP - Accounting and Assets Coordination;
- CPO - Planning and Budget Coordination;
- CPPD-PI - Permanent Teaching Personnel Committee;
- DAP - Administration and Planning Directorate;
- DCEV - Department of Communication and Events;
- DERI - Department of Institutional Relations;
- DETEC - Technical Education Directorate;
- DESU - Directorate of Higher Education;
- DGP - Personnel Management Department;
- DPOG - Department of Planning, Budget and Management;
- DPPGI - Department of Management, Research, Postgraduate Studies and Innovation;
- NRE - School Registration Center;
- NTI - Information Technology Center;
- SGCC - Contract and Agreement Management Sector.

After approval by the Research Ethics Committee (Opinion no. 5,623,877), from January to July 2023, data was collected through observations in the administrative sectors and application of an online questionnaire via the Google platform Forms . The questionnaire contained sociodemographic, occupational and questions regarding compliance with the criteria of Regulatory Standard No. 17, regarding the conditions of the workplace furniture, comfort in the environment and work organization. Additionally, it contained Corlett and Manenica 's self-report diagram of painful areas (Iida, 2016).

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⁸Approved by the Ethics Committee of the Federal University of Maranhão: opinion no. 5.623.877.2.



A quantitative assessment of environmental agents was carried out in each workplace in the 16 sectors, during regular hours and in the three shifts of operation on the campus. The institution begins its working day at 7am and closes at 10pm. To evaluate the noise level, the Audiodosimeter was used, an integrative meter (Model DOS-500, manufacturer Instrutherm), carried by the server during the sampling time. For temperature, relative air humidity, air speed and illuminance, the portable digital Thermo-Hygrometer-Anemometer-Luxmeter (Model SKTHAL) was used.

The variables were analyzed using descriptive statistics (mean, frequency and percentage). The environmental agents measured were evaluated based on the parameters of NR 17 (Brazil, 2022), the Occupational Hygiene Standard n0 11 (NHO 11) of Fundacentro (Brazil, 2018) and the National Surveillance Agency Sanitary (Brazil, 2003).

4. RESULTS AND DISCUSSION

4.1 General characterization

The IFMA Campus São Luís — Monte Castelo, is located in the central region of São Luís - Maranhão, being the largest and oldest among the campuses. It offers technical, undergraduate and postgraduate courses. The administrative technicians in the administrative areas researched carry out activities similar to those in offices in general, maintaining a sitting posture and using computers and peripherals. Twenty-seven (27) administrative technicians participated in the study, corresponding to 38% of the estimated population. The average age of participants is 43 years old, with 55.6% female and 44.4% male. As for education, 48.1% have specialization, 51.8% have family income ranging from 4 to 6 minimum wages, 44.4% have 11 to 15 years of work at IFMA, and 85.1% work under a 40 hours per week.

4.2 Environmental Factors

In the quantitative assessment of environmental comfort conditions, the parameters analyzed were: noise, luminosity, relative air humidity, air temperature and air speed.

To evaluate the noise, the Audiodosimeter (measuring equipment) was used by the server most exposed to the agent in their work environment, as established in the Occupational Hygiene Standard n0 01 (NHO 01) of Fundacentro. In the assessment of air temperature, relative air humidity, air speed and illuminance, the portable digital Thermo-Hygrometer-Anemometer-Luxmeter (measuring equipment) was positioned at each of the workstations in the sectors, as determined by the Regulatory Standard (NR) n0 17 of the Ministry of Labor and Employment and Occupational Hygiene Standard n0 (NHO 11) of Fundacentro. This procedure was carried out in all sectors of the study.



An **illuminance level** below 500 Lux (minimum considered acceptable by Fundacentro's NHO 11) is characterized as insufficient and uncomfortable. In workplaces where registered values are equal to or greater than 500 Lux, they comply with the standard.

For **relative air humidity**, the recommended range for the level of thermal comfort varies from 40% to 65% in an air-conditioned environment, according to ANVISA. Registered values that are not within this recommended range characterize an unsuitable environment for the performance of functions.

Regarding **air temperature**, the acceptable temperature range is between 18 and 25°C for an air-conditioned environment, according to NR 17. Values recorded above the permitted level characterize the environment as thermal discomfort, therefore, non-compliance for the server's performance. of administrative activities.

For registered **air speeds** of less than 0.25 m/s (maximum acceptable by ANVISA), the environment is characterized as comfortable for carrying out functions in administrative activities. For values higher than this, an environment unsuitable for the performance of functions is characterized.

And for **noise**, a registered NEN of up to 65 dB(A) is considered acceptable for the purpose of acoustic comfort, according to NR 17. Registered values higher than this characterize an unsuitable environment for the performance of functions.

Table 1 presents a summary of the quantitative assessments of environmental comfort conditions.

Table 1: Quantitative assessment of environmental comfort conditions (16 sectors)

SECTORS			ILLUMINANCE	RELATIVE HUMIDITY	AIR TEMPERATURE	AIR SPEED	DOSIMETRY NEN
			≥ 500 Lux NHO 11 (Fundacentro)	65% RH ANVISA	18°C to 25°C NR 17	0.25 m/s ANVISA	65 dB (A) NR 17
1	DGP	Area 1	NC (354 Lux)	NC (77.2% RH)	NC (27.8°C)	* (0 m/s)	* (55.3 dB (A))
		Area 2	NC (394 Lux)	NC (70.9% RH)	NC (31.3°C)	* (0 m/s)	* (55.3 dB (A))
		Area 3	NC (175 Lux)	NC (67% RH)	NC (25.4°C)	* (0 m/s)	* (60.7 dB (A))
		Area 4	NC (98 Lux)	NC (65.6% RH)	* (23.9°C)	* (0 m/s)	* (60.7 dB (A))
tw o	DCLC – SCL – SGCC	Only	* (699 Lux)	NC (69.1% RH)	NC (28°C)	* (0 m/s)	* (55.07 dB (A))
3	CCP	Only	NC (274 Lux)	NC (69.8% RH)	* (25°C)	* (0 m/s)	* (48 dB (A))
4	DESU	Area 1 (Momi)	* (526 Lux)	NC (70% RH)	NC (32.9°C)	* (0 m/s)	* (58.84 dB (A))



		ng)					
		Area 1 (Afternoon)	NC (399 Lux)	NC (70.3% RH)	NC (27°C)	* (0 m/s)	* (58.84 dB (A))
		Area (Night)	NC (150 Lux)	NC (76.6% RH)	* (25°C)	* (0 m/s)	* (58.84 dB (A))
		Area 2 (Morning)	* (2060 Lux)	* (59.7% RH)	NC (29.4°C)	* (1.3 m/s)	* (58.84 dB (A))
		Area 2 – Afternoon	* (860 Lux)	NC (74% RH)	* (25°C)	* (1.1 m/s)	* (58.84 dB (A))
		Area 2 (Night)	NC (191 Lux)	NC (70.6% RH)	* (25°C)	* (0 m/s)	* (58.84 dB (A))
5	DERI	Area 1	NC (261 Lux)	NC (68.2% RH)	NC (27.5°C)	* (0 m/s)	* (53.9 dB (A))
		Area 2	NC (297 Lux)	* (63% RH)	NC (25.4°C)	* (0 m/s)	* (53.9 dB (A))
6	DCEV	Only	NC (383 Lux)	NC (67.1% RH)	* (24°C)	* (0 m/s)	* (58.81 dB (A))
7	ARQ	Only	NC (306 Lux)	NC (66.6% RH)	NC (25.9°C)	* (0 m/s)	* (62.53 dB (A))
8	DETEC	Only	NC (317 Lux)	NC (71% RH)	* (25°C)	* (0 m/s)	* (57.56 dB (A))
9	NTI	Only	NC (242 Lux)	NC (72.2% RH)	* (25°C)	* (0 m/s)	NC (70.39 dB(A))
10	DPOG – CPO	Area 1	NC (337 Lux)	* (62.5% RH)	NC (26.9°C)	* (0 m/s)	* (48.09 dB(A))
		Area 2	NC (157 Lux)	* (62.2% RH)	* (25°C)	* (0 m/s)	* (48.09 dB(A))
11	CAP	Only	* (918 Lux)	* (60.2% RH)	NC (31.5°C)	* (0 m/s)	* (55.48 dB (A))
12	DAP	Only	NC (362 Lux)	* (62.9% RH)	* (23°C)	* (0 m/s)	* (48.45 dB (A))
13	DPPGI	Only	NC (413 Lux)	NC (70.2% RH)	* (25°C)	* (0 m/s)	* (54.1 dB (A))
14	NRE	Area 1	NC (259 Lux)	NC (72.5% RH)	NC (26°C)	* (0 m/s)	* (47.06 dB (A))
		Area 2	NC (249 Lux)	* (63.6% RH)	NC (26.7°C)	* (0 m/s)	* (47.06 dB (A))

Source: Authors (2023)

Subtitle:

(*) In accordance with the recommendations of the standard;

(NC) Non-compliance with the standard's recommendations.

Note: In Table 1, the quantitative assessment of 14 sectors was presented, due to the fact that 2 of the 16 sectors are integrated into the same environment. Furthermore, there are sectors made up of more than one area. The administrative sector of the Directorate of Higher Education — DESU was the only one to have measurements in the three operating shifts (morning, afternoon and night) due to the needs and demands of undergraduate students.



Regarding the perception of employees in relation to the comfort conditions in the work environment, regarding the presence of environmental agents and the layout of workstations, for 25.9% of employees, the level of lighting causes some type of discomfort and/or uncomfortable, as it does not prevent glare, reflections, etc.

And for 63% of servers (this being the highest percentage), this issue partially occurs, which is due to the fact that there is the possibility for servers to rotate during the working day, that is, to work at different periods, taking into account given that the institute operates in three shifts. Furthermore, it is related to the positioning of workstations close to windows (51.9%). For only 11.1%, the lighting level is favorable.

This issue raised by the employees is proven through the quantitative evaluation of this agent, in which it was found that in 87.5% of the sectors surveyed, the lighting is deficient, as they are lower than the levels recommended by Fundacentro's NHO 11 for office environments. Therefore, it is necessary to adopt measures to correct illuminance levels in the administrative sectors of the campus.

Regarding the noise level, for 59.3% of servers, it is considered acceptable. And for 40.7%, they consider there is no acoustic comfort in their work environment. One of the main sources of noise is air conditioning. Despite there being a large percentage of servers considering there to be no acoustic comfort, it was found, through quantitative assessment, that in only 6.25% of the sectors, the noise is non-compliant, as the recorded values do not meet the recommendations of the NR 17 for acoustic comfort. However, the other values recorded in the measurement that are at an acceptable level come close to the maximum allowed value.

Regarding thermal comfort, 44% of those surveyed indicate that it is pleasant during the day, while 18.6% indicate that the temperature is partially pleasant. The fact that it is considered partial is due to temperature and factors related to the presence of natural light, in which, throughout the day, the positioning of sunlight falls directly on the workstations. And 37% of servers claim that the temperature is unpleasant. This fact was proven through quantitative evaluation, as in 37.5% of the sectors evaluated, the air temperature is higher than what is considered acceptable by NR 17 for the purpose of thermal comfort.

Even with 74% reporting that there are blinds and curtains, some sectors have protective films on the window frames, however, these are not as effective for controlling



temperature in the work environment. With regard to air currents applied to the server, 74.1% indicate that there are none.

4.3 Work organization

Still regarding comfort issues, following the recommendations in item 17.4 - Work Organization (NR 17), information was collected that must be considered as recommended in subitem 17.4.1. Regarding the existence of standardization of production standards for each work function, there was partiality in the responses among the population studied. This is due to the fact that different sectors have different administrative activities and daily demands. It may also be related to the server's operating mode, that is, the prescribed activity differs from the real activity (Brazil, 2022).

Regarding strict time requirements for carrying out tasks, a little more than half (55.6%) say there are none, that is, there is no pressure or time imposition to carry out tasks. In their answers, the server indicates that they have the possibility of managing their work rhythm (85.2%), controlling the way in which they carry out their activities (81.5%), the content of the tasks and the instruments for their execution, adapting to their characteristics and psychophysiological needs (81.5%).

The elements collected indicate that employees at the MTC campus have flexibility and autonomy to carry out their activities. All of these elements contribute positively to the well-being of these public servants (Andrade & Tonin, 2024; Lahoz, 2018).

According to Moraes (2012, p. 219), a flexible work organization values the exercise of practical intelligence, the creation and invention of new things. In this way, autonomy favors the achievement of pleasure at work, based on the transformation of the suffering of not knowing into the pleasure of knowing how to do it.

For 40.7% of participants in this research, there is cognitive demand at work (attention, concentration, memory, perception, decision making). However, it is considered to be manageable, since the server can control its operating mode, production time, has flexibility and autonomy, these being positive points for maintaining the worker's mental health (Cardoso & Gontijo, 2018).

4.4 Jobs



In observations carried out in the administrative area of the campus, it was found that employees maintain a sitting posture throughout the working day. The workstations have standard furniture, in good condition, consisting of a table, adjustable and swivel chair, computer, desktop and peripherals. Taking into account the characteristics of the activity, the Corlett Diagram (Figure 1) was adopted as an analysis instrument to identify musculoskeletal symptoms that employees considered to be due to work.

The highest percentages of pain complaints were in the neck (70.4%), along with pain in the thoracic spine (40.7% in the upper back). Next comes the lumbar region (lower back) and the right wrist with percentages equal to 37%, as shown in Figure 2. According to the perception of the servers, obtained through the electronic questionnaire, it was observed that, with regard to the furniture set of workstations, more than 60% consider the table to be compatible and meet their needs. In the online questionnaire, more than one option could be selected.



Figure 1: Corllet diagram .

Source: https://encrypted-tbn2.gstatic.com/images?q=tbn:ANd9GcThmq2I75zTiCLdVmzP3HfXjyXRug-2AZFHxS0os_CQkxkTaYy_ . Accessed on: June 25, 2023. (Edited by the authors)

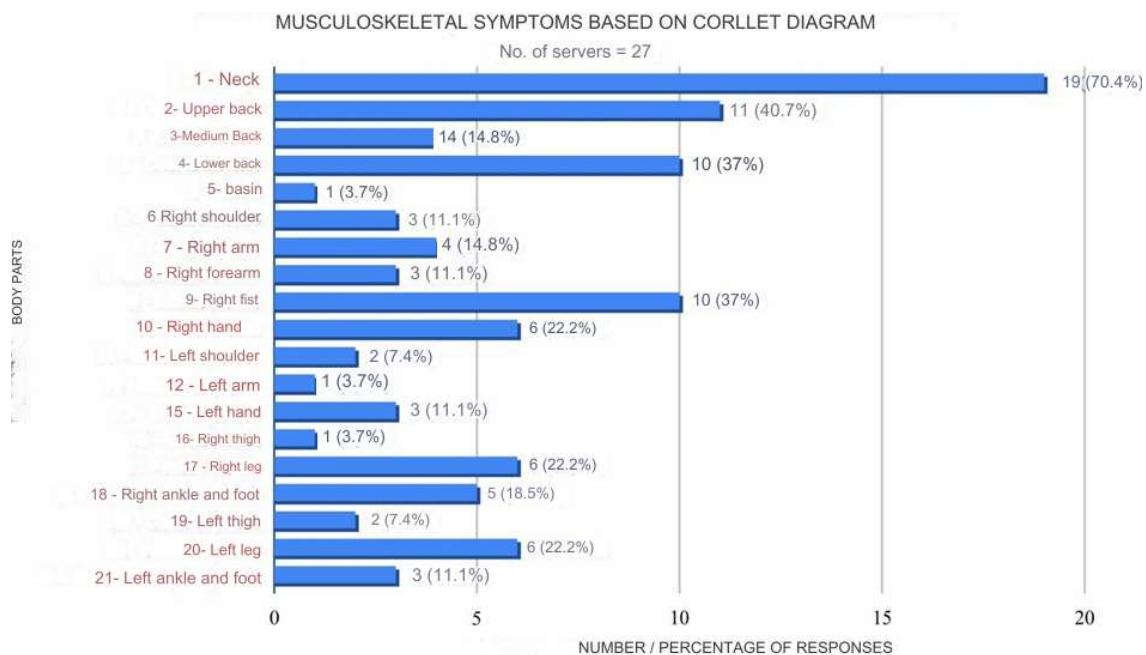


Figure 2: Parts of the body where employees feel the most pain and believe they are caused by work.

Source: Authors (2023)

The findings of this research are similar to the results found in the study with an exploratory and quantitative analytical approach carried out on “Ergonomic risks and musculoskeletal symptoms in administrative technicians at the Instituto Federal Catarinense during teleworking in the COVID-19 pandemic”. In this study, the predominance of pain in the same regions of the body segments highlighted by the employees of the IFMA campus Monte Castelo was also found. The most affected regions found at the Instituto Federal Catarinense were: the neck (68.9%), the lumbar spine (61.6%) and the right shoulder (49%) (Guimarães et al., 2022).

In relation to the seats (chairs) of the furniture, issues such as the conformation of the base of the seat, adjustment of the dorsal support (backrest) and casters in good working order present partiality in terms of user satisfaction requirements. Which may justify the highest percentages of pain occurring in the central axis of the body (spinal column).

From what was observed at work: It is noted that, due to the restricted space for performing the task, the server leaves the neutral line and maintains a forced posture, leaning the upper limbs forward. This workstation does not accommodate larger people, as it does not provide free, ample and adequate space for the movement of legs and knees (Figure 3). Therefore, it is non-conformity, as it does not meet the recommendations of NR 17.

According to NR 17 in subitem 17.4.6:



The dimensions of the work and circulation spaces, inherent to the execution of the task, must be sufficient so that the worker can move their body segments freely, in order to facilitate the work, reduce the worker's effort and not require the adoption of extreme postures. or harmful.

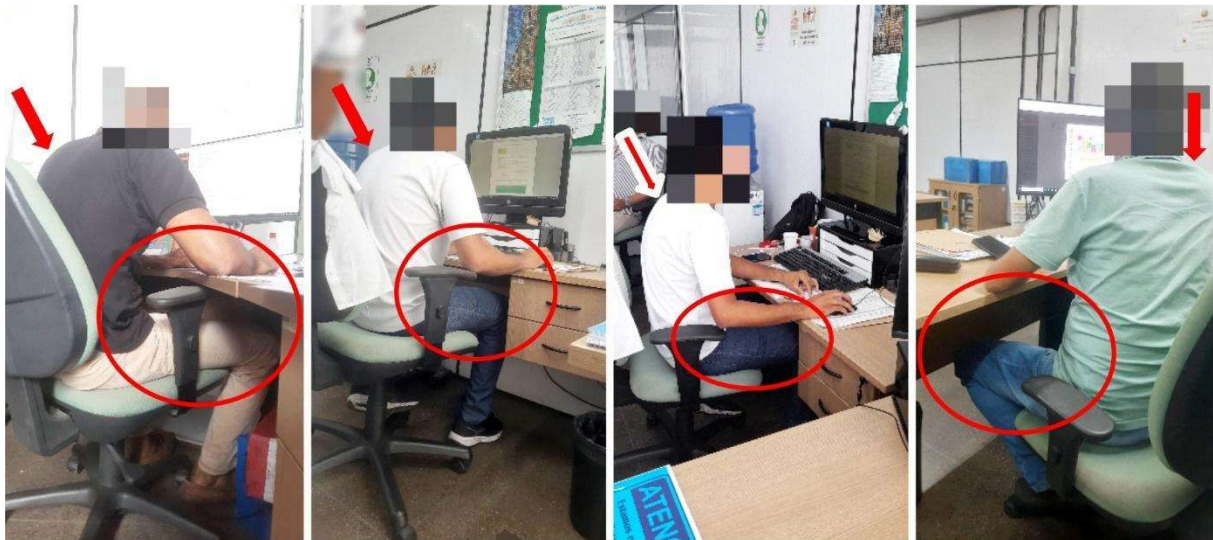


Figure 3: Depth for legs and space under the table top

Source: Authors (2023)

From what was observed at work: The reduced work surface does not make it possible to perform secondary tasks in addition to the main one (restricted to the computer). This fact causes the server to lean forward or keep their arms unsupported on the table top. Figure 4.

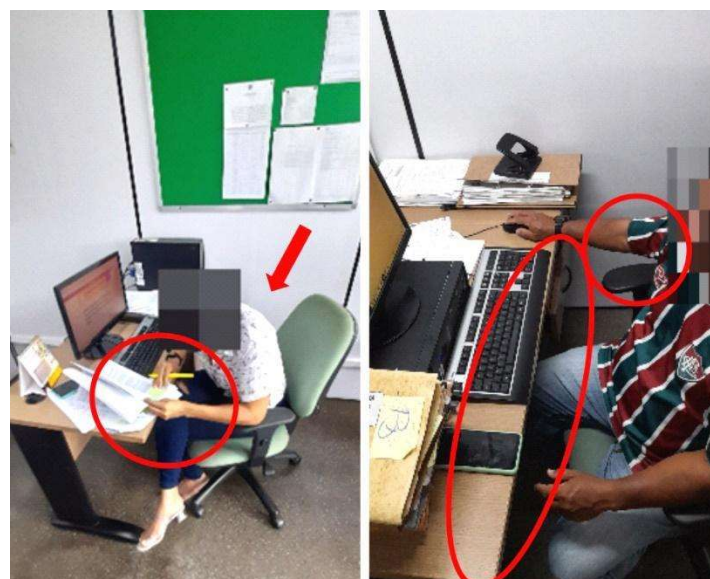


Figure 4: Table top with reduced dimensions

Source: Authors (2023)

Through analysis and evaluation of the results in this and in research with a similar approach, it appears that these symptoms are related to the conditions of the organizational



environment, with the main responsible factor being the inadequate furniture available at workstations (Guimarães et al., 2011) , leading employees to maintain incorrect postures throughout the workday. Added to this are other aggravating factors for non-compliance with work organization issues, as defined by the Ergonomics standard (NR 17), such as: production standards, time requirements and cognitive demands.

According to the Digital Observatory of Health and Safety at Work - Smartlab (MPT), in the Notifiable Diseases Information System - SINAN, between 2007 and 2022, 109,076 work-related RSI/WMSDs were reported in Brazil. Faced with this adverse context, the Ministry of Health reinforces compliance with preventive actions, focusing on the ergonomics provided for in NR 17, to avoid these health problems for workers.

It is imperative that the institution solves the problems identified, without forgetting to listen to the servers, because according to Pinto (2018), the adaptation of machines, equipment and furniture to the physical and psychological conditions of the worker, as recommended by ergonomics, contributes to the quality of work. life at work.

5. FINAL CONSIDERATIONS

Given the results of both the employees' perception and the qualitative and quantitative assessment of the environmental comfort conditions, with regard to physical and organizational ergonomics, it was found that the working environment conditions are unfavorable in several requirements and do not provide, in their totality, comfort, safety, health and well-being for employees, which can affect the performance of their tasks during the working day and even favor illness.⁹

With the result of applying the assessments, it was possible to understand the activities carried out in each sector and the crossing of this information gave us the opportunity to

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develop requirements for composing proposals to adapt jobs, as can be seen in the four classes of following requirements:

- **Design guidelines** - Indication of elements for creating a design (artifact or process);
- **Purchase specification** - Indication or elaboration in accordance with the needs of the artifact to be acquired;
- **Functional model** - Spatial or methodological organization
- **Training** - Good practices. Below is a table of requirements.

Requirements	Type	Implementation
Study of new <i>layout</i> in some sectors;	Design guidelines	Mid-term
Acquisition of furniture compatible with the needs in relation to the activity carried out;	Purchase specification	Mid-term
Need to extend the study to other sectors of the institution.	Functional model	Mid-term
Use of furniture;	Training	Short term
Use of equipment;		Short term
Safety at work.		Short term

Therefore, it is necessary that non-conformities are corrected to provide a safe and comfortable working environment, to maintain the psychophysiological well-being of employees, in accordance with the recommendations of Ergonomics and labor legislation. The results obtained supported the preparation of the Ergonomic Action Plan, aiming to contribute to the quality of life policy of IFMA employees, through the proposition of corrective and preventive measures in the context of ergonomics.¹⁰

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¹⁰“The authors declare that there is no relevant conflict of interest”



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