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Dimensioning of the Work Environment and Prevalence of Pain in University Staff

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Aims: The research aimed to investigate the correlation between musculoskeletal pain and the dimensions of the work environment during sitting posture among university staff.

Methodology: The evaluation of the prevalence of musculoskeletal pain using a recall record. The measurements in the sitting working posture evaluated were: popliteal height, height from elbow to seat, table height, thigh height, hip width and sacral length. The arrangement of the workstation was also evaluated, and the height of the monitor was checked. All measurements were made using a measuring tape, with a 1mm scale. The study comprised university staff from UNICENTRO who voluntarily participated in the research.

Results: The results of measurement vs estimated height, for male there was different in all variables (chair to floor, arm bent to the chair, depth measurement, eyes to the ground and table to monitor), in female group just in chair to floor, arm bent to the chair, depth measurement and table to monitor ($p<0.05$). The comparation of without pain vs with pain for male, there was difference in

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measurement from chair to floor and measurement from eyes to ground, in female group just measurement from table to monitor, ($p<0.05$).

Conclusion: The results suggest that inadequate work station conditions can be linked to development of pain.

Keywords: Musculoskeletal pain; furniture; ergonomics, eyes, work environment, worked night shifts, university staff.

1. INTRODUCTION

The absence of discomfort is closely linked to the use of suitable furniture, tailored to the user's postural requirements. Therefore, several improvements are demanded and there is an increasing need for ergonomic solutions for work [1]. The ergonomic solutions mentioned by the author directly influence the individual's well-being, since operators cannot be considered just as a 'pair of hands'. From an ergonomic perspective, workers must be viewed as holistic entities. This approach helps alleviate the burden of work beyond necessary task [2].

While most of the ergonomics assessment studies to date have been conducted on industrial workers, very few studies have considered evaluating the working postures of staff or professors in universities who are exposed to prolonged sitting, while working at computer workstations [3]. Thus, the objective of study was to verify the relationship between musculoskeletal pain and the size of the work environment in the sitting posture of university agents. Furthermore, provide a factual background, clearly defined problem, proposed solution, a brief literature survey and the scope and justification of the work done.

2. MATERIALS AND METHODS

The research presents a cross-sectional correlational study, being approved by the Ethics Committee for Research with Human Beings of the University of Middle-West –UNICENTRO, under opinion no. 857.660/2014. Firstly, the total number of university agents working on the Santa Cruz and CEDETEG campus of the Central-West State University was surveyed. At the outset of the study, there were 277 university staff members, of which 248 worked in a sitting position and 71 were at their workstation at the time of the evaluations and agreed to participate in the research, 29 agents from the CEDETEG campus and 42 agents from the Santa Cruz campus.

The university staff member was asked to respond at their workstation to a questionnaire to assess the prevalence of musculoskeletal pain, using the questionnaire proposed by Corlett and Manenica [4]. The questionnaire consists of an illustration of the human body, seen from above and divided into 22 body segments, 6 single segments and 16 double segments (right and left), with the leg segment subdivided into 4 parts. The segments are indicated by: neck, cervical region, back, top position, back, middle position, back, bottom position, hip, shoulder - left side and right side, arm - left side and right side, elbow - left side and side right, forearm - left and right side, wrist - left and right side, hand - left and right side, thigh - left and right side, leg - left and right side. For each of these painful regions or areas there is a gradation that varies between the minimum value (1), which indicates the absence of pain or discomfort in the body segment, to the maximum value (5), which indicates intolerable pain or discomfort in the segment. considered. The markings are made linearly on the diagram from left to right.

Next, anthropometric data on body mass (kg) and height (cm) were collected by recall record to obtain the BMI (body mass index in kg/m^2). The measurements in the sitting working posture evaluated were: popliteal height, height from elbow to seat, table height, thigh height, hip width and sacral length [5]. The arrangement of the workstation was also evaluated, and the height of the monitor was checked. All measurements were made using a measuring tape, with a 1 mm scale.

At the end of the research, data were collected from 71 university agents (42 men and 29 women). Agents not evaluated were excluded for various reasons: they refused, were on leave, were on vacation, were not found at their work stations, worked outside the municipality, worked night shifts and no longer worked at UNICENTRO.

Descriptive statistics, including mean and standard deviation, were employed for data analysis. For inferential analysis, Student's t-test

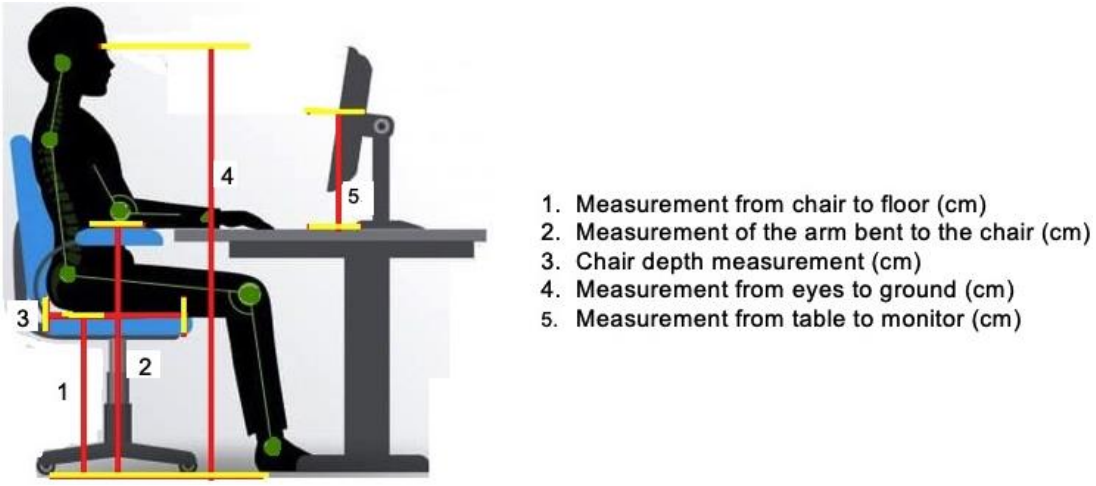

Fig. 1. Measurements in the sitting working posture

was used for independent variables. All analyzes were performed using SPSS version 20 software, with a significance level of $p<0.05$.

3. RESULTS AND DISCUSSION

The furniture used by both male and female participants revealed that measurements of the chair's height from the floor and the distance from the armrest to the chair exceeded the estimated values, as shown in the records in the following tables. The depth measurements the chair, eyes to the ground and table to monitor obtained values lower than the estimates respectively.

Table 1. Comparison between the evaluated measures and the estimated measures among university agents

		Mean	Standard deviation	p
Male (42)	Measurement from chair to floor (cm)	47.8	7.6	0.002*
	Estimate of the measurement of the chair to the floor (cm)	43.9	2.1	
	Measurement of the arm bent to the chair (cm)	56.9	20.3	0.001*
	Estimate of the measurement of the arm bent to the chair (cm)	23.8	1.1	
	Chair depth measurement (cm)	44.3	2.7	0.001*
	Estimate of chair depth measurement (cm)	49.4	2.3	
	Measurement from eyes to ground (cm)	117.1	6.7	0.001*
	Estimated measurement from eyes to the ground (cm)	123.5	7.1	
	Measurement from table to monitor (cm)	25.7	7.7	0.001*
	Estimated measurement from table to monitor (cm)	56.2	2.7	
Female (29)	Measurement from chair to floor (cm)	46.3	3.8	0.001*
	Estimate of the measurement of the chair to the floor (cm)	40.9	1.3	
	Measurement of the arm bent to the chair (cm)	57.9	19.5	0.001*
	Estimate of the measurement of the arm bent to the chair (cm)	22.2	0.7	
	Chair depth measurement (cm)	43.9	2.9	0.005*
	Estimate of chair depth measurement (cm)	45.9	1.5	
	Measurement from eyes to ground (cm)	114.2	6.8	0.446
	Estimated measurement from eyes to the ground (cm)	115.5	3.2	
	Measurement from table to monitor (cm)	26.1	6.5	0.001*
	Estimated measurement from table to monitor (cm)	52.3	1.6	

Significance level: $p<0.05$
Tested by Student's t-test for independent variables

This result is similar to the study by Villarouco and Andreto [6], which shows that the chairs in the researched environment were inadequate, causing constant back pain for employees. In this sense, it is observed that the study in question can contribute to improving the work environment in the HEI researched, as another aspect of ergonomics highlighted for the improvement of human work is the study of the environment in which the work is carried out, this is the area of ergonomics in the built environment [3].

The collected data indicate that ergonomically inappropriate furniture, deviating from established standards, primarily contributes to the prevalence of neck pain, for approximately 17% of women and 24% of men; pain in the thoracic spine region affects around 14% of women and 12% of men in the surveyed population, and low back pain is the complaint of around 20% of women and 28% of men.

In the study of Chowdhury et al. [2], "with objective of ergonomic assessment of working postures for the design of university computer workstations, the upper limbs of computer workstation users seem to be more prone to work-related musculoskeletal disorders and repetitive stress injuries symptoms. In 85.5% of cases, they indicate that work of office employees may cause a disorder more in the upper limbs than the lower limbs. Therefore, alignment of the monitor was found to be the most significant design parameter. Among different body parts, trunk was the most affected one, as a result of poor posture and/or workplace design followed by shoulder and upper arm, and forearm and wrist".

"The physical measurements in 40 computer workstation design in typical offices, forty-five percent of the employees used nonadjustable chairs, 48% of computers faced windows, 90% of the employees used computers more than 4 h/day, 45% of the employees adopted bent and unsupported back postures, and 20% used office tables for computers. Major problems reported were eyestrain (58%), shoulder pain (45%), back pain (43%), arm pain (35%), wrist pain (30%), and neck pain (30%). These results indicated serious ergonomic deficiencies in office computer workstation design, layout, and usage" [7].

In a sample of 30 computer operators was selected purposively from private and public sector organization, the assessment of computer workstation design revealed that 36.6 percent of workers used chairs with low seat height which was not proper. Chairs with adjustable seat height were used only by one half of the users. "The distance from acromion to edge of desk was in average range and 56.7 percent of the users were having pull out extra leaf for keeping keyboard while only 13.3 percent respondents were using the extra leaf for keeping the mouse. It was revealed that none of the respondents kept the screen straight ahead which is the most appropriate position. A vast majority reported that they suffered from shoulder pain, headache, eyestrain, back pain and felt discomfort during computer work. Ninety percent of workstations were found in 'Average' category. Assessment of body discomfort revealed that after 4 hour of work 40 percent of the workers felt 'Moderate' discomfort while 10 percent expressed feeling of 'Severe' discomfort. Assessment of localized body discomfort elicited that the respondents felt discomfort in right shoulder, in eyes and pain in neck" [8].

In a survey with 42 participants who use desktop computer workstations for at least 6 hours per day, the electromyography results indicated that discomforts are pronounced in shoulder, neck, lower and upper back and hand-wrist regions. The risk assessment model showed that experiencing troubles in the neck ($p=0.022$), shoulder ($p=0.023$), and wrist/hands ($p=0.020$) within 12 months were the significant factors. ANOVA results proved that the optimized design of a computer workstation causes less muscular pressure on the muscles at each measured body region [9].

Rodrigues et al. [10], demonstrated that "computer office workers who reported musculoskeletal pain had worse ergonomics indexes for chair workstation and worse physical risk related to upper limb than workers without pain. However, there were no observed differences in workers with and without musculoskeletal pain regarding work-related psychosocial factors. The results suggest that inadequate workstation conditions, specifically the chair height, arm and back rest, are linked to improper upper limb postures and that these factors are contributing to musculoskeletal pain in computer office workers".

Finally, Workineh and Yamaura [11], studied "a new type of ergonomic computer workstation, which allows users to sit in multiple working positions, is proposed in order to provide better comfort to people who spend a long time sitting

Table 2. Comparison between furniture measurements and the prevalence of neck pain

			Mean	Standard Deviation	p
Male	Measurement from chair to floor (cm)	Without Pain (32)	45.5	4.2	0.001
		With Pain(10)	55.4	10.9	
	Measurement of the arm bent to the chair (cm)	Without Pain (32)	55.4	19.8	0.404
		With Pain(10)	61.7	22.1	
	Chair depth measurement (cm)	Without Pain (32)	44.1	3.1	0.415
		With Pain(10)	44.9	1.1	
	Measurement from eyes to ground (cm)	Without Pain (32)	116.2	3.2	0.001
		With Pain(10)	123.4	4.4	
	Measurement from table to monitor (cm)	Without Pain (32)	25.9	7.6	0.660
		With Pain(10)	24.8	8.9	
Female	Measurement from chair to floor (cm)	Without Pain (24)	46.3	3.9	0.986
		With Pain (5)	46.3	3.3	
	Measurement of the arm bent to the chair (cm)	Without Pain (24)	59.7	19.1	0.282
		With Pain (5)	49.2	21.1	
	Chair depth measurement (cm)	Without Pain (24)	44.2	2.7	0.466
		With Pain (5)	43.0	3.8	
	Measurement from eyes to ground (cm)	Without Pain (24)	114.9	6.2	0.361
		With Pain (5)	112.2	4.8	
	Measurement from table to monitor (cm)	Without Pain (24)	27.3	5.8	0.031
		With Pain (5)	20.4	7.6	

Significance level: $p<0.05$
Tested by Student's t-test for independent variables

at their workstations. The researchers have designed and developed a new multi-position ergonomic computer workstation which has 19 degrees of freedom and which can accommodate from 5th to 95th percentile human size. Results showed that the new workstation is much more comfortable, supporting the body in a balanced way. Users have the freedom to stretch and relax in different working positions before they feel any noticeable discomfort; as a result, it lets users work for a longer period without strain, thus resulting in higher productivity".

4. CONCLUSION

The study identified certain problematic aspects, such as chair height, overlooked by users but noted by researchers. Thus, the evaluations carried out with UNICENTRO university agents allowed us to conclude that the furniture found is ergonomically incorrect and this fact results in musculoskeletal pain and, as a result of this disconnection, there is a loss of productivity. In this sense, it is suggested that correct ergonomic planning of work furniture or small changes, such as adjusting chairs, for example, employees of the university evaluated are able to improve their quality of life at work.

CONSENT

It is not applicable.

ETHICAL APPROVAL

All authors hereby declare that all experiments have been examined and approved by the appropriate ethics committee and have therefore been performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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