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EVALUATION OF THE POSTURE ADOPTED BY OFFICE WORKERS USING "L" TABLES IN TWO DISPOSITIONS

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Abstract

This study aims to compare the posture of the head, upper back and upper limbs of office workers who use L shaped desks in two different ways: straight and concave part of the desk. Posture data were collected from 16 subjects by means of inclinometry and the results indicate that regardless of the position of VDUon the L table there are no differences in relation to the posture of head, upper back, and upper limbs in office workers.

Keywords: Furniture, Office Work, Posture, Ergonomics.

1. Introduction

There is evidence of an association between computer use and musculoskeletal disorders (Ijmker *et al*., 2007). During the use of computers, the forearm support has been recommended as an alternative to reduce static overload in the cervical region and shoulders (Aaras *et al.*, 1998; Visser *et al.*, 2000; Delisle *et al*., 2006; Straker *et al*., 2009).

In this sense, the curved design of the "L" tables would provide adequate support for the forearm (Straker *et al*., 2009). However, the lack of training and guidance on the use of these desks results in different positions of the monitor and keyboard on the desk: workers can position themselves on the concave edge, on the straight edge or between these two positions (Moriguchi *et al.*, 2014). Workers who use the straight part of the "L" table to use the computer have asymmetrical upper limb support (ULM), compared to those who use the concave part (Moriguchi *et al.*, 2014). By observational analysis, these workers would also present greater postural risk. However, direct measures are needed to confirm this hypothesis.

Therefore, this study aims to compare the posture of the head, upper trunk and upper limbs of office workers who use the "L" table and position the computer in two different configurations: in the concave part and in the straight part of the table.

2. Methods

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2.1. Study Location and Participants

The study was carried out in a Secretariat responsible for Distance Education of a University. We evaluated 16 women who work in the administrative sector of this sector and who mainly use computers, alternating typing and mouse use tasks.

The inclusion criteria were to be female, to be between 18 and 60 years old, to have an office work routine (at least 4 hours/day 5 days a week), to agree to participate in the study by signing the free and informed consent form. The exclusion criteria for the study were: BMI greater than 30 kg/m², being left-handed, not having a fixed job and having undergone surgery in the last 6 months.

The research project was submitted to the Ethics and Research Committee with Human Beings of the University.

Among the 16 workers evaluated, 8 positioned the computer in the concave part of the table (CG) (Figure 1A) and 8 workers positioned the computer on the straight part (RG) of the table in an "L" shape (Figures 1B and 1C). In addition, the RG was subdivided according to the arrangement of the screen, keyboard, and mouse on the right or left side (Figures 1B and 1C). Figure 2 shows the participants during data collection.

Figure 1. *Layout* of the tables, representing the different modes of use.

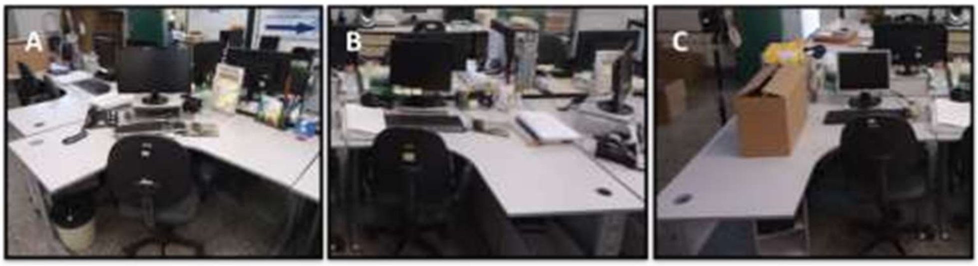

Figure 1A: Use of the concave part of the "L" table

Figure 1B and 1C: use of the straight part of the table, subdivided into 1B: right support and 1C: left support.

Figure 2. Different ways of using the "L" table..

Figure 2A: Use of the concave part of the "L" table

2B and 2C: use of the straight part of the table, subdivided into 2B: right support and 2C: left support

2.2. Equipment and instruments

Initially, a questionnaire was applied that contained information on gender, age, weight and height, manual dominance, education level, occupational history, presence of pain or physical discomfort, and lifestyle habits. Data on body mass, height, anthropometric measurements and the positioning of the mouse, monitor and keyboard were collected on an evaluation form. To perform anthropometric measurements and furniture, a tape measure and ruler were used.

Four triaxial inclinometer sensors and a data acquisition unit (Logger Teknologi HB, Akarp, Sweden) with an acquisition frequency of 20 Hz were used to evaluate the postures and movements of the cervical spine, head, thoracic spine and shoulders. Prior to data collection, the sensors were calibrated according to technical recommendations, on a straight surface, parallel to the ground, for each of their faces for a period of 5 seconds (Hansson *et al*, 2001, Moriguchi *et al*., 2011).

A digital camera (Sony, 14.1 *megapixels)* was used to capture the photos.

2.3. Evaluation Protocol

Initially, the questionnaire was applied in order to characterize the workers and apply the inclusion and exclusion criteria. Anthropometric and furniture measurements were then taken in both groups while the worker performed his usual activities. The measurements of the workstation obtained were: seat height, seat width, table height, table width and length, distance from the popliteal fossa to the chair, distance from the monitor to the eyes, monitor height, distance from the monitor, mouse and keyboard to the front edge of the table.

Anthropometric measurements were obtained with the worker sitting in a chair adjusted in a position in which the hips and knees are at 90º flexion and their feet are resting on the floor. The following measurements were obtained: vision height, elbow height, shoulder height, thigh length, thigh height, and popliteal fossa height. The fit between anthropometric and furniture measurements was defined according to Panagiotopoulou *et al.* (2004).

The postures of the head, cervical spine, thoracic spine and shoulders were recorded during the work by means of inclinometry. The inclinometer sensors were attached to the subjects by means of elastic bands and bands. The head sensor was fixed in the center of the volunteer's forehead; the upper trunk sensor was fixed to the right of the seventh cervical vertebra (C7) and the shoulder sensors were fixed over the deltoid muscle insertion bilaterally.

For the calibration of the sensors in the volunteers, the following postures were adopted: the neutral reference position for the head and upper trunk (0 degrees of flexion-extension and inclination) consists of the subject's upright posture, with the gaze fixed on a mark positioned at eye level 2 meters away from the subject. The reference position indicative of movement was head flexion and thoracic spine. The neutral position for the upper limbs was reproduced with the subject seated, with the armpit resting on the back of the chair and the arm free vertically. The support of a 2 kg dumbbell ensures that the arm will be kept perpendicular to the ground. The reference position indicative of the direction of movement of the upper limbs was the abduction of the arms at 90º in the scapular plane (Moriguchi *et al*., 2011).

2.4. Data analysis

The data were descriptively analyzed using measures of central tendency and variability. The Kolmogorov-Smirnov test was applied to test the normality in the distribution of the data and the Levene test to test the homogeneity between the variances of the groups. The difference between the groups was tested using the MANOVA *one-way* test. The 10th, 50th, and 90th percentiles of flexion and tilt of the head, upper trunk, and cervical spine and upper limb elevation (UL) were compared. A significance level of 5% (α=0.05) was considered.

Regarding the length of stay in the angular sectors of 30°, 60° and 90°, the difference between the CG and RG groups was tested using the Mann Whitney test and between the CG, GRD and GRE groups using the Kruskal Wallis test, since the parametric assumptions were not met. Thus, the level of significance was adjusted by Bonferroni's correction (αBonf=0.016). The data were analyzed using the SPSS 17.0 program.

3. FINDINGS

The personal and demographic data of the subjects are presented in Table 1 and the adequacy of anthropometric measurements to the furniture are presented in Table 2.

Table 1. Personal and demographic data of individuals included in the concave (CG) and straight (RG) groups. *Data are presented as mean (standard deviation).

	CG (n=8)	**GR**(n=8)	**Total**(n=16)
Age (years)*	27,6 (3,2)	31,0 (4,4)	30,0 (7,2)
Weight (Kg)*	61,2 (10,2)	74,7 (9,4)	66,8 (11,7)
Height (cm)*	161,0 (6,3)	166,8 (9,5)	163,4 (7,2)
Working time (months)*	30,1(29,5)	39,3(21,6)	39,4(36,7)
Proportion of symptomatic	4/8	4/8	8/16

Table 2. Adequacy of anthropometric measurements to furniture in the concave (CG) and straight (GRD and GRE) groups.

Data are presented in n (%).

	GC	**GRD**	**GRE**	**Total**
Chair height				
Proper	0 (0)	1 (25)	0 (0)	1 (6)
Inadequate	8 (100)	3 (75)	4 (100)	15 (94)
Table height				
Proper	4 (50)	2 (50)	4 (100)	10 (62)
Inadequate	4 (50)	2 (50)	0 (0)	6 (38)
Monitor height				
Proper	2 (25)	2 (50)	3 (75)	7 (44)
Inadequate	6 (75)	2 (50)	1 (25)	9 (56)

The height of the chair was inadequate for all workers in the GC and GRE groups and for most of the workers in the GRD group. Regarding the height of the table, there was adequacy for all workers in the GRE group and for half of the GC and GRD groups. The height of the monitor was inadequate for the majority of the CG group and for half of the GRD.

The GRE group had greater adequacy in this item. No significant differences were found between the groups (CG and RG) for head posture (*P=0.06), upper trunk* (*P=0.36) and cervical spine (P=0.72) (Table 3). There were also no significant differences between the groups in* *terms of right (P=0.49) and left (P=0.80) shoulder posture and in the time spent in shoulder ranges greater than 30º (P=0.62), 60º (P=1.00) and 90º (P=1.00) (Table 4).*

Table 3. Mean values and standard deviation of the posture of the head, cervical spine and upper trunk in the concave (CG) and straight (RG) groups, and also for the straight part group with support from the right (GRD) and left side (GRE) and for the total sample.

	GC	GR	GRD	GRE	Total
Head flexion					
10th percentile	4,2(5,3)	-2,4(5,0)	-3,3(2,2)	-1,6(3,1)	-1,0(5,2)
50th percentile	8,9(6,0)	5,7(4,7)	3,8(2,7)	7,7(1,7)	7,3(5,4)
90th percentile	22,8(6,9)	19,1(4,5)	15,9(2,0)	22,2(1,2)	20,9(5,9)
Tilt head					
10th percentile	-4,5(3,9)	-7,6(3,8)	-5,3(1,3)	-9,9(1,8)	-6,0(4,1)
50th percentile	8,5(2,9)	-1,2(2,5)	-0,1(0,9)	-2,3(1,5)	-1,7(2,9)
90th percentile	6,3(4,3)	4,0(3,4)	4,3(1,4)	3,8(2,2)	5,2(3,9)
Cervical spine flexion					
10th percentile	-8,9(7,4)	-15,2(8,0)	-16,9(2,9)	-13,6(5,2)	-12,1(8,1)
50th percentile	1,4(8,4)	-5,2(8,4)	-8,3(3,3)	-1,9(4,8)	-1,8(8,8)
90th percentile	14,7(8,4)	9,6(6,9)	6,2(2,3)	13,0(3,8)	12,2(7,9)
Cervical spine tilt					
10th percentile	-3,0(6,2)	-4,1(5,6)	-1,9(0,8)	-6,2(1,9)	-3,5(4,9)
50th percentile	3,9(4,2)	3,0(2,7)	4,2(1,1)	1,8(1,4)	3,5(3,4)
90th percentile	10,1(3,5)	9,1(3,7)	9,6(2,1)	8,6(1,8)	9,6(3,5)
Upper trunk flexion					
10th percentile	1,0(7,6)	4,4(6,0)	6,3(2,8)	2,4(3,3)	2,7(6,8)
50th percentile	8,2(5,4)	11,2(6,2)	12,1(3,8)	10,3(2,7)	9,7(5,8)
90th percentile	14,1(4,1)	17,6(7,0)	17,3(4,7)	17,9(2,7)	15,8(5,9)
Upper torso tilt					
10th percentile	-7,2(4,3)	-7,9(2,7)	-7,6(1,9)	-8,2(0,8)	-7,5(3,5)
50th percentile	-2,7(5,0)	-4,2(2,5)	-4,1(1,7)	-4,3(0,9)	-3,5(3,9)
90th percentile	1,3(4,7)	-0,6(2,3)	-1,0(1,2)	-0,2(1,2)	0,3(3,7)

Table 4. Mean values and standard deviation of the posture of the right and left shoulders and length of stay in the angular sectors of 30º, 60º and 90º in the concave (CG) and straight (RG) groups, and also for the straight part group with support from the right side (GRD) and left side (GRE) and for the total sample.

	GC	GR	GRD	GRE	Total
Right					
Shoulder	37,3(6,6)	31,2(11,3)	39,0(4,9)	23,4(3,0)	34,3(9,5)

10th Percentile					
50th percentile	45,5(3,4)	41,0(7,9)	44,8(4,0)	37,1(3,3)	43,2(6,3)
90th percentile	51,2(3,3)	47,0(6,9)	48,6(3,4)	45,4(2,8)	49,1(5,7)
Left shoulder					
10th percentile	32,3(11,8)	32,3(11,3)	34,5(6,5)	30,1(5,4)	32,3(11,1)
50th percentile	44,5(4,7)	43,5(8,4)	46,3(4,5)	40,8(3,9)	44,0(6,6)
90th percentile	53,3(4,3)	52,2(6,7)	52,9(4,4)	51,5(2,5)	52,8(5,5)
Right shoulder					
30th	95,9(4,0)	82,9(16,0)	92,9(5,1)	73,0(7,6)	89,4(13,1)
60th	1,9(2,3)	1,3(1,0)	1,1(0,7)	1,4(0,2)	1,6(1,7)
90th	0,2(0,4)	0,1(0,1)	0,03(0,0)	0,1(0,02)	0,1(0,2)
Left shoulder					
30th	89,7(11,7)	84,4(17,3)	88,8(5,2)	80,0(11,6)	87,1(14,5)
60th	2,2(2,5)	5,9(11,3)	9,5(8,1)	2,3(0,8)	4,0(8,1)
90th	0,1(0,2)	0,2(0,2)	0,1(0,05)	0,2(0,1)	0,1(0,2)

The comparison between the CG, GRD and GRE groups indicated that there was a difference for the right shoulder posture only for the 10th percentile (*P=0.01), and the post hoc test indicated a* difference between the CG and GRE (*P=0.02) and between the GRD and GRE (P=0.03). For the head, cervical and upper trunk postures, no differences were found when the three groups were compared (P=0.17; P=0.94 and P=0.79, respectively).*

Regarding the time spent in the angular sectors, there was a significant difference between the groups for the right shoulder in amplitudes up to 30º (*P=0.04). The post hoc test* indicated that the difference occurred between the CG and GRE groups (*P=0.011), and the lowest values were found in the GRE.*

4. Discussion

The results obtained indicated that there was no difference in the posture adopted by the workers according to the positioning of the computer on the "L" table. These results were not expected, since it was believed that asymmetry in the forearm support could result in postural asymmetries.

From these results, it was hypothesized that as the RG varied the side of the support this could cancel out postural asymmetries. Thus, the RG group was subdivided into GRD and GRE. This analysis indicated that the GRE group had lower values of right shoulder elevation in the 10th percentile. All volunteers were right-handed, that is, they used the mouse with their right hand, so when they supported the right side (GRD) the shoulder elevation was greater. For the

GRE, this support did not interfere with the elevation of the right shoulder, since the support was on the opposite side. In the CG, the support was given on both sides, also increasing the elevation of the right shoulder. This difference did not appear in the left shoulder, possibly due to right hand dominance in all women. Thus, we can interpret that support is related to greater elevation of the dominant shoulder in situations in which the workstation is not properly adjusted.

Thus, the evaluation of the posture adopted during 1 hour of office work did not confirm the findings obtained by Moriguchi *et al.* (2014), which were obtained observationally. One of the aspects that may have contributed to this finding was the global assessment of exposure, without division by activities, such as mouse use and typing.

The design of the "L" tables should favor the use of the concave part, ensuring better support of the forearm and reduction of biomechanical overload. Moriguchi *et al.* (2014) found that the symmetry of the upper arm was associated with the position of the monitor on the table, that is, the symmetry depends on the way the table is used in an "L". Six of the eight workers who positioned the keyboard and monitor on the concave edge of the table had symmetrical armrests, while when using the straight part, five of the six workers had asymmetrical armrests. In addition, the same study found that higher levels of comfort were associated with the use of the concave edge of the table (Moriguchi *et al*., 2014).

Straker *et al.* (2009) found that the use of the concave table compared to the straight table resulted in greater variability and range of motion, as well as greater variation in muscle activity, thus suggesting an advantage of this type of table when compared to the straight table.

In another study by Straker *et al.* (2008), the curved table resulted in a small decrease in head flexion; however, the activity of the erector cervical and upper trapezius muscles increased.

Dumas *et al*. (2008), evaluated the posture on a straight table, also comparing it with a support for bilateral support of forearms placed on a straight table, simulating a concave table situation. The authors also found no significant differences in the different table conditions, both for abduction and shoulder flexion, as found in the present study. The position of the trunk was considered neutral in both situations, and trunk flexion decreased, but not significantly, with the use of the concave support. Trunk rotation to the left decreased significantly when used on the concave table.

Unlike this study, which also compares posture on a straight table and on a concave table, the results of the study by Delisle *et al.* (2006) show that shoulder flexion and abduction were greater with the use of the concave table compared to the use of the straight table.

One aspect to be considered is that the studies by Delisle *et al*. (2006), Dumas *et al*. (2008), Straker *et al.* (2008) and Straker *et al*. (2009) were carried out in a laboratory environment, in which the furniture was adjusted according to the anthropometric measurements of each volunteer. In the present study, carried out in an occupational environment, no furniture adjustments were made, which may have influenced the results, since the CG group presented greater inadequacy of chair height, which may have caused greater shoulder elevation in this group.

In addition, previous studies evaluated the posture of these individuals at different tables and not in different situations at the same "L" table.

5. Conclusions

The results of the present study indicate that the arrangement of the monitor and keyboard on the table with a curved design does not seem to influence the postural exposure of the workers.

6. Thanks

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