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Research paper

An ergonomic evaluation and intervention of the computer workstation among the office staff in an engineering college in India

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Abstract

As the office automation increases, the use of computer workstations is swiftly growing. Regardless of its several benefits, work-related risks such as eye strain and musculoskeletal stresses have developed as a significant problem. This analysis was designed to investigate the effects of work postures upon the musculoskeletal stresses experienced by the computer tasks operators in Karunya Institute of Technology and Sciences. A survey is done using the Occupational Safety and Health Administration evaluation checklist and an evaluation checklist prepared by 'Rauf Iqbal' in order to gather information on the issues like work practice, workstation, and health-related issues on the users. A detailed analysis of the body posture of 20 employees was done using the tool Rapid Upper Limb Assessment (RULA). The results of the checklist's and RULA were analyzed to identify the specific problems faced by the computer users. Based on the specific problems identified, changes in the workstation were proposed. RULA analysis was conducted again on the redesigned workstations and results were compared. It was concluded that this ergonomic analysis helped to identify the reason for discomfort and implement relevant changes in order to reduce the discomfort level of the subjects in the different office section.

Keywords: *Checklist; Ergonomics; RULA; Visual Display Terminal; Work Posture; Workstation.*

1. Introduction

Musculoskeletal discomforts and disorders, due to high workload and non-neutral work postures. The placement of the keyboard, mouse and other input devices are the three components of workstation constrains [1-4]. Further physical risk factors related with the input devices usage include the design of the input devices, the repetitiveness and the force applied in the task. This indicated that supporting the arms during keyboard and mouse use was a desirable posture for most computer users. A number of types of forearm support and wrist rest have been designed and considerable research has been done on the effectiveness of using the forearm and wrist support [4-5].

VDTs, as with any other equipment, when used properly do not cause adverse effects for the operator. However, they can contribute to significant health and safety problems if they are used improperly or are poorly matched with the operator. Fitting the workplace and working conditions to the physical and mental needs of the VDT operator is recommended as the solution [2]. Symptoms such as eye problems and lower back, neck and shoulder pain are common among computer users. These problems adversely affect the workers, quality of life, efficiency of work and results in decreased productivity [7].

This study was therefore aimed at evaluating the computer workstation among computer by analyzing the effect of work postures upon the musculoskeletal stresses experienced by the employees involved in Visual Display Terminal (VDT) tasks in Karunya Institute of Technology and Sciences, Coimbatore. Based on the analysis, the aim is to identify the discomfort caused due to various reasons and implement relevant changes in workstation.

2. Methods

2.1. Subjects

The study involved 20 male participants. They were employees from various departments of Karunya Institute of Technology and Sciences who had used a computer for a minimum of 4 years and continuously working for 3.5 to 10 hours per day. They were recruited from 10 faculties.

2.2. Materials and method used

Occupational Safety and Health Administration (OSHA) evaluation checklist and a checklist designed by 'Rauf Iqbal' [9] was used for employee survey in order to gather information on the issues like work practice, workstation and health related issues on the users and to analyse the data. All the details were tabulated and discomforts faced by the subjects were identified.

Rapid upper limb Assessment (RULA) is a survey method developed to ergonomically investigate workplaces. This tool gives a quick valuation of the postures of the neck, trunk and upper limbs the body. A coding system is used to generate an action list which indicates the level of intervention required to reduce the risks of injury due to physical loading on the operator [3, 6]. A RULA assessment requires little time to complete. The RULA levels and indications are shown is Table 1.

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Table 1: Rapid Upper Limb Assessment (RULA) Levels and Indicators

Grand Score	Action Level	Indicators
1 or 2	1	acceptable posture
3 or 4	2	further investigation, change may be needed
5 or 6	3	further investigation, change soon
7	4	investigate and implement change

2.3. Procedure

A survey is done using the OSHA Evaluation checklist and the evaluation checklist prepared by 'Rauf Iqbal' for 20 employees in Karunya Institute of Technology and Sciences in order to gather information on the issues like work practice, workstation and health related issues on the users and to analyse the data. Working posture for the 20 employees was evaluated using the RULA tool. The results of the checklist's and RULA were analyzed to identify the specific problems faced by the VDT workstation users. Based on the specific problems identified, changes in the workstation were proposed. RULA analysis was conducted again on the redesigned workstations and results were compared.

3. Results and discussions

A survey was done with the help of OSHA evaluation checklist for 20 employees in some of the departments in Karunya University. With the help of this checklist, problems faced by the employees were identified. Based on the checklist, a detailed problem report has been prepared compiling the problem faced from the employees in the various departments i.e. E-Governance, Dean Academic Affairs office, Library, Student Section, Computer technology centre, ECE, MBA, Mechanical etc. as shown in the Table 2.

From the filled in Evaluation Checklist by 'Rauf Iqbal' by the selected subjects, the details of age, height, weight, total work experience, work schedule of the employees, physical arrangement of the work station, body discomfort, chair specification and eye stress were received. The details received are tabulated and documented. The mean and SD of the physical profile and work schedule of the subjects is given in table 3 and table 4 is given respectively. The details regarding the physical arrangement of the work station is mentioned in table 5. The specifications of the chair used by the subjects are shown in table 6. The percentage level of the discomfort occurring in different parts of the body is tabulated as shown in table 7 and the various specific eye problems are identified as shown in table 8.

After the survey, RULA analysis was carried out for the same 20 subjects. The RULA score for 7 subjects out of the total 20 subjects was more than 5 (Score 5 or 6 = further investigation, change soon; Score 7= investigate and implement change). Hence, it is concluded that for these 7 subjects, there should be some modifications in the workstation needs to reduce the respective discomfort faced by them. The RULA score for the 7 subjects is shown in table 9.

Table 2: Detailed Problem Report Compiled from the Filled in OSHA Evaluation Checklists by the Subjects.

S.No	OSHA Evaluation Checklist
1	• Working Posture • Shoulder and upper arm are not perpendicular to the floor. • Neck pain is caused due to bending neck to use documents (neck angle is beyond 20º). • Trunk (Trunk angle = 20º to 50º) is not in neutral position, hence, causing back pain. • Top of the screen is not at or below eye level. • Forearms are not in neutral posture due to continuous use of mouse and keyboard. • Pressure on wrists and hands due to lack of wrist pad and sharp edges leading to bending of wrists (Wrist angle goes beyond $+15^0$ and -15^0).
2	• No footrest for supporting the foot. • Seating • No proper back rest for supporting the lower back. • Edge of the seat hits the back of knee and legs. • Normal plastic chairs are used without cushioning. • Armrest is not proper.
3	• Key board • Absence of wrist pad and forearm rest pad. • Forearm resting on the sharp edges.
4	• Monitor • Top of the screen is not at or below the eye level. • The distance between eyes and monitor is not proper • Cannot read the screen without bending the head or neck backward. • Glare is reflected on screen.
5	• Working Area • No sufficient clearance between the top of the thighs and your computer table/keyboard platform. • No sufficient clearance for legs and feet.
6	• Accessories • There is no proper document holder to hold the documents. • Wrist/palm rest not padded and is placed in sharp edges. • Forearms and wrist are not in straight line while working. • Telephone cannot be used with head upright and shoulder relaxed.
7	• General • There is no micro-breaks or recovery pauses while at the computer workstation.

Table 3: Mean and SD of the Physical Profile of the Subjects

Variable	Age (years)	Height (cm)	Weight (kg)	Total work Experience (years)
Min	26	154	51	4
Max	54	178	96	35
Mean	38.15	167.2	67.75	14.1
±SD	9.039	7.480	10.577	7.587

Table 4: Mean and SD of the Work Schedule of the Subjects

Variable	Working on computer (years)	Computer Work/shift (hours)	Work on computer at stretch (min)	Duration of break (min)	Home PC	
					Having Home computer (%)	Daily exposure home PC (min)
Min	2	3.5	45	1.5	-	5
Max	23	10	50	60	-	220
Mean	12.3	6.975	8.625	24.3625	0.6(60%)	44.4
±SD	6.626	1.609	13.660	21.712	0.502	72.411

Table 5: Physical Arrangement of the Workstation

No of Observation	Computer on Separate computer table (%)	Computer on ordinary office table (%)	Keyboard on computer table (%)	Separate key board tray (%)	Mouse on computer Table (%)	Mouse on key board tray (%)
n=20	75	25	15	85	25	75

Table 6: Chair Specification

Seat height adjustability (%)	Hydraulic press adjustment (%)	Adjustment in operation (hydraulic press) (%)	Manual adjustment (%)	Adjustment in operation (Manual press) (%)	Seat edge rounded (%)
80	10	25	75	80	65

Table 7: Body Discomfort

Intensity	Neck discomfort (%)	Shoulder discomfort (%)	Chest discomfort (%)	Elbow discomfort (%)	Back discomfort (%)	Wrist discomfort (%)	Knee discomfort (%)
Low (%)	45	35	40	50	20	40	45
Mod (%)	20	25	20	10	35	15	25
High (%)	15	10	0	5	20	15	5
Acute (%)	0	0	0	0	5	0	0
Total	80	70	60	65	80	70	75

Table 8: Eye Stress among the Subjects

Stress	Percentage
Fatigue	5
Strain	45
Burning	25
Watering	5
Itching	10
Redness	5
Blurring	15

Table 9: RULA Analysis Before and after Redesign of the Workstation

Subject No.	Name	Rula Score (Before)	Rula Score (After)
1	D. Samuelsunder	5	3
2	D.Stephen	5	4
3	C.M Revi	6	3
4	Sebastin	6	4
5	Manikandan. R	6	4
6	K. S Maharasan	6	3
7	Gomas. P	6	4

Based on the above analysis done using the checklists and the specific RULA score for the body parts, it was found that most of the computer users were suffering with neck and back pain (Table 7). The reason for this could be the lack of document holders to view the documents for their respective work. Hence, a temporary document holder was fabricated and provided to the subjects with RULA score more than 5. The height and angle of the document holder could be adjusted according to the users comfort. They were advised to use the document holder for 5 days.

It was also noticed that the employees with RULA score more than 5 did not have their wrist, forearm and back in neutral position due to the absence of wrist pad, proper support for the forearm and proper back rest. Hence, wrist padded keyboards and ergonomically designed chairs were provided for the ergonomic intervention.

The subjects were advised to continue their respective work in their respective modified workstation. After 5 days, RULA analysis was carried out again for the 7 subjects whose previous RULA score was more than 5. It was noticed that the RULA score had reduced after the ergonomic intervention as shown in the table 9. The computer workstation before and after the ergonomic intervention of three employees with RULA score more than 5 are shown from Fig. 1 to Fig. 3.



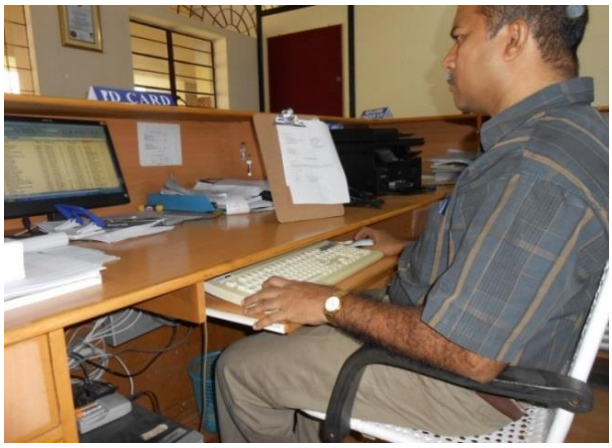
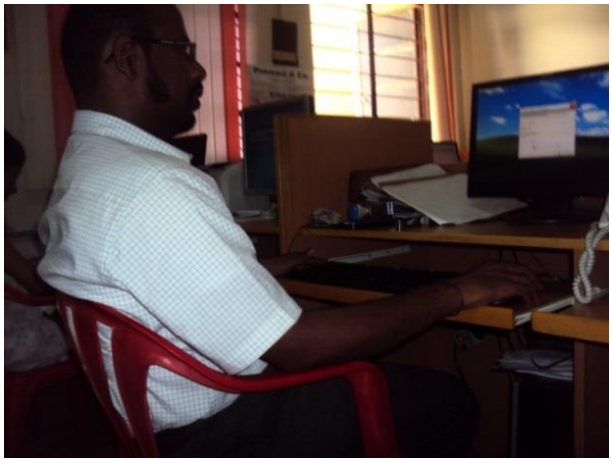


Fig. 1: The Workstation of Subject 3 before and after the Ergonomic Intervention (Document Holder and Chair with Arm Rest is Provided).



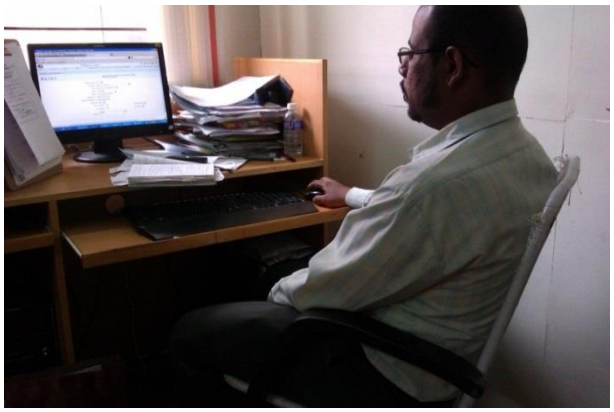
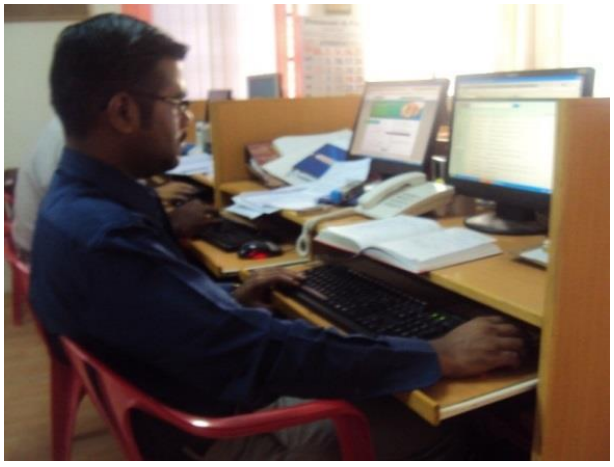


Fig. 2: The Workstation of Subject 6 before and after the Ergonomic Intervention.



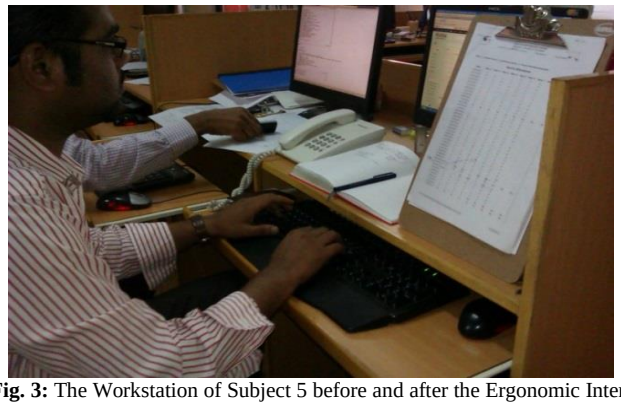


Fig. 3: The Workstation of Subject 5 before and after the Ergonomic Intervention.

4. Conclusion

The working postures of 20 employees from Karunya Institute of Technology and Sciences were analysed. After the ergonomic intervention, the computer workstations of [7] employees having RULA score more than 5 were improved. The workstation is now widely used by the computer users with ease. The RULA analysis was conducted again on the [7] employees and there was an improvement in the RULA score. This ergonomic intervention helped to identify the reason for discomfort faced by the computer users and implement relevant changes in order to reduce the discomfort level of the subjects in different office section in the University.

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