

Impact of Computer Workstation Design on Health of the Users

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ABSTRACT Computer has become a familiar and much talked about technology these days. Today, no aspect like business, leisure, health education etc. has been left untouched by the computer revolution. There has been an increased frequency of ergonomic injuries and illness in the computer work station. Hence the present study was undertaken with the following objectives (i) To assess the workstation design of VDT in selected organizations as per principles of ergonomics related to human and machine interface. (ii) To take feed back of computer workers on health problems related to VDT workstation design. A sample of 30 computer operators was selected purposively from private and public sector organization, involved in data entry work. A checklist was used to assess the computer workstation design for VDT users and to assess health of the workers. Overall and Localized Body Discomfort was also assessed. Assessment of computer workstation design revealed that 36.6 percent of VDT workers used chairs with low seat height which was not proper. Chairs with adjustable seat height were used only by one half of the VDT 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. The work place of the VDT users elicited that in 43.3 percent workstations there was glare and reflection of light falling on computer screens. 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.

INTRODUCTION

In an age dominated by technology, computers have become most influential to keep pace with time and progress as it is a Meta source. Even a child of 8-9 years is looking for net information just for completion of his/her school assignment. The increasing use of personal computer in homes has become an integral part of life. Now computers are easily accessible even to a middle class family. Not only banks and government offices but also private bodies, autonomous institutions and almost every organization are being computerized for smooth and faster flow of data and information. The application of computer technology and the accompanying use of VDTs are revolutionizing the work places in India and their use will continue to grow in the future.

The proliferation of video display terminals (VDT), in the modern office setting has generated concern related to potential health hazards associated with their use. There have been numerous operator complaints of a wide range of symptoms including headaches, general malaise, eyestrain and musculo-skeletal problems. The rise in computer use and flat light

touch keyboards that permit high speed typing have resulted in an epidemic of injuries of the hands, arms and shoulders. Carter (1994) recommended that short term musculo-skeletal discomfort is experienced by many V.D.T. operators in the tele communication industry and chronic disability may result in the long term. The VDT operator usually complains of discomfort in the back, arm, shoulders, neck and occasionally in the legs.

Computer vision syndrome is one of the most common complaints of people working with monitors. This problem is with eyes on vision. The complaints include strain, burning sensation etc. Most of the problems are due to fatigue caused by combination of factors. According to a Survey (1991) conducted by the American Optometric Association, at least 10 million cases of computer related eyestrain were reported each year. The most commonly reported symptoms of discomfort and fatigue were the glare and reflection from the monitor screen. Visual discomfort including eyestrain, burning or itching eyes, blurred vision and double vision affect workers in all office environments, however they are generally more common and severe in the video display terminal environment.

Narayana (1999) stated that there was the usual health risks associated with spending too much time in front of computer/monitor. Typical problem included eyestrain and more dangerous problems such as carpal tunnel syndrome and diseases associated with scope for psychological malfunctioning also affected on the health horizon of individuals.

Sheddy (1999) reported that 50-90% of computer users experienced the symptoms of computer vision syndrome. Computer vision syndrome is a serious problem associated with computer use and about three-quarter of computer users were suffering.

Ergonomics is a science that makes product fit people. Its goals are to create products that are easy, enjoyable, safe and efficient to use. Even with well-designed visual display terminal, keyboard and mouse, it is important to set up and use equipment properly. This will help to increase personal comfort and also the out put. Various ergonomic recommendations are made by different specialists after long experience and research. By making use of these recommendations the users can avoid many health problems resulting from inappropriate V.D.T. work station design.

Chaffin and Anderson (1991) considered that the seat alone is insufficient for stabilization and the use of the legs, feet and back in contact with other surfaces, as well as muscular forces, are necessary to produce equilibrium. Leg support is also critical for distribution and reducing buttock and thigh loads. Feet need to rest firmly on the floor or foot support so that the lower leg weight is not supported by the front part of the thighs resting on the seat.

Pheasant (1991) reported that people who work with computer have shown an increased output from 20 to 25 percent because of ergonomic improvement in work station layout. The computer workers who received screen alerts to take the breaks were 13 percent more accurate in their work than those who did not as reported by Hedge (2001).

Margarita et al. (2002) conducted a study with the subjection to analyze the causes of lumbar discomfort while sitting on a chair, by analyzing the relationship of lumbar curvature, pelvic inclination and their mobility with discomfort. The results revealed that great changes of posture are a good indicator of discomfort, and that lordotic posture with

forward leaned pelvis and low mobility are the principal cause of the increase of discomfort.

Thus, on the basis of a comprehensive review of literature it can be concluded that computer is a marvelous tool and the only solution to the information need. But increasing use of it has given rise to many health related issue like occupation overuse syndrome, straight spine syndrome, repetitive strain injuries and cumulative trauma disorders. Providing a satisfactory work environment can resolve the work related problems of almost all the staff. A particular point of concern is the lack of control that an individual has over his or her own task environment. It is therefore, advisable that all aspects of office design should provide flexible system that enables individual to create their own comfortable environment. Moreover review of existing literature reveals that most of the studies on computer users are done in developed countries very few are done in our country. It is important to note that the environmental, social and economical condition of developing country is entirely different from developed one. Therefore, the present study was an attempt to fulfill this gap by making an extensive investigation in this area in Indian context.

The investigation focused to study the existing design of computer workstation on ergonomic parameters and its effect on health of users, with the following objectives:

Objectives

1. To assess the computer workstation design in selected organizations as per principles of ergonomics related to human-machine interface.
2. To gather feed back of computer workers on health problems related to computer workstation design.

METHODOLOGY

The present study was conducted in urban areas of Udaipur district. A purposive sample of 30 computer operators was chosen for the study. Those who were working from last 2 year as computer data operators and worked on computer every day for not less than 4 hours continuously were selected for the study. The study was divided in to three phases:

Phase-I Assessment of Computer Work-

station Design: A checklist was used to assess the computer workstation design for the VDT users in terms of dimensions and placement of chair, desk, computer screen, input device, other paraphernalia along with light intensity and posture of workers.

Phase-II Health Assessment of VDT Workers: For this a checklist containing statements focusing possible health problems was developed based on literature survey. The respondents were asked to elicit their responses in scores on a 4 point continuum viz, Always (3), Often (2), Sometime (1) and Never (0). Mean Weighted Scores for each statement were calculated.

Phase-III Assessment of musculo-skeletal Disorders (MSDs): Psychophysical scale given by Corlett and Bishop (1976) was used to assess overall and localized body discomfort using Body Map.

RESULTS

Grading of Computer Work Stations Design: Grading of Computer Workstations Design was done on the basis of total scores obtained in various parameters. Table 1 extrapolates that 90 percent of workstations where VDT users worked were of 'Average' type i.e., there was lot of scope for improvement in order to enhance health and efficiency of the workers. It was elicited that only 10 percent VDT workstations fell in 'Good' category, none was in either 'Very good' or 'Poor' categories (Fig. 1).

Table 2 shows Mean Weighted and Mean Percent Score of respondents for various parameters enlisted in the checklist. There were in all seven parameters on which assessment of

Table 1: Grading of computer workstations design based on Mean Weighted Score (MWS)

Percentage of scores	Categories	Percentage of workstation design
Below 37%	Poor (below 20)	-
38-59%	Average (21-33)	90
60-74%	Good (33-41)	10
Above 75%	Very good (42-54)	-

Table 2: Mean Weighted Score (MWS) and Mean Percent Score (MPS) of respondents for various parameters of computer workstation

S. No.	Parameter of computer workstation design	Maximum obtainable score	MWS	MPS
1.	Chair	9	4.7	52.5
2.	Desks	9	4.6	51.4
3.	Screen	5	2.4	48.6
4.	Keyboard	9	5.4	60.4
5.	Mouse	6	1.2	20.0
6.	Lighting	4	2.8	70.0
7.	Work Posture	11	7.8	70.9
	Total	54	28.9	54.52

VDT workstation was carried out, with maximum 54 scores which could be obtained. It was seen that for parameters viz. chairs, desk and screen respondents got nearly 50 percent or less scores out of maximum obtainable scores in each of these parameters. It has been stressed by Stewart (1995) that a good chair is probably one of the most critical workstation investments, when a chair is properly adjusted, worker should position their feet firmly on the ground. Their hips and knees should assume a horizontal plane position at a

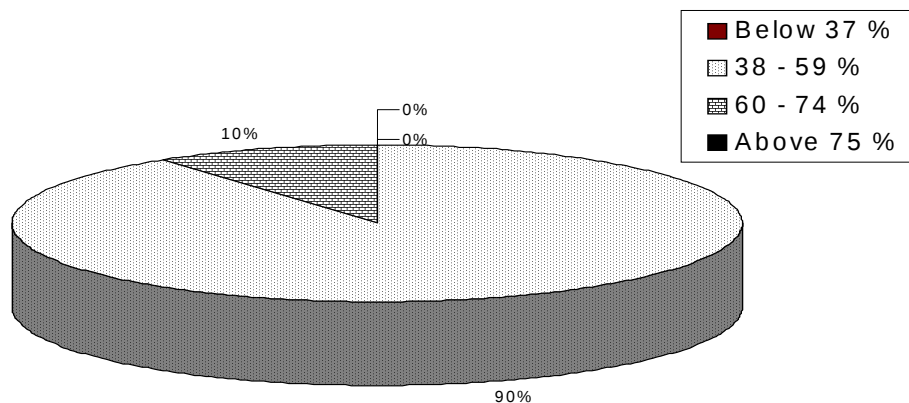


Fig. 1. Grading of computer workstations design based on Mean Weighted Score (MWS)

degree angle, and the pan of their seat should measure 15 to 20 inches from the floor.

Moreover, Darpanjot (1996) remarked that muscular stresses, postural changes and complaints of pain in different body parts were minimum when the distance of 29 cm. from seat to upper edge of the table was achieved and when the subjects could place their feet comfortably on floor while working on computers.

In case of input device viz, mouse only 20 percent respondents could gain scores as per ergonomic parameters, but for keyboard as input device about 60 percent respondents had provisions as per standards. Green et al. (1991) did a study on 15 keyboard operators for 2-4 hours of determine the effect of symptoms of over use, the types of keyboards, time of the day and sex on work postures. The only factor which significantly affected posture was the type of keyboard, at which operators adopted a more extended shoulder position. It was reported by Hallow (2001) that the key board and mouse should both be positioned directly to ensure that upper arm remains close to the body and the amount of static muscle work around the shoulders is minimized.

Lighting and work posture were the only two parameters where 70 percent of VDT users could get good scores. Hedge (1992) reported that in national survey, 85% of US workers used

personal computers at work, 92% of workers rated proper lighting as being very important but only 64% had proper lighting, 47% reported eye strain as a serious problem.

Thus, most of the parameters needed further improvement in dimensions, placement or use for improving Man-machine compatibility for enhancing health and efficiency of VDT users (Fig. 2).

Impact of VDT Workstation Design on Health of Users: The health problem and musculo-skeletal disorder of computer users working on computer for long hours is one of the most important factors responsible for musculo-skeletal problems. The computer user is constrained to remain in the same position for extended periods of time, with repetitive small movement of the eyes, head, arm and fingers. This leads to various health problems, (Table 3)

Table 3 extrapolates the various health problems experienced by VDT workers as a result of working on computers. It was elicited that a roaring majority of respondents experienced eye related trouble viz. strain, itching, burning or irritation in eyes which was attributed to long hours of continuous work and insufficient or inappropriate light source resulting in glare or reflection on computer screen. This was supported by response of 26 percent of the respondents that they 'Always' suffered from glare on the screen. Sen and Sepatnekar (1994) recorded similar complaints like watering of eyes, tiredness, irritability, persistent headache etc. among computer operators. Anshel (2001) studied and found that visual symptoms occurred in 75-90% of computer workers and 22% of workers suffered from musculo-skeletal disorder.

Backache was also another common problem. A vast majority (86 percent) reported that they suffered from shoulder pain and headache as a result of working on computer. A high majority i.e. 83 percent felt discomfort while working on computers, while 76 percent felt mental stress and equal percent suffered from back pain and 66 percent suffered from body pain after computer work. More than half of the respondents felt muscular fatigue while about 50 percent got intense pain in wrist. Carter (1994) reported that most of the muscle-skeletal discomfort experienced by an operator is short term while chronic disability may only develop after a long period of time. Musculo-skeletal discomfort associated with VDT work is

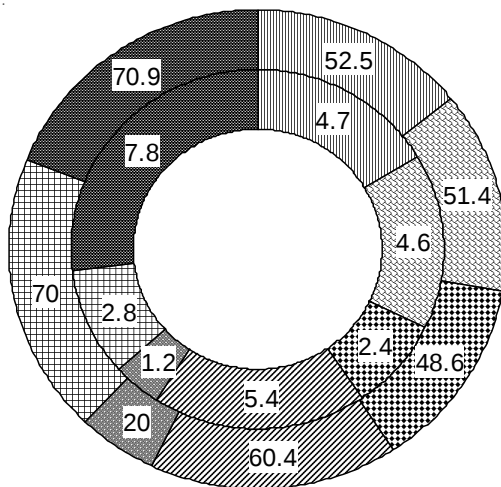


Fig. 2. Mean Weighted Score (MWS) and Mean Percent Score (MPS) of respondents of computer workstation

Table 3: Assessment of health problems of VDT users

Statements	Respondent N = 30					*Total percent affected
	Always (3)	Often (2)	Sometime (1)	Never (0)	MWS	
I feel discomfort while working on computer	10%	33.3%	40%	16.7%	1.3	83.3%
I feel muscular fatigue while working on computer	-	16.7%	40%	43.3%	0.7	56.7%
Suffer from glare in the computer screen	26.7%	6.6%	23.4%	43.3%	1.1	56.7%
I feel itching, burning or irritation in eyes while working on computer	3.3%	33.3%	46.7%	16.7%	1.2	83.3%
I get back pain while working on computer	10%	13.3%	53.4%	23.3%	1.1	76.7%
I get mental stress after working on computer	3.3%	53.4%	20%	23.3%	1.3	76.7%
I get body pain after working on computer continuously	6.7%	6.6%	53.4%	33.3%	0.8	66.7%
I get pain in knees while working on computer	-	13.3%	26.7%	60%	0.5	40%
I suffer pain in shoulder while working on computer	13.3%	60%	13.3%	13.3%	1.7	86.6%
I feel breathing troubles while working on computer	-	-	3.3%	96.7%	0.03	3.3%
I suffer from headaches while working on computer	6.6%	33.3%	46.7%	13.4%	1.3	86.6%
I get intense pain in wrist while working on computer	-	23.3%	26.6%	50%	0.7	49.9%
I feel strain in eyes during computer work	10%	60%	20%	10%	1.7	90%
I suffer from gastro- intestinal troubles	3.3%	10%	20%	66.6%	0.5	43.3%
I feel pain in finger muscles while using keyboard	-	3.3%	23.4%	73.3%	0.3	26.7%

*Does not include 'Never' category.

attributable to static muscular loading of the system bio-mechanical stress and repetitive work.

These health problems were attributed to mismatch between human-machine interfaces and long hours of work on computer. It emerged from interaction of investigator with respondents that VDT users were not very conscious about the causes of their health problems which were due to design of their workstation which in long run will result into serious health problems.

CONCLUSION

The assessment of computer workstation design elicited that there were short coming/ limitation pertaining various parameters under study which resulted in many health problems experienced by VDT users. A vast majority of respondents (63-70%) changed trunk, arm and overall work posture 2-5 times in every 15 min. which reflected discomfort of the worker while working on computer. The upper arm was not hanging straight down for about 36 percent of the respondents and for 26.7 percent the forearm was not parallel to the floor. It was observed that 36.6 percent of VDT workers could not keep wrist straight while working, they either bent wrist up or down or the left or right. This was because of improper dimensions and placement of the input device. A substantial number of respondents could not keep thighs parallel to floor

which puts pressure on the thighs while seating this was attributed to low seat height of chair used. Further, 56.7 percent were not able to keep upper body straight while working on computer; this was due to improper support provided by chair backrest.

Moreover, it was seen that 90 percent of VDT workstation design fall in 'Average' category based on scoring in various parameters. This indicated that there was lot of scope and need for improvement in the workstation layout on ergonomic parameters for improving health and efficiency of VDT users. With this aim a set of Ergonomic Guidelines for efficient VDT Workstation Design were suggested by the investigator.

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