

Ergonomic evaluation of computer workstation used by female employees in Ludhiana district

■ KHUSHDEEP KAUR, HARPINDER KAUR AND M.K. SIDHU

Received: 26.03.2014; Revised: 18.04.2014; Accepted: 29.04.2014

See end of the paper for authors' affiliations

KHUSHDEEP KAUR
Department of Family Resource
Management, Punjab Agricultural
University, LUDHIANA (PUNJAB)
INDIA

■ **ABSTRACT** : Workstation design from an ergonomics perspective can effectively enhance productivity and minimize stress through the interaction between various system components. Ergonomic interventions are most commonly used to reduce work related neck and upper limb symptoms, but physical activity also plays an important role in making the person active and hence, symptom free (Sharma *et al.*, 2009). Poor design of workplace resulted in adopting awkward postures, which in turn affected the ability to do work efficiently and productively. Proper posture is considered to be a state of musculo-skeletal balance that involves a minimal amount of stress or strain to the body. Therefore, a study was conducted to do the ergonomic evaluation of computer workstation used by female employees in Ludhiana district. A total of 120 female employees were taken as respondents. A pre-structured interview schedule was used to ergonomically evaluate the work station design of female VDT users. The results showed that due to improper dimension and placement of workstation accessories lead to postural discomfort.

■ **KEY WORDS**: Ergonomic evaluation, Workplace, Postural discomfort

■ **HOW TO CITE THIS PAPER** : Kaur, Khushdeep, Kaur, Harpinder and Sidhu, M.K. (2014). Ergonomic evaluation of computer workstation used by female employees in Ludhiana district. *Asian J. Home Sci.*, 9 (1) : 149-152.

Ergonomics is the science of fitting workplace conditions and job demands to the capabilities of the employee. It considers the capabilities and limits of a worker as they interact with tools, equipment, work methods, and tasks in the work environment. Each employee is different so a single setup doesn't work for everyone. Today, it is possible to carry out many of these activities using a computer without ever having to move from the workstation. In addition to this, change in the nature of the work, there are more and more significant time constraints and complaints about various health problems that have begun to appear. India, being the forerunner in the cyber world, the health personals are slowly awakening to this group of modern occupational diseases, which are slowly taking roots, especially among the Video Display Terminal (VDT) users. Workstation design from an ergonomics perspective can effectively enhance productivity and minimize stress through the interaction between various system components. Ergonomic interventions are most

commonly used to reduce work related neck and upper limb symptoms, but physical activity also plays an important role in making the person active and hence, symptom free (Sharma *et al.*, 2009). Poor design of workplace resulted in adopting awkward postures, which in turn affected the ability to do work efficiently and productively. Proper posture is considered to be a state of musculo-skeletal balance that involves a minimal amount of stress or strain to the body. Therefore, a study was conducted to do the ergonomic evaluation of computer workstation used by female employees in Ludhiana district.

■ RESEARCH METHODS

Field survey was conducted on female employees working on Video Display Terminals (VDT) in different banks of Ludhiana district. Out of four zones of Ludhiana city, two zones were randomly selected. Out of each selected zone, 60 female employees in the age group of 25-35 years working in

various private and nationalized banks as VDT users were purposively selected, thus making a total sample of 120 respondents. A pre-structured interview schedule was used to ergonomically evaluate the work station design of female VDT users.

■ RESEARCH FINDINGS AND DISCUSSION

The results of the present study as well as relevant discussions have been presented under following sub heads:

Evaluation of working chair used by respondents with the formulated/ recommended standards:

The most important piece of office equipment from ergonomics point of view is the chair. A typical office worker spends maximum time sitting on their office chair and this chair should be comfortable in all respects to maintain a good posture (Gandotra *et al.*, 2013). Improperly designed chairs, that do not properly fit the individual may exert pressure on the legs and buttocks and provide poor body support (Brophy and Grant, 1996). Therefore, various measurements of workstation chair used by respondents were taken and compared with the formulated/recommended standards (Table 1). It was found that regarding seat height, 20.83 per cent of respondents' workstation fulfilled the recommended / formulated standard of 41.75-48.25 cm. Whereas, the criteria of seat width (47.65-59.35 cm) and seat depth (48.26-54.74 cm) was fulfilled by 58.33 per cent and 66.66 per cent of respondents' workstation, respectively. The recommended armrest height of chair was 22-30 cm which was fulfilled by

70.00 per cent of respondents' workstation. It was observed that 70.00 per cent of office chairs had provided with the armrest. Whereas, all the respondents were having chair with backrest height between 48.20-63.80 cm which is a recommended range for backrest height of a chair. The recommended range for backrest width of the chair is 32-36 cm and only 33.33 per cent of respondents were using chairs having this range of backrest width. It is also recommended that the chair should have rounded front edge which was provided at workstation of 85.83 per cent of respondents. Therefore, it can be concluded that a comfortable and ergonomically designed chair helps to maintain the good working posture. Mehta *et al.* (2007) also mentioned that a worker cannot maintain a natural alignment of body during work when the height of the seat and table on which worker works is not made according to the height of the worker.

Evaluation of working desk used by respondents with formulated/ recommended standards:

Appropriate dimensions of the working desk also play a great role in reducing the musculo-skeletal problems and physical stress of the workers. Too low or too high work surface can lead to fatigue particularly in arms and shoulder muscles (Canadian Standards Association (CSA) guideline 2004). Therefore, evaluation of working desk used by respondents were also evaluated and compared with the recommended/ formulated standards and presented in Table 2. It was found that only 10.00 per cent of respondents were using the desk with surface height range of 69-72 cm which is

Table 1: Evaluation of working chair used by respondents with the formulated/ recommended standards				(n=120)
Parameters	Existing dimensions mean and S.D.(cm)	Recommended criteria for formulating dimensions	Formulated dimensions \pm S.D.	Percentage of respondents' workstations fulfilled the recommended standards
Seat height	49.52 \pm 3.59	Sitting popliteal height	45 \pm 3.25 (41.75-48.25)	20.83
Seat width	50.92 \pm 2.13	Sitting hip breadth+7.5 cm	53.5 \pm 5.85 (47.65-59.35)	58.33
Seat depth	50.95 \pm 2.41	Sitting buttock- popliteal +7.5 cm	51.5 \pm 3.24 (48.26-54.74)	66.66
Armrest height	18.89 \pm 0.77	22-30 cm	-	70.00
Backrest height	58.77 \pm 3.22	Sitting shoulder height	56 \pm 7.80 (48.20-63.80)	100.00
Backrest width	40.33 \pm 3.81	32 -36 cm	-	33.33
Rounded front edge	-	Should be provided	-	85.83

Source : Robert (1960), Grandjean (1988) and Mehta *et al* (2007)

Table 2: Evaluation of working desk used by respondents with the formulated/ recommended standards				(n=120)
Parameters	Existing dimensions mean and S.D. (cm)	Recommended criteria for formulating dimensions	Formulated dimensions \pm S.D.	Percentage of respondents full fill the recommended standards
Desk surface height	76.52 \pm 2.29	69-72 cm	-	10.00
Desk width	136.15 \pm 11.52	122-147 cm	-	61.66
Desk depth	62.67 \pm 8.50	horizontal forward reach	45 \pm 3.25 (41.75-48.25)	33.33
Foot rest	Not provided	Footrest should be provided	-	Nil
Document holder	Not provided	Should be provided	-	Nil

Source : OSHA (1997), Malik (2005) and Mehta *et al.*(2007)

the recommended height for the VDT users. Whereas, 61.66 per cent of respondents had the working desk width range of 122-147 cm thus, meeting the recommended standards. The recommended desk depth criteria of 41.75-48.25 cm was fulfilled by 33.33 per cent of respondents' workstation. Therefore, it can be concluded that desk measurements of maximum of respondents were not according to the recommended standards which could lead to musculo-skeletal problems and postural discomfort for the respondents. Table 2 further reveals that foot rest and document holder was not provided at any of the workstation which is the necessity for VDT users. It is being also emphasized by Canadian Standards Association (CSA) guideline on Office Ergonomics (2004) that if a worker's feet cannot reach the floor, the front edge of the chair may press into the underside of the worker's thigh, which may impair blood circulation and cause discomfort. These problems can be avoided by using a footrest. Similarly the importance of document holder was emphasized as it reduces the head and eye movements between the document and the screen and also decreases the likelihood of muscular and visual fatigue. It was reported by Brophy and Grant (1996) that a document holder can minimize the amount of neck flexion and twisting necessary to glance back and forth from the computer screen.

Evaluation of environmental parameters at workstation:

When computer work environments are planned, it includes overall lighting, noise, relative humidity and temperature at workstation. The comfortable parameters at workplace help to perform the activity easily and lead to increase in work output (Gupta, 2012). Therefore, evaluation of environmental parameters at workstation of respondents was done and compared with formulated / recommended standards and are presented in Table 3.

Regarding lighting, it was observed that half of the

respondents' workstation fulfilled the recommended range of 500-700 lux indicating if proper light is not provided at computer workstation it can lead visual fatigue and discomfort.

The general noise in the workplace such as air conditioning units, other operators, general office noise, Video Display Unit and printers can add to the fatigue and stress level of users (Shobha, 2011). Therefore, noise level was observed at workstations of respondents and found that 40.83 per cent of workstation had the noise level between the recommended limit of 50-65 dB (Table 3). This may be due to the movements of customers in the banks. Relative humidity was also observed at workstation and it was found that relative humidity range of 40-50 per cent was met by all the workstation due to installation of air conditioners in all the banks.

Maintaining a consistent room temperature is a difficult task, however, it is vital that temperature does not become too low or high. Therefore, considerations should be taken to ensure that temperature controls take into account the amount of heat generated by electrical equipment *i.e.* VDUs, printers and lights etc. Table 3 reveals that 98.33 per cent of respondents were working under the comfortable temperature range of 20-25°C as the temperature was maintained by installation of air conditioners in the banks.

On the whole, it can be concluded that environment parameters at the workstation were comfortable for the respondents. Shobha (2011) also reported that temperature and light intensity requirement was comfortable for the call centres employees.

It can be concluded from explanations (Table 4) that if work surface is too high, user has to raise her arms and shoulders which may be fatiguing and may also hinder blood flow, adding to discomfort and even the risk of injury. In addition, the wrist may be flexed (bent forward) to the keys, placing stress on forearm muscles and wrist tissues. Further,

Table 3: Evaluation of environmental parameters at workstation (n=120)			
Parameters	Existing mean and S.D.	Formulated / recommended standards	Percentage of respondents fulfill the recommended standards
Lighting (lux)	374.43 ± 53.98	500-700 lux	50.00
Noise (dB)	69.71 ± 9.95	50-65 dB	40.83
Relative humidity (%)	43 ± 2	40-50%	100.00
Temperature (°C)	23.13 ± 1.38	20-25°C	98.33

Source: Grandjean (1978), Chartered Institution of Building Service (1984) and Dalela and Saurabh (1999)

Table 4: Reasons causing un-natural postures observed at workstation	
Postures observed at workstation	Reasons observed at workstation
Elbows away from the side of body	Work surface too high, keyboard too close to the body
Feet on base of chair	Chair too high
Sitting forward on chair, away from back of seat	Chair too high, keyboard too far away, screen too far away
Wrist resting on sharp edge or surface of desk	Keyboard too far away, work surface too high, chair too low
Wrist extension	Wrist resting on work surface, keyboard too low, chair too high
Neck extension	Screen too high, chair too low, bifocal used by employees
Excessive turning/twisting of head, neck, or trunk	Unorganized workstation, poor chair support, incorrect position of equipment/files

if the work surface is too low, the worker has to lean forward, placing stress on the arms and back. As well, the wrists will tend to bend back, also stressing the muscles and tissues. It is, therefore, suggested that if the user is using bifocal which causes discomfort or awkward head positioning, the screen could be lowered such that the head is in a neutral position when viewing the top line of text or other material. In addition, it was also observed that in some cases, respondents adopted poor posture while trying to reduce the glare by changing their orientation on the screen. Therefore, positioning of screen should be changed to avoid glare and source of glare should be eliminated. Hibibi (2001) and Sarkar and Samanta (2007) also found that various risk factors for musculo-skeletal problems were specifically related to the nature or design of VDT work and workstation. They further suggested that the modifications of the workstation design and improvement in work organization can reduce the prevalence of these risk factors.

Conclusion:

Evaluation in terms of key workstation dimensions, dynamic anthropometry of respondents and environmental parameters was done and compared with formulated/recommended standards. It was observed that some parameters like seat width, depth and arm rest height of the chair (used by 60 to 70 % of respondents) were according to the formulated/ recommended standards. Regarding the evaluation of working desk used by respondents, it was found that nearly half of the respondents were having the desk depth according to the formulated/ recommended standards. Whereas, the height of the desk used by all the respondents was according to the formulated/ recommended standards.

Evaluation of different environmental parameters showed that more than 90.00 per cent of respondents were working under the recommended limits of temperature and relative humidity. Whereas, half of the respondents' workstation were fulfilling the recommended standards lighting and noise. Some of the reasons were also observed which lead to postural discomfort, these were improper dimensions and placement of working accessories.

Authors' affiliations:

HARPINDER KAUR AND M. K. SIDHU, Department of Family Resource Management, Punjab Agricultural University, LUDHIANA (PUNJAB) INDIA

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