Original Article

# Knowledge and practices of ergonomics in computer users

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## Abstract

**Objective:** To assess knowledge and practices of ergonomics among desktop users of different professions.

**Methods:** It was an observational cross-sectional study conducted over a two-week timeframe (from November 7 to 21 2009), through a self-reporting questionnaire. Responses were analysed using SPSS version 15 and considered significant at p value<0.05.

**Results:** The study population comprised 210 males and 134 females. Of the total, 52% said they had heard about ergonomics, while 92% were aware of its importance. Knowledge about the importance of arm-rest (24%) and backrest inclination at 120° (32%) was there, but practised by 21% and 31% respectively (p = <0.02). Straight placement of wrist in line with elbow was known to 194(56.39%) and practiced by 138(40%), while 186(54.06%) respondents had knowledge about the ideal height of the chair, but it was adjusted only by 112(32%). Disproportion was observed between the knowledge and practices of correct viewing distance from the computer screen, maintaining print at eye level, keeping computer screen free of glare and moving the chair for better keyboard use.

**Conclusion:** Almost half of the respondents were not aware of the principles behind safe ergonomic practices. Even those who had the knowledge were not able to carefully and entirely apply this for prevention from health hazards.

**Keywords:** Computers, Ergonomics, Musculoskeletal symptoms, Musculoskeletal disorders, Lower back pain (JPMA 62: 213; 2012).

## Introduction

The word ergonomics is derived from Greek words, "ergo" and "nomos", meaning work and law respectively.[1] International Ergonomics Association describes it as the engineering science dealing with various anatomical, physiological, psychological and engineering philosophies and their interaction with people. The application of this science to design a workplace in terms of tasks of the worker, use of equipment and the overall environment is called ergonomic design. A good ergonomic design not only maximises the capabilities of workers by increasing productivity and job satisfaction, but also benefits the employer by decreasing the cost for health and absenteeism. In other words, ergonomics enables "fitting the task to the worker".

Computers are an integral part of life and no longer need specialised training for use. In every sphere of life the dependence on computers is ever increasing and this widespread use has led to some important "user" health concerns. In the absence of a good ergonomic design, extended work for prolonged periods can adversely affect not only vision, but also the muscles of neck, upper back, shoulders and arms, leading to visual and muscular fatigue and discomfort (musculoskeletal condition). Globally, the number of people suffering from musculoskeletal conditions has increased by 25 percent over the past decade[2] and these conditions make up 2% of the global disease burden. Ergonomics emerges as an issue since many of these musculoskeletal conditions are common computer-related injuries.[3] The risks include both improper workstation design and faulty posture as prolonged sitting for extended periods leads to poor circulation, stiffness of joints and pain. Extended hours of continuous work can increase the chance of developing an injury and repetitive strain injuries that develop over time may lead to long-term disability.[3]

Critical reviews have shown that ergonomist should be aware of the ergonomic implications of common rationalisation strategies at individual workplaces in order to satisfy stakeholders as well as to prevent musculoskeletal disorders,[4] a common cause of chronic disability.[5] Workers highly exposed to both physical and psychosocial workplace risk factors are more likely to report symptoms of musculoskeletal disorders than workers highly exposed to one or the other.[6] The results suggest an interaction between these risk factors in the workplace that amplified the possibility of reporting symptoms in the upper limbs.[7]

Psychosocial risk factors at work were more important when exposure to physical risk factors at work were high than when physical exposure was low.

Ergonomics is a relatively new concept in Pakistan yet to be considered an essential component of most enterprises. Literature recognises the importance of ergonomic relationship between mechanical exposure of the upper limb at work and ailments such as pain, numbness, tingling in the wrist, shoulder, back and legs and eye strain.[8] A user-centered approach to impart knowledge of the anatomy and physiology of the body in addition to the nature of work and workstation design is needed to enable individuals to organise their workplace to prevent various health hazards.[9,10]

In computer handling; span of usage, duration of total work , number of consecutive hours , nature of job, type of computer used and its placement are to be considered. Both physical and psychosocial factors have to be measured to enhance efficacy. Symptoms like pain, numbness, tingling etc in various body parts like wrists, shoulders, back and legs and eye strains occur due to improper seating, lack of short breaks during work and improper viewing distance. Organisation of workplace, proper height of the seat, working posture, proper use of armrest, backrest, straight alignment of the wrist and the elbow and positions on keyboard can prevent various health hazards.

In the absence of any formal education/orientation on ergonomics, the study aimed at identifying the knowledge and practices of ergonomics in various occupational groups with respect to workstations. These findings can form a building block for further research and practical ergonomic interventions which can bring occupational well-being for individuals using computers.

## Subjects and Methods

The observational cross-sectional study was conducted over a two-week timeframe, from November 7 to 21, 2009, to assess the attitudes and practices of computer users from different disciplines of life. A self-reporting questionnaire on ergonomics was developed using the guidelines of the Occupational Health and Safety Act of the Ministry of Labour, Ontario, Canada; and "Easy Ergonomics for Desktop Computer Users" (prepared for publication by the Cal/OSHA Consultation Service, Research and Education Unit, Division of Occupational Safety and Health, California Department of Industrial Relations)[12] to assess workstation ergonomics, its knowledge and practices by identified users.

Organisations executing ergonomics in the workplace were identified and included in the study through a formal invitation of participation and explanation of the procedure by description of the questionnaire. Participants using desktop on a regular basis for a minimum of five years met the inclusion criteria. Those using computers for less than five years or having orthopaedic prescription for any musculoskeletal disorder were excluded from the study. Based on inclusion/exclusion criteria, a list of potential participants (convenient sampling) was obtained from each institution and a letter was sent to the individuals for their willingness to be part of the study. Written informed consent was obtained from all the participants. A 15-minute briefing on terms such as ergonomics and a few others, objectives of study and the use of instrument was delivered which was followed by a question-and-answer session to address any queries. The questionnaire was distributed among 382 participants to be completed and returned within two days. The participants from various disciplines comprised; 46 from Information Technology departments, 16 marketeers, 56 bankers, 48 doctors, 46 teachers and 132 students enrolled in full-time master's and bachelor's programmes and mature students enrolled in different part-time and weekend programmes who met the inclusion criterion (the selection criteria).

Completed responses were acquired by 344 participants; 38 incomplete forms were rejected. The sample size was found to be 341 out a population of 3000 with e (margin of error) of 5% and z (confidence interval) of 95%. SPSS software version 15 was used for data entry and analysis. Values were presented as mean ± SD; SE of mean; Chi square test was applied to evaluate the data, and p value <0.05 was considered significant.

## Results

Participants of the study included 210 males and 134 females, within the age range of 21 to 59 years, and a mean age of 29.49 ± 8.78 years, median 26 and mode 24. The inter-quartile range was 24 and 33. More than half of the

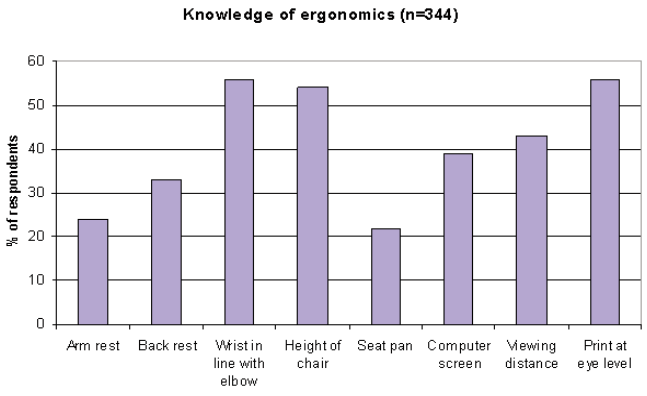


Figure-1: Knowledge of Ergonomic Principles.

**Table: Desk top Usage.**

| | Duration | No of participants | Percentage |
|---|---|---|---|
| Length of computer usage | 5-9 years | 158 | 45.93% |
| | >10 years | 186 | 54.07% |
| Duration of usage | >8 hours | 72 | 20.94% |
| | 6-7 hours | 84 | 24.41% |
| | 4-5 hours | 188 | 54.65% |
| Consecutive hours on computer | 6 or more hours | 46 | 13.37% |
| | 3-5 hours | 130 | 37.79% |
| | <3 hours | 168 | 48.84% |

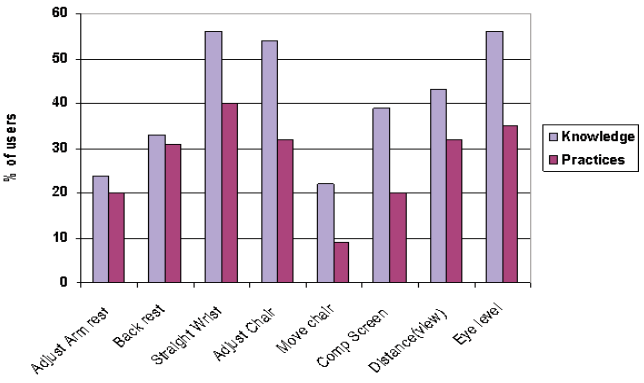


Figure-2: Comparison of knowledge with Ergonomic Practices.

participants (54%) were using computer for over 10 years; 21% were using it for more than 8 hours a day, 24% for 6-7 hours, and 55% for 4-5 hours (Table-1).

Among the participants 180 (52.33%) responded that they had heard about ergonomics, while 164(47.67%) had never heard of the term. Of those who had heard of it, 166 (92.22%) were of the opinion that knowledge of ergonomics is important for the well-being of its users.

A subjective rating of this knowledge on a scale of 1 to 4 (where 1=excellent, 2=good, 3=satisfactory and 4=poor) showed that only 18(10%) of those who had heard of ergonomics, rated it as excellent, 40(22%) rated their knowledge as good, 60(33%) rated it as satisfactory and 62(35%) rated it as poor.

The knowledge of participants with regard to their workstations (Figure-1) showed awareness of computer ergonomics in terms of the importance of armrest (24%), backrest (32%) and moving chair close to the keyboard (21%). More than half of the respondents knew the importance of the height of the chair, keeping print at the eye level and wrist in line with the elbow. Analysis of data (Figure-2) showed comparison of knowledge and practice of the following factors: wrist straight in line with elbow ($p < 0.02$); adjustment of armrest and inclination of backrest ($p < 0.020$). The practices of adjusting the height of the chair and its movement was not significant when compared with knowledge. As far as the distance from the computer screen was concerned, 42% (145) respondents were aware, while 32% (102) always maintained it. Besides, (55%) 189 knew, but only 120 (35%) managed the top line of print at their eye level.

## Discussion

Workplace well-being is evolving and efforts are being made to promote a culture in which health and safety of the employee should be given prime importance. In developing countries such as Pakistan, occupational health and safety unfortunately takes a backseat most of the times. Due to regulatory deficiencies and lack of awareness of the employees and the employers, cases of work-related injuries generally go unreported. The employees are not fully aware of their rights, have little knowledge of workstations and are not trained to prevent and control occupational hazards which are likely to affect their health.

With the advancement in technology, people have become more apt towards the use of computers for the purpose of education as well as recreation. With increasing use of computers, interest, involvement and greater number of hours spent in front of the computer screens, users need to know about the proper posture and the need to take short breaks, which, if forgotten, ends up in multiple complications. Knowledge of ergonomics is required to discipline computer users to avoid certain risk factors that can contribute to the development of musculoskeletal symptoms (MSS) and musculoskeletal disorders (MSD). Application of this knowledge can be directed to fulfill two goals of health and productivity; correction of physical, work, organisational and psychological stress factors; and designing of safe furniture for easy-to-use interface with machines.

In our study, 52.33% of the participants had heard about ergonomics and a subjective rating of their knowledge on a Likert scale revealed that only 10% rated their knowledge as excellent and 20% rated it as good, suggesting dire need for improved awareness. A similar study examined the factors of computer use, job tasks, musculoskeletal and visual discomfort and organisational support to better understand the magnitude of their impact on the safety and health of computer work employees.[11]

Human machine (computer) interface can thus be paramount with the knowledge of machine as well as the organisation of the workplace with respect to a number of parameters. The aim of workplace organisation is to keep

frequently-performed tasks within easy reach to avoid fatigue, wastage of time, loss of productivity, accuracy decline and the risk of injury. As far as workstations are concerned, 21% respondents knew the importance of seat adjustment to be able to perform tasks within reach, but only 9% were actually practicing which may lead to increased risk of upper limb injuries.

Perceived muscular tension is an early sign of musculoskeletal disorder as a result of work directorial and psychosocial factors as well as from physical load and individual factors[12] It has been found that lack of ergonomic layout, which is failure of adjustability to the workstation and the keyboard, is predictor of distal upper limb disorders.[8] Ergonomics emphasises the need to keep shoulders relaxed, arms comfortably on the sides with armrests slightly below the elbows, without the users access to keyboard, using mouse or a writing surface. Several studies have suggested increased prevalence of upper extremity musculoskeletal symptoms associated with increased use of the mouse.[11] In our study, 24% respondents were aware and 21% of them were adjusting the armrest. The knowledge and application of ergonomics can serve to prevent the onset and progress of musculoskeletal injuries and improve one's health status.[13] The "at-ease posture" requires feet resting comfortably on the floor or on a footrest; knees slightly lower than the hips with a 2-4 inch gap between the back of the knees and the front edge of the chair with the back against the chair.[14] More than 50% of our participants knew the importance of adjustments of the height of the chair to keep them in a comfortable position, but only one-third (32%) were practising it.

The duration of work on a desktop is also important since long duration of improper posture contributes to repetitive injuries of the back. Studies suggest that specific tasks performed while sitting in an ergonomically unfit chair for longer periods was associated with low back pain (LBP).[15] Prolonged sitting without breaks or rest increases intra-discal load and weakens posterior lumbar structures. A study done earlier found that return to work and exposure to workplace environment resulted in the recurrence of LBP in most of the workers.[15] In our study, 33% participants were aware of the importance of adjusting backrest and 31% were, in fact, inclining the backrest to an angle comfortable for their posture($p < 0.02$). The comfortable sitting position, use of backrest inclined for maximum convenience, frequent change in posture, rest or stretches can help in the prevention of LBP.

Workstations need to be organised so that the height of the keyboard and the location of the pointing device allow the wrist to be straight in line with the elbow. The etiology of computer-related MSDs is not fully understood, but is suggested to be multi-factorial, involving repetitive and forceful hand and finger exertions, awkward postures, prolonged hours of computer use, and non-neutral postures of the hands and arms with repetition of forceful work.[16] Support to forearms and wrists while working on keyboard and input device was proposed as a preventive measure as it decreases muscle activity in the trapezius muscle and, hence, reduces shoulder pain.[17] Although 56% of our participants knew the importance of placing the wrist straight in line with the elbow, only 40% actually putting it into practice.

The visual acuity of computer users was found to be less when compared to non-users.[18] The complex of eye and vision problems related to near-work experienced during computer use has been termed "Computer Vision Syndrome". Eye strain, the leading problem in computer use, is defined as blurred or double vision, irritation, headaches, eye fatigue, colour perception change, decreased visual efficiency, more frequent errors[19] and decreased efficiency. Visual discomfort and related symptoms occurring in computer workers can be avoided if workers recognise preventive aspects to tackle growing health problems.[18] The ideal viewing distance of 1.5 feet was known to 43% participants; 32% moved their seats closer to the desktop for convenience; 35% managed to keep it at the eye level; and computer screen was kept free of glare by only 20% users.

As the dictum goes, "Prevention is better than cure." It emphasises the need to know the machines we are working with. This knowledge enables us to derive maximum output from the machine without compromising our health. Identifying and solving workplace MSD problems require some level of ergonomic knowledge and skills. The educational component of ergonomics training ensures employees are well-informed about ergonomic hazards so they can actively participate in identifying and controlling exposures. To be "well informed" includes knowing why using ergonomically safe procedures are important. Education and training should start at an early stage — preferably at the student level.

The study had its limitation as population distribution was weighted towards different age groups and computer users of a diverse variety. On the other hand, it is the first study conducted in the region to highlight the importance of computer ergonomics.

## Conclusion

Ergonomic interventions, aimed at preventing musculoskeletal disorders can be initiated through risk

assessment, safety measures and control procedures at workplaces together with instructions and training of computer workers of all age groups. Occupational health services should design effective workplace layout in combination with a feedback survey of the psychosocial work environment and individual training focussing on the working technique to increase the efficiency and productivity of employees, and to minimise the risk of repetitive injuries in all age groups.

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