

Health Hazards Related to Computer use: Experience of the National Institute for Medical Research in Tanzania

V. P. Mvungi, J. Mcharo, M. E. Mmbuji, L. E. Mgonja, and A. Y. Kitua

Abstract—This paper is based on a study conducted in 2006 to assess the impact of computer usage on health of National Institute for Medical Research (NIMR) staff. NIMR being a research Institute, most of its staff spend substantial part of their working time on computers. There was notion among NIMR staff on possible prolonged computer usage health hazards. Hence, a study was conducted to establish facts and possible mitigation measures. A total of 144 NIMR staff were involved in the study of whom 63.2% were males and 36.8% females aged between 20 and 59 years. All staff cadres were included in the sample. The functions performed by Institute staff using computers includes; data management, proposal development and report writing, research activities, secretarial duties, accounting and administrative duties, on-line information retrieval and online communication through e-mail services. The interviewed staff had been using computers for 1-8 hours a day and for a period ranging from 1 to 20 years. The study has indicated ergonomic hazards for a significant proportion of interviewees (63%) of various kinds ranging from backache to eyesight related problems. The authors highlighted major issues which are substantially applicable in preventing occurrences of computer related problems and they urged NIMR Management and/or the government of Tanzania opts to adapt their practicability.

Keywords—Computers ergonomic hazards, computer usage health hazards.

I. INTRODUCTION

THE history of computers goes as far back as 1642 when Black Pascal invented a mechanical calculator [1]. With a series of developments made thereafter by a number of expertises, the first IBM Personal Computer was born in 1981 costing about US\$ 10,000.00. This was gradually improved until when a version that has footprint of today's PCs was released in 1984. Since then the speed, power, capability and interface, operating systems and application software have been developed very fast while allowing very powerful PCs available at affordable costs. Today, the PCS have replaced virtually all typewriters and become a necessity for almost all officers.

The use of Personal Computer has grown tremendously to the extent that today millions of people around the world are using computers. Like many organizations and individual that uses computers all over the world, NIMR staffs have

developed awareness of the potential benefits derived from the use of computers. Computer facilities were introduced in NIMR in early 1990s through acquiring two desktop computers, which by then were restricted to secretarial services, being among the functions that PCs can accomplish effectively and for which relevant software were readily available. With time, PC computing power increased, varieties of software become available at minimal costs, and NIMR Management responded by acquiring more computers to fill up gaps whenever realized. Currently, almost all NIMR offices are equipped with at least a computer set.

There have been fears on the potential health problems that computer users may face, the worries that made producers to react by preparing and distributing articles to counter its effects on computer market growth. Funds were also made available to conduct research work on the area. Consequently, numerous studies have been conducted worldwide in attempt to specifically determine the nature and extent to which health hazards may be present from prolong exposure to computer [2]. The computer related injuries cover a wide variety of health problems caused by or contributed by computer usage [3-4], which are all preventable [5]. The most common reported medical problems are eye strain, carpal tunnel syndrome, neck and back strain, conjunctivitis (itchy, bloodshot eyes) and dermatitis [6].

The problems associated with computer usage have been reported in the United Kingdom (UK) and the United States of America over a decade ago. The UK government established a legislation to protect computer operators from the risks inherent in computer use [5], by setting out legal requirements of employers for their computer operators. The requirements aims at ensuring that; all computers fit a minimum specification for health use, all work stations are assessed for risk and computer equipment are fit for the job to avoid strains and discomfort. Furthermore; all users be made to take regular breaks from computer work, eye tests and special glasses be provided if requested, training on computer safety be provided to all computer users and users be given relevant information relating to their health and safety.

NIMR uses computers not only in facilitating research activities, but also to keep and process financial transactions, produce reports and to accomplish all secretarial duties. The use of computers by the majority of NIMR staff has reduced

All the five authors are with the National Institute for Medical Research, P O Box 9653, Dar es Salaam, Tanzania.

tremendously the typing work that was commonly done by secretaries and typists only. Despite the fact that computer usage at NIMR is extensive at present, apparently, most users remained unaware of the possible potential health hazards they may consequently experience. Very unfortunate, the literature review conducted did not reveal investigation done on any computer usage associated health hazards in Tanzania. There was no retrievable information available either in printed form or from electronic. In that regard, it has never been established as to what extent NIMR staff might have suffered through exposing their bodies to possible hazards they may contract while working with computers. This is now important in view of a large number of the staff using computers to accomplish their duties daily. From this consciousness, NIMR felt the urgency of conducting an investigation to determine the impact of using computers with respect to health conditions of its employees, and eventually put forward recommendations for possible solutions.

II. METHODOLOGY

A. Study population

The investigation was limited to NIMR staff and staff of Institutes and units associated with NIMR in their operations including those in projects, whose duties demanded use of computers. Among NIMR staff; Research Scientists, Laboratory Technologists/Technicians, Secretaries, Data Entrants, Clerical officers, and the Administrative staff were the most relevant groups of staff consulted to provide data. These were the major groups of people in NIMR, whose functions demanded supports of computer application.

B. Data Collection

Pre-designed self-administered questionnaire was used in data collection. Copies of the questionnaire were circulated to NIMR Headquarters, Centres and Stations and project offices for computer users to fill them up. The questionnaire accommodated a wide range of questions believed to represent the most probable computer associated health hazards entities. Demographic characteristics of each interviewee were recorded. Each respondent was asked to give reasons for using computers, the period elapsed since they begun operating with computers and the time they spent on computers on daily basis. They were further, asked if involved in little or extensive usage of computers and any breaks taken in between. Wrists and arm behaviors while typing, type and font size used and positioning of eyes against computer screen were among the information the investigators sought. The habit of changing body position while working with computers and the way the chair supported legs while workings on computers were among the aspects of interest to the investigators. Finally, the respondents were asked to mention any other problems they had ever experienced subsequent to their commencements in computer use. Direct interviews were supported by filled questionnaire by respondents.

C. Data Analysis

The data was entered through Epi Info version 6 and analyzed using Stata software.

III. RESULTS

A. General and Demographic Characteristics

The study involved a total of 144 employees. The target was to reach 214 who were qualified to take part in the

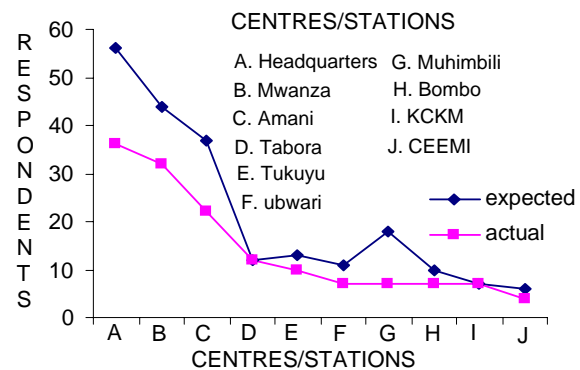


Fig. 1 Distribution of respondents by Centre

investigation. However, it was not possible to reach 100% coverage of the targeted sample because some of the employees were either on study leaves or in field works far away from their working stations. Among the respondents, 91(63.2%) and 53 (36.8%) were males and females

TABLE I
DISTRIBUTION OF RESPONDENTS BY CENTRE/STATION

Center / Project	Expected		Actual		Actual to Expected Ratio [%]
	No.	Population Ratio [%]	No.	Ratio of Planned [%]	
Headquarter	56	26.2	36	64.3	25.0
Mwanza	44	20.6	32	72.7	22.2
Amani	37	17.3	22	59.5	15.3
Tabora	12	5.6	12	100.1	8.3
Tukuyu	13	6.1	10	77.0	6.9
Ubwari	11	5.1	7	63.7	4.9
Muhimbili	18	8.4	7	38.9	4.9
Bombo	10	4.	7	70.1	4.9
KCKM	7	3.3	7	100.1	4.9
CEEMI	6	2.7	4	66.7	2.8
Total	214		144	67.3	100.0

respectively. Age profile ranged between 20 to 59 years with a mean age of 38.6 years. Profession-wise, the interviewees incorporated the research scientists, laboratory technicians, secretaries, data entrants, accountants and administrators. Others were the Librarians, Accountants/Account clerks, Computer Operators, Assistant Medical Officers, Office Supervisors and Health Officers. Table 1 displays the

distribution of the respondents by Centre/Stations. Among the

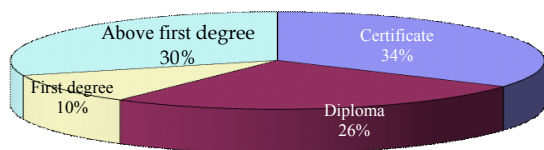


Fig. 2 Education Profile

interviewees, research scientists, laboratory technicians, data entrants and secretaries were the groups of staff members who use computers mostly to accomplish various official duties. The results displayed significant variations in education levels among the respondents. However, majority of the interviewees attained at least first-degree education level as shown in figure 2.

B. Computer use in NIMR

The findings of this study revealed that 87.3% of the respondents had experience in using computers as essential tools applied in their daily activities. The activities demanded computers were data management activities, research development (proposal development and report writing), secretarial duties, on-line information retrieval, and e-mail services. Besides research, computers were also used as tools in executing accounting and administrative duties.

Epochs of using computers among the respondents varied from 1-20 years. Apparently, 59.5% used computers for more

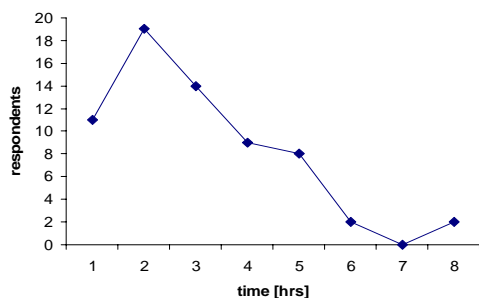


Fig. 3 Time Spent on Computer before

than five years. The majority 102 (71.8%) were involved in extensive typing using computer key boards and 95 (66.4%) declared to break regularly at frequent intervals while working with computers. Similarly, majority of the respondents 98(68%) claimed to have a habit of changing their body positions regularly while working with computers. However, a significant variation was noted on the time spent on computers (1-8 hours) before taking a break, (Fig. 3). While 53% claimed to spend more than two hours on computers before taking a break, 45% of the respondents claimed to spend more than 5 hours working on computers daily.

C. Assessment on Ergonomic Associated Hazards

The ergonomic hazards were part of the assessment conducted during the survey. Whereas 72 (50%) of all

interviewees criticized the design of the chairs they used to sit on in that they did not support their legs in a horizontal position, 46(32%) of respondents were complaining that their chairs did not allow their feet to touch the floor properly.

Whereas 57(39.7 %) of the respondents alleged that they use to keep their wrists on the edge of the computer keyboard while typing, the rest declared that they just let their wrists floating in the air. Moreover, the majority of respondents, 113

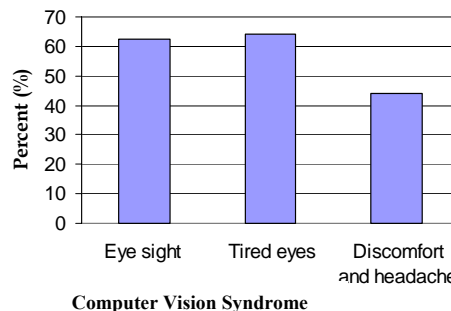


Fig. 4 Eye related Problems

(79%) use two hands to perform double keys operations. Likewise, majority of the respondents 88(61%) keep their wrists straight and level, while the rest usually bend their wrists far down or way back while typing.

A great portion of interviewees (62%) claimed to move their hands around while typing and the rest keep their wrists rest and get stretched to hit keys with their fingers. Regarding font size preferences, 88 % of the respondents were in favors of 12-font size whereas the rest use either 10 or 11 font sizes.

D. Experienced Health Problems among computer users

Sixty three percent (63%) of the interviewees complained about pains in the upper back, shoulder and neck. Eye and headache problems were among the health problems the interviewees experienced. Eyesight problem, suffering from tired eyes as well as some discomforts accompanied by headache were the problems reported. (See figure 4). Regarding sight position while working on computer screens, the observation reveled that most of the respondents (81%) position their eyes at the middle of the computer screen and the rest point their eyes at the top of the screen.

RSI was among the problems NIMR computer users suffering from. The prominent hazards were the tightness discomfort, stiffness or burning in the hands, wrists, fingers, and forearms or elbow that were noted in 44.4% respondents. Other similar problems were also encountered but at a smaller proportions (Table 2)

IV. DISCUSSION

The study reached 67.3% of the targeted 214 employees. This can be taken as a good return rate for any study sample to provide meaningful results reflecting the target community.

TABLE II
EXPERIENCED RSI PROBLEMS AMONG COMPUTER USERS IN NIMR

Problem (%)	Proportion of respondents	
	No.	[%]
Tightness discomfort, stiffness or burning in the hands, wrists, fingers, forearms or elbow	64	44.4
Tingling, coldness, numbness in the hand	27	19
Loss of strength and coordination in the hands	32	22
Pains that wakes you up at night	32	22
Any thickness, inflamed and pains on tendon sheath	36	25
Feeling a need to massage your hands, wrists and arms	56	40

Gender-wise, males were the majority, 63.2% of the interviewees. This is attributed to the male: female staff ratio at NIMR where the females are the minority. Research scientists, laboratory technicians, data entrants and secretaries were the professions identified to spend much most time on computers. The outcome of this study reflects the reality when one considers the nature of work the groups perform. The majority has first-degree education level, being research scientists; the remaining professional groups with exception of administrators do not have degree education level.

The need for using computer facilities is real for NIMR being involved intensively in data collection, processing, analysis and publishing. The Institute has created and is operating a data bank of its research work, incorporating research proposals, reports and publications, and other resources. NIMR has been connected to the rest of the world through computer network enabling its staff to access literature as well as using e-mail services. Moreover, secretaries are always busy typing various correspondences for their bosses and the Account clerks are really busy processing institutional financial data. All those functions are facilitated and done better using computers.

Despite the fact that NIMR has acquired computer facilities since early 1990, some staff members reported using computers for a period of over 20 years. These are NIMR staff who came from other Organizations or institutions that acquired computers earlier than NIMR.

Eighty eight percent (88%) of the respondents preferred using font size 12 while working on computers, and the rest use relatively smaller font sizes ranging between 10 and 11. Skincare [7] recommended using the appropriate font size on a screen to prevent hunching shoulders forward to read, the situation pressurized nerves and blood vessels in the neck and shoulders that may eventually lead to neck and back pains. Most of the problems encountered in NIMR are associated with poor ergonomic positioning that expose users to physical and mechanical strains. Sixty three percent (63%) of the interviewees complained of pains in upper back, shoulder and neck. These conditions are suspected to have a connection with those using a smaller font sizes than 12, as they have to

move their shoulder forwards looking for appropriate focus on screens. Similarly the longer period the respondents spent on computer works before taking breaks may have contributed to such experienced pains.

The respondents claimed to break regularly at frequent intervals, normally after 2-3 hours of working on computers. Jonathan [8] recommends changing sitting position at least every 15 minutes and takes active breaks at least every 30 minutes especially those spending more than 2 or 3 hours on keyboarding daily. Researchers supports the idea of more frequent very short breaks done, for example 30 seconds break after every 10 minutes [9]. The behaviors of NIMR computer users are in line with those recommendations only they relatively spent a bit longer period prior taking break. Such behaviors reflect the occurrence of RSI and other health problems reported.

Proper typing practice is one of the best ways to prevent RIS. ScreamSaver [5] describes the common problems associated with computers use to include, RSI which is associated with performing the same repetitive task over a long time. The common forms of RSI are carpal tunnel syndrome and tendon injuries. The former is a condition in which the median nerve that controls the functioning of the hands and fingers become compressed inside a "tunnel" in the wrist by typing for extended period ending up in swelling of muscles that pinches the nerves in a hand and fingers. The symptoms for RSI include; tightness, discomfort, stiffness, soreness or burning in the hands, wrists, fingers, forearms, or elbow; pain that wakes you up at night; tingling, coldness or numbness in the hands; and loss of strength and coordination in the hands[5]. A few respondents reported experiencing those pains; most likely those acknowledged practicing poor ergonomic while keyboarding.

Letting wrists floating in the air is the best position or behavior of wrist while keyboarding [8]. The most common mistake people make is to contort their hands to perform key combinations such as a shifted letter, Ctrl and Alt keys, the behaviors leading to experience numbness, tingling or loss of feeling in the little finger. Jonathan [8] recommends using one hand to hit the letter key and the index finger of the opposite hand to hit the shift, Ctrl or Alt key to avoid strains caused by twisting hands while keyboarding. Resting on a wrist rest, the table, or arm rests while typing reinforces twisting of a hand to reach some keys. It is recommended to keep hands moving freely above the keyboard to let the strong muscles of the arms move the hands, and have a hand and wrist be level with each other, no angling up or down of the hand. They are level when the forearm is horizontal and parallel to the floor, and the upper arm hanging straight down [10]. Majority of the respondents (61%) acknowledged keeping their wrists straight and level, while the rest usually bend their wrists far down or way back while typing. The later could have displayed the effects arising from poor posture. Over 60 % of the respondents moved their hands around while typing and the rest keep their wrists rest and get stretched to hit keys with their fingers. RSI were the main problems the

respondents claimed to experience. These might be the impact of poor or bad wrist positioning while keyboarding for those who acknowledged practicing such unpleasant behaviors as well as those taking longer periods on computers without a break.

Eyestrain and discomfort resulting from staring at a computer monitor for extended periods are problems associated with computer usage. Looking at the monitor for extended periods can cause eyestrain [11]. It leads to problems like headaches, fatigue, and blurring of vision, dizziness, tingling, burning, tightness, sharp pains, dull pains, watering, double vision and other sensations are eye problems associated with computer maneuverings. Major factors causing eyestrains when using computers are glare, luminance, contrast, reflections on screen, distance between eye and screen, and readability of the screen. NIMR staff complained about eyesight problem, suffering from tired eyes as well as some discomforts accompanied by headaches. The time the respondents claimed to spend on computers before taking a break, the small font size (10-11) used by a few, and practicing eye sight position at tops of the screens were possibly the sources of eyestrains and discomfort observed. Majority of the staff hardly use the zooming function on the screen to improve readability. The staff involved in extensive use of computer keyboarding should be advised to condition themselves to take frequent very short breaks at short intervals and to use large font sizes and/or zooming function in order to correct the problems encountered while preventing themselves from further similar exposure risks.

The screen should be kept 18-30 inches from ones eyes or about an arm's length [8]. Many people find a low monitor to be more comfortable for eyes and neck [7], [11]. Computer Safety [10] recommends that the monitor be placed below the level of the head, and be tilted slightly upwards, so that the user gaze slightly downward, putting the neck in a more natural relaxed position. Most of the respondents (81%) in this investigation claimed to position their eyes at the middle of the computer screen while working with computers. This position is not bad at all, however, the rest direct their eyes at the top of the screen. Such a position is fine for some people but wrong for many [11].

A well-designed chair may favorably affect the posture, circulation and the extent of strain on the spine. The chair should allow the feet firmly on the floor or a footrest should be used to support the feet. Most chairs used by computer users in properly designed computer facilities and institutions have adjustments to make them comfortable to sit on and therefore preventing back pains. Recent research supports the idea of a much wider hip angle with 130 degrees or so as an optimum angle [9]. When the hips are straightened, the vertebrae of the lower spine are aligned with each other in a way that reduces and evens out the pressure on the intervertebral discs. Concerning NIMR, 50% of all interviewees were complaining that their chairs they used to sit on do not support their legs in a horizontal position, and 32% of the respondents were complaining that their chairs do not allow their feet to

touch the floor firmly. This might be the cause for the 63% of the respondents who complained about pains in the upper backs, shoulders and necks.

The costs of computer related injuries in Tanzania can be enormous if the Government not take a precaution and preventive measures to counter the growth of problems associated with computer usage. In the UK and United States of America the costs are dominated by RSI, which is now one of the top five occupational diseases in UK [5], where over £3 million were spent to pay victims of RSI in 1997. The United States of America spent \$20 billion in 1993 to pay compensation claims for RSI and other indirect costs were estimated to reach \$100 billion [5]. This is really a challenge to not only NIMR but to Tanzania in general where computers are increasingly becoming a common tool in offices and working places.

This was just for a single small entity in Tanzania, involving NIMR. It is of interest to extend this study to a much larger sample involving more organizations nationwide to obtain results reflecting national character since this work shows that there is a problem.

V. CONCLUSION

The outcomes of this study revealed existence of health problems associated with practices and habits of computer users in NIMR. Previous studies revealed that most of the problems associated with the use of computer and its accessories can largely be attributed to improper use of computer input devices like keyboard and output devices like monitor and insufficient knowledge about safe computer usage techniques and practices. The situation is similar at NIMR resulting in the observed problems. All staff using or expected to use computers in their duties needs training on how to avoid or minimize computer related health problems. Further, the Government of Tanzania and those of some of the developing countries could adopt lessons learned from the U.K and USA on how to manage the problems originating from computer work, with emphasis on preventive measures. Specific recommendations are provided here under.

VI. RECOMMENDATIONS

The recommendations given here provide a highlight on major aspects that computer users are supposed to abide to while working with those machines to avoid preventable hazards. Educating users on the possible health risks associated with computer uses and some respective preventive measures against could definitely make a difference.

A. Key Board and Mouse

Improper use of keyboard and mouse can cause illness generally referred to RSI. Proper typing habit is recommended to prevent RSI. While keyboarding, it is recommended to keep wrist straight and inline with the forearms approximately parallel to the floor; using a slight touch on the keyboard, rather than pounding on it. Also, keyboard and mouse should be placed close together at about the same height to avoid a

twisted or reaching posture while using mouse. Furthermore, the hands should be kept moving freely above the key board while typing and both hands should be used while typing key combinations such as shift, Ctrl or Alt keys rather than contorting one hand. One hand be used to hit the letter key and index finger of the opposite hand to hit the shift, Ctrl or Alt key while sitting centered over the part of the keyboard that one use most and not centered over the number pad if it is never used. One should avoid constant gripping or squeezing of mouse.

B. Monitor

The monitor be kept far enough for comfortable reading to avoid eyestrains, preferably more that 20 inches from the eyes. The monitor be placed low enough for it's top not to be above the horizontal line of sight to limit the need to tilt the head backward to see the screen and therefore preventing fatigues on the neck and shoulder muscles. The user to make sure that light sources whether natural or artificial are not reflected off you monitor's screen. Glare and reflection off the monitor can cause eye problems leading to blurred vision, preferably use flat screens setting the brightness and contrast control of the monitor properly for comfortable viewing. The use of appropriate font size on the screen is advocated to prevent hunting of the shoulder forward to read.

C. Ergonomic Behaviors

The chair should be adjusted to allow placing feet firmly on the floor or a footrest, with the hip slightly flexed and the knees kept at 60-90 degree angle. Adjustable chairs are recommended with the backrest of 6 to 9 inches high and at least 12 inches wide in the lumber region to make it comfortable to sit on. Note that sitting upright is less desirable than reclining that makes the lower back muscles work less and the spine to support less weight. Computer users should take frequent short breaks e.g. 30 second breaks every ten minutes while keeping hands away of the keyboard and letting arms drop at the side. Also they should change the sitting position every fifteen minutes by getting up from the chair and do a few exercises to loosen the neck and shoulder muscles. For those who perform more that 2 or 3 hours of keyboarding a day should take a break at least every 30 minutes.

D. General

All frequently used components such as monitor, keyboard, and mouse be placed in front of the use so as not to have to turn the head from side to side.

REFERENCES

- [1] John Lockwood (1999) History of Computers <http://ipoint.vls.uiuc.edu/people/lockwood/lockwood.html>
- [2] Jim L Lee, "Computer Health Hazards: Fact or Fiction?", <http://members.aol.com/zenion/introduction.html> 4/10/2003
- [3] "Computing Basics", Smart Computing Magazine PC Health Hazards, vol.11, No. 6, 2000, pp61-62.
- [4] "Hearts to Heart talk" Computer Health Hazards, *Internet Article*, 2003
- [5] ScreamSaver, "Protect yourself from computer related injuries (RSI, WRLD, eye strain, back pain etc)", Internet source, 2001
- [6] Leapfrog News, "Are Computers a Health Hazards?", http://www.rabbit.net/computers_health_hazard.html, 17/01/2005
- [7] Skincare, "Harms of Computer to Health, How Computer use Effect Health in long Run", <http://www.Adeptadvice.com/complete-insight-Harm,2005>
- [8] Jonathan, Ergonomic and Computer injury. <http://www.netsci.org/Science/Special/feature0,17/01/2005>
- [9] "Safe Computing Tips", <http://www.aarogya.com/Conditions/Computer/tips.asp>, 2004
- [10] Computer Safety, "Computer Hazards and Safety" Artist Resources <http://www.artistresources.org/hazards.htm>, 2006
- [11] "Safe Computing Tips: How to avoid RSI and computer related health hazards India", Infotech.com, http://www.India-infotech.com/Articles/safe_computing.html, 20/01/2005