THE SAFE USE OF VISUAL DISPLAY UNITS

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ABSTRACT

The use of visual display units (VDUs) has been increasing throughout the world in the last decade. The most common type of VDU uses the cathode ray tube, and this has resulted in concern among the public about possible adverse effects of radiation exposure from VDU use. Radiation emission from the VDU is negligible and has not been shown to be harmful to health, or to cause adverse pregnancy outcomes. However, many full-time VDU users often complain of visual discomfort, musculoskeletal discomfort of the neck, lower back and upper limbs, and psychosocial problems. The likelihood of having such complaints is positively associated with the duration of hours worked per day, the nature of the work, work schedules and workload, and workstation design and layout, rather than the VDU technology per se. Such complaints are often transient and resolve rapidly when stopping work. Other alleged adverse health effects of VDU use, such as skin complaints, have been discounted.

Guidelines on the safe use of VDUs have been issued by various industrial corporations and national institutions. The guidelines generally address three main areas, viz (1) the provision of a suitable workstation and work environment, (2) good work technique and work schedules, and (3) preplacement and periodic health examinations for the detection and correction of personal impairments. The implementation of these guidelines will resolve many of the potentially correctable factors which result in many of the adverse health effects associated with VDU use.

Keywords: Visual display units (VDUs), visual display terminals (VDTs), health effects of VDU work, VDU work guidelines.

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Introduction

Visual display units (VDUs) were first used as control terminals and display systems in industry and the military. Its use has been increasing over the last few decades, and VDUs are now found in most offices and even in many home environments.

There has been concern that the VDU itself may be a health risk. This is because the commonest type of VDU uses a cathode ray tube (CRT) for the visual display, and CRTs are a source of electromagnetic radiation.

However, numerous studies and reviews have indicated that in addition to the VDU, a poorly designed workplace incorporating a VDU may cause a variety of health effects[1-5]. Poor work schedules and work practice may increase the risk of such health problems.

Health concerns of working with VDUs

The main health-related issues which have frequently been raised regarding work with VDUs are the risks of exposure to radiations emitted by the VDU and the occurrence of visual, musculoskeletal, dermatological and psychosocial complaints associated with VDU work.

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Radiations emitted by VDUs - A non-issue

There are many different kinds of radiation. For example, visible light is a form of radiation, which is produced when the electron beam strikes the phosphor coating of the CRT. At the same time, X-rays emissions are also produced, but most of these are absorbed by the glass screen.

Studies[6-9] have shown that most of the radiations and radiofrequencies emitted from VDUs are lower than values considered to be adverse to health (Table I). In fact, the radiation levels are very much less than from the natural environmental sources such as the sun.

All these levels are well below the limits which are considered harmful by expert bodies such as the National Radiological Protection Board of the United Kingdom and the International Commission of Radiological Protection. The National Institute of Occupational Safety and Health of the U.S.A. has concluded that the VDU does not present a radiation hazard to employees working at or near a VDU[10].

Table I - Levels of ionising and non-ionising radiation from VDUs

Radiation region	Detection limit	No. of VDUs with radiation	Maximum Reading
Radiofrequency	0.1 mW/cm^2	2	4.5 mW/cm^2
Microwave	0.1 mW/cm^2	0	–
Infrared	10^{-8} mW/cm^2	11	7.6 X 10^{-5} mW/cm^2
Ultraviolet (Shortwave)	0.1$\mu W/cm^2$	0	–
X-rays	0.02 mR/h	0	–

* Based on a study conducted in Singapore on 12 different makes of VDUs[6].

Radiation and adverse reproductive outcomes

The concern persists in the general public as to whether certain susceptible groups, such as the pregnant woman and her unborn child, may be at risk from even this very low level of radiation from the VDU. Most experts do not consider that emissions from the VDU will put the pregnant VDU operator or her unborn child at risk[11]. The Health and Safety

Executive of the UK[12] has stated that even if a person works full-time at a VDU during the pregnancy, the radiation received does not add significantly to the natural background level.

To date, most studies are unable to show any link between miscarriage[13-15] or birth defects[16-19] with VDU work. Thus, if a VDU operator is pregnant or thinking of doing so, there is no reason to stop working with VDUs.

It is however true that some people can be very anxious, especially if they had a previous bad obstetric history; and this anxiety itself could cause problems while working with the VDUs during pregnancy. It is best to consult the doctor to discuss the issues involved if a VDU operator is concerned about this matter.

Other frequent health related complaints of VDU operators

The other main health concerns of VDU operators are visual, musculoskeletal, dermatological and psychosocial complaints.

Visual complaints

Some VDU operators complain of subjective symptoms of tired, irritated eyes, blurring of vision, and headache. Generally, the more intensive and prolonged the VDU work is, the more likely the person is to have these complaints[20]. Swedish studies have indicated that about 50% to 75% of full-time VDU operators may have such complaints[21, 22]. Other reports have suggested that transient myopia and dysfunction in visual accommodation may be a problem[23-26].

The exact causes and mechanisms for these eye complaints are improperly understood. The VDU display characters (eg flicker, brightness, contrast, legibility), the length of work in front of a VDU, and personal characteristics (eg age, uncorrected visual impairment) may be likely contenders. However, any work in which a person has to stay in the same position and concentrate for a long time is liable to cause eyestrain and headache. These problems may be aggravated by glare and reflection from an improperly positioned VDU, or if the workplace is poorly lit or noisy.

What is important is that these symptoms are transient, and usually resolve rapidly after stopping work. There have not been any research studies which indicate that work with the VDU can cause damage or permanent impairment of the eyes[2-4].

A recent finding of visual response in VDU operators was a decreased blink rate during VDU use[27]. A significant relationship was also found between the blink interval and the stability of the precorneal tear film[28]. In another small study[29], no difference in precorneal tear film stability was found between VDU operators and non-VDU operators. However, tear volume of VDU users was greater than that of the non-VDU users[29].

Another interesting recent report[30] stated that VDU users were found to require more complex horizontal and vertical eye movements as compared to persons doing other desk work. Expert VDU users had the vision mainly fixed on the CRT screen and moved their eyes more slowly than non-expert VDU operators. Non-expert VDU operators also had their vision mainly fixed on the keyboard.

Musculoskeletal complaints

Reports of musculoskeletal complaints are fairly frequent among VDU operators. The common complaints are fatigue and body aches of the neck, shoulder, upper back and upper limbs. In a recent study of 672 full-time female VDU operators in Singapore[31], stiffness and discomfort of the neck (60%), low back pain (54%), shoulder pain (43%) were commonly reported, while discomfort of the hand/wrist/elbow was less frequent (<20%). This is similar to results found in other studies of VDU operators[3].

The prevalence of such symptoms among VDU operators have consistently been shown to increase significantly with an increase in VDU work hours[3, 22, 32]. Other factors which are known to influence the risk of developing such disorders include the task design, the workplace design, postural constraints, bio-demographic elements and psychosocial factors[31].

However, studies of musculoskeletal complaints are made difficult by a confusing array of terminology, imprecise case definitions and the reliance on subjective self-reported symptoms. The results are further confounded by the influence of psycho-social factors on the prevalence of such complaints[33, 34].

Such disorders have also been observed in traditional office work. Occupational factors when implicated, are believed to be mainly awkward work postures and prolonged or uninterrupted work. Most people find that such symptoms disappear quickly when they stop work. If these symptoms persist, the operator should be advised to consult his or her doctor.

Anthropometric differences and postural preferences of VDU operators

Another issue which may be relevant to VDU operators in the Asia Pacific region is that of the difference in body dimensions of Asian and Caucasian operators. As to be expected, differences in body dimension and also workstation postural preferences exist between Asian and Caucasian populations.

It has been shown[35] that while few anthropometric differences were noted for adult female Chinese, Malay and Indian VDU operators, their body size was much smaller as compared to adult Caucasian females from Germany and USA. As a result of the smaller body size, the Asian females preferred sitting and working heights of 46 cm and 74 cm, as compared to 47 cm and 77 cm for the Caucasian females.

The implication of these findings are that the imported workstations from the West, which are designed for the Caucasian physique, may not always be suited for Asians of smaller body build. This factor should be taken into account when workstations are obtained for Asian VDU operators, and wherever possible, workstations with adjustable dimensions are preferred.

Dermatological complaints - Another non-issue

Within the last decade or so, several reports from temperate countries such as Norway[36], Sweden[37-39], North America[40,41] and the United Kingdom[42] have suggested that work with VDUs might be associated with skin rashes, especially of the face and forearms. However, these reports were mainly case series or prevalence studies of VDU users in isolation, without comparison with non-exposed control groups.

The most recent epidemiological studies[43-46] and experimental provocation studies[47] however, show no association between work with VDUs and the presence of facial skin rashes.

The current consensus, based on these recent epidemiological and provocation studies, is that work with VDUs is unlikely to induce any recognised type of facial skin disease.

Psychosocial disorders

While methodological problems are inherent in studies of psychosocial disorders among VDU workers[5], many researchers believe that the problem lies not in the technology, but the nature of work undertaken[5, 48].

One study[49] showed that monotony experienced during VDU use was related to perceived feelings of lack of controllability and low levels of productivity, while another study[50] reported that rigid work procedures, high production standards and constant pressure to perform resulted in increased self-reported stress and work demands in VDU operators as compared to other occupational groups.

The World Health Organisation[5] has recommended that "control of psychological risk factors associated with VDU use can best be addressed through primary prevention of VDU job and organisational problems".

It however, recognises the fact that "many variables influence the relationship between psychosocial factors and health outcomes in VDU work" and that "this, combined with the fact that no two situations are the same, makes it inappropriate to set rigid recommendations governing psychosocial conditions in the VDU workplace".

The safe use of VDUs

Given that the main health problems affecting VDU operators are eyestrain and musculoskeletal discomfort, how can these be prevented or minimised? Many international and national bodies and product manufacturers are in the process of, or have already issued guidelines for the safe use of VDUs[12, 21, 51-55].

As an example, the Ministry of Labour in Singapore has issued guidelines on the safe use of VDUs[51]. In these guidelines, some simple suggestions are offered to make VDU work more comfortable and to lessen the risk of these problems. These include the adjustment of the work environment to suit the individual needs of the operator, good work practice and schedules, and adequate health care for the operators.

Adjusting the work environment to meet the individual's needs

The workplace design should include adjustable workstations and chairs with backrests, a comfortable workstation layout, and a pleasant work environment.

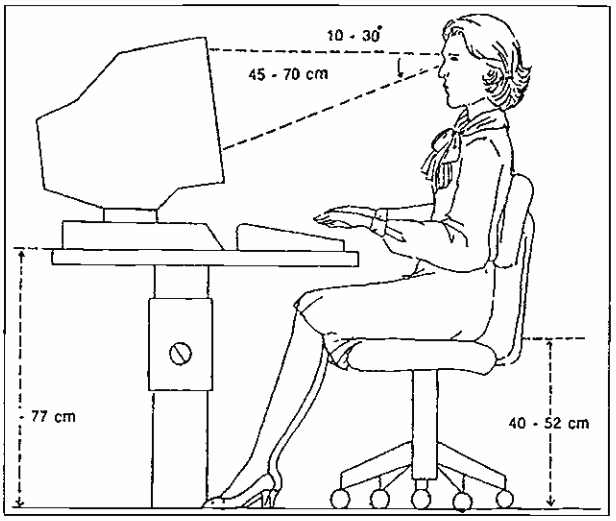
Adjustable furniture and equipment, such as a chair with adjustable height and adjustable good back support, a VDU with an adequate sized screen, with good brightness and contrast adjustment and which can be tilted and swiveled, and a detachable keyboard would allow the operator to adjust the equipment to meet his or her individual preferred working posture (Fig 1).

A proper workstation layout, for example, is one which minimises glare and reflection from the VDU screen (a screen hood may be needed in some cases), which avoids the operator from directly facing a window or bright light (windows to have adjustable blinds or curtains), and which has adequate local or supplementary illumination.

The placement of the document holder at approximately the same viewing distance as the screen, and the arrangement of the work layout to reduce the need for repeated stretching movements is also recommended. It is best to experiment with the placement of the keyboard, the screen and other items which are frequently used to find an arrangement which works best for the operator.

The general work environment should also be conducive

Fig 1 - Workstation Layout



Source: Guidelines for work with VDUs. Ministry of Labour, Singapore. 1991[51].

in terms of ambient lighting, temperature, humidity and noise levels.

New technology is constantly being introduced, and should be evaluated for its effectiveness in prevention of the health risks, or for the introduction of new problems. These include new keyboard design and the advent of other input devices such as the mouse, track-balls, and pen and voice input systems.

Good work practice and schedules

New VDU operators should be given on-the-job training, and may be required to work at lower keystroke rates or for shorter work periods.

The work schedule should be designed wherever possible to provide time away from the VDU for part of the day ie. job rotation or job variation.

Rest periods are also beneficial, instead of working continuously at the VDU throughout the day. As a rough guide, approximately 10-15 minutes rest should be taken for every 1-2 hours of continuous VDU work. All the rest breaks should be away from the VDU.

It is also generally true that being able to choose when to take a break is preferable to having fixed rest schedules. Operators should be advised to change position, stand up, stretch, whenever they begin to feel tired, and to rest their eyes occasionally throughout the work day.

A good keyboard technique is important when prolonged work of the VDU is required. Pascarelli and Kella[56] have demonstrated that in persons with soft tissue injuries of the forearms, elbows, wrists, shoulders and hands, many had harmful inefficient keyboard styles. They stated that changes in the workstation alone may not be adequate treatment for such persons, but that such inefficient styles must also be recognised, addressed and corrected by keyboard technique retraining. For example, the wrists should not be rested on the edge of keyboard or the hands bent at the wrist too much. A soft touch should be kept on the keyboard and the fingers should not be stretched excessively. If only one thumb is used to activate the space bar, the other thumb should not be held in extension and abduction in an active attempt to keep it out of the way when engaged in keyboard use (the "alienated thumb" phenomenon).

Medical examinations

In some cases, visual discomfort may be related to uncorrected vision problems which the VDU operator is unaware of, but which is made worse by prolonged work. It is therefore advisable to have the operator's vision checked (far acuity, near acuity and near point of accommodation) as part of his or her pre-employment and regular health care programme, and to have the appropriate corrections made if necessary[51-54].

Persons with a history of epilepsy are also advised to seek medical advice regarding fitness for VDU work. This is because epileptic seizures may sometimes be induced by the use of VDUs for persons with photosensitive epilepsy[57, 58]. Fortunately, this is a rare disease, with estimates of the prevalence of photosensitive epilepsy in the population ranging from 1 in 5,000 to 1 in 10,000[2].

Conclusion

The use of VDUs is widespread and beneficial for improvement of work quality and productivity. It is a part of daily working as well as family life for many workers in the Asia-Pacific region.

However, the alleged health effects of VDU use are rife and often discussed in the popular press. Sometimes, this may lead to misconceptions and erroneous beliefs.

The scientific and medical communities have expressed concern about these issues and there is consensus that musculoskeletal discomfort, visual fatigue and psychosocial distress may be some of the adverse health effects associated with VDU work.

The causes of these health effects are often related to poor workstation design and adverse work environments, improper work technique and work regimes, and uncorrected personal impairments. These are all correctable factors.

While we continue to optimise the use of VDU technology to improve the quality of work and life, it must be done in a manner which is safe to all workers. Many of the strategies for the prevention of adverse health effects from VDU use are already known. What is needed is for employers, employees and the government to implement these strategies for the protection of the health and well being of VDU users.

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