The research on RSI and Breaks

Wellnomics® White Paper

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Introduction

This document provides background information and research on Work-Related Musculoskeletal Disorders (WMSD), commonly referred to as Repetitive Strain Injury (RSI), and focuses on the scientific evidence supporting introduced breaks for computer users to prevent and manage musculoskeletal disorders.

The development of Wellnomics® WorkPace® is based on this scientific evidence and the effectiveness of its breaks and exercises programme is well proven.

What is the real problem?

Repetitive Strain Injury (RSI) or Carpal Tunnel Syndrome (CTS) are names that are commonly associated with computer-related injuries. However, the problems are actually far wider than these names suggest. Table 1 (below) lists the range of medically defined injuries and conditions that are known to be associated with musculoskeletal injuries [New Zealand OSHA 1999, Turner 1999].

Local inflammations	Compression syndromes	Pain syndromes	Other
Trigger finger de Quervains tenosynovitis epicondylitis rotator cuff syndrome bursitis tendinitis cervicothoracic dysfunction postural syndromes muscle strain	CTS thoracic outlet syndrome ulnar nerve compression radial nerve compression	chronic pain syndrome myofascial syndromes fibromyalgia complex regional pain syndromes reflex sympathetic dystrophy	eyestrain eye blurring

Table 1 Range of recognised medical conditions under the banner of WMSD

As shown above, there are a considerable range of conditions - not just one injury type. These conditions apply to injuries caused in many work situations. However, when it comes to Visual Display Unit (VDU) use, it is the pain syndromes and eyestrain that are actually the most common. True tendinitis and CTS are relatively uncommon among computer users.

What are the true underlying causes?

There are a number of causes of the conditions shown in Table 1. Localised inflammations like tendinitis result from a combination of forceful and repetitive movements. The compression syndromes can be caused by postural extremes, or pressure on nerves as a result of inflammation of tendons. The pain syndromes have multiple contributing causes, but an important one is constrained posture and static muscle tension. Use of a computer keyboard and mouse does require some repetitive action, but very little force, meaning that the first two groups of conditions are less likely. In practice, computer use is primarily characterised by a static constrained posture, fixed focal distance, and sustained muscle tension, such as gripping the mouse). These factors contribute to making eyestrain and the pain syndromes very common.

How common are the problems?

Many studies have shown a high prevalence of complaints among computer users. One report "Investigation into the factors associated with symptoms of ULDs [Upper Limb Disorders] in keyboard users" [Hanson, Graveling, and Donnan 1996] published by the UK Institute of Occupational Medicine surveyed 3,500 keyboard users and found that

"… 55% of the subjects had at some time suffered from some discomfort in their upper limbs. 14% of all subjects were currently suffering, or had suffered within the last three months, from ULDs symptoms which were severe enough for them to seek professional medical advice."

Other studies have found similar results for eyestrain, and neck and shoulder pains. For example, a review paper from the Proceedings of the Third International Scientific Conference on work with Display Units [Luczak, Cakir, and Cakir 1992], looked at the issues of visual fatigue, musculoskeletal problems and stress with respect to VDU use. They found a prevalence rate of up to 50% in some studies. Rates for visual symptoms in particular were reported between 40% and 92% for occasional problems, and from 10% to 40% for daily complaints.

A report by the Health Council of the Netherlands commissioned by the Dutch government (2000) found prevalence rates of 38% for work-related pain complaints among secretaries and typists. Of those VDU users who spend more than 2 hours using a computer per day

"47% of the participants 'sometimes' experience complaints and the neck, shoulders arms, fingers or wrists, and 9% experienced such complaints 'frequently'"

More recently, the results of a 3 year study on 632 computer users in North America published in 2002 [Gerr et al.] showed that more than 50% of computer users develop musculoskeletal symptoms in the hand or arm, neck or shoulders during the first year after starting a new job. 35% actually develop a specific neck/shoulder disorder and 21% a hand/arm disorder during this time.

What are the injury rates?

Injury rates for work-related musculoskeletal disorders (WMSDs) are relatively high. Statistics from the American Occupational Health and Safety Administration (OSHA) show that in recent years WMSD have approached 50% of all occupational injuries [United States Department of Labor 2001]. In Europe a report on Musculoskeletal Disorders (MSDs) from the European Agency for Safety and Health at Work (2000) found MSD injuries ranged from 30% (Luxembourg), to 75% (Spain), of reported occupational disease statistics.

These statistics show that a very high proportion of recorded work-related injuries are musculoskeletal disorders. However, the true picture for MSDs for computer users is less clear. The term MSD is rather general and it is not known what proportion of these injuries match the definitions shown in Table 1. Secondly, it is understood that the majority of these MSDs are not related to computer use. Other workers, especially those employed in manufacturing industries, such as chicken or meat processing, report the highest incidence of these injuries. Although VDU related MSDs comprise a relatively small percentage of the total number of injuries reported, they still represent a significant issue.

VDU user injury rates across specific industry groups are not currently collected and analysed by governmental bodies. However, some statistics have been found for specific organisations. The Government Department of Social Welfare, New Zealand statistics for 1999 showed 82% of injuries were MSDs related to computer use. Clinton Laboratories (Eli Lilly and Company, USA) had an average of 15% of serious injuries attributed to office work during the period 1994 to 1999. A major oil company with 30,000 employees, had a steadily increasing level of MSDs as a proportion of total injuries, reaching over a third of Total Reported Injury Rate (TRIR) in 1999.

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Once again, the statistics show quite a large spread. This can potentially be explained by differences in definition, reporting requirements, and work characteristics between organisations and countries.

Overall, there is certainly evidence that MSDs from VDU use are a significant issue. With increasing proportions of the workforce now using computers, the issue is likely to continue growing.

How important are breaks?

The importance of breaks has often been overlooked in the past by a more general focus on the physical ergonomics of the work area. Adjusting the physical ergonomics of the work area (such as chair, desk and monitor position) has been seen as the most important factor in preventing VDU related MSDs. However, increasingly research is now shifting to the issue of workload and breaks. This in part may be because the physical ergonomic issues have been largely addressed, leaving other less tangible issues like as workload regulation still to be resolved. Scientific evidence in recent publications suggests that the importance of sufficient breaks has been somewhat underestimated, particularly for high users. A regulated workload with sufficient intervals for muscular and mental recovery may be just as important as a good ergonomics of the physical work area.

The need to focus further on the inclusion of breaks during a work cycle is illustrated by discussion in the recent Ergonomics journal paper “A field study of supplementary rest breaks for data-entry operators” [Galinsky et al. 2000].

“…workstation redesign does not appear to be sufficient for completely eliminating work induced discomfort, and in some cases, discomfort has been virtually unaffected by ergonomics interventions. For example, compared to discomfort in the upper and lower extremities, discomfort in the neck and shoulders has been shown to be particularly impervious to ergonomic/workstation improvements (Oxenburgh 1984, Winkel and Oxenburgh 1990, Sauter et al 1991). Neck and shoulder discomfort associated with VDT [Visual Display Terminal] work has been attributed to prolonged muscle tension from static contractions of the neck and shoulder muscles (Waris 1979, Hagberg 1983). Winkel and Oxenburgh (1990) noted that since constrained shoulder/neck postures are inherently characteristic of VDT work, prolonged stated contractions in these muscles are probably not preventable through workstation design changes. They suggested the possibility that neck and shoulder discomfort in VDT work might be relieved only by changes in work organisation such as task rotation or increased rest breaks, which allow for periodic interruptions of the VDT task (Winkel and Oxenburgh 1990).”

This paper was written by authors at the Taft Laboratories of the National Institute for Occupational Safety & Health (NIOSH), USA.

The UK Institute of Occupational Medicine report [Hanson, Graveling, and Donnan 1996] analysed 450 computer users and undertook a detailed ergonomic evaluation of their workstations. They looked at many factors including

“keyboard work, furniture and equipment, postures adopted when keying; physical work environment; psychosocial aspects of work, activities outside work, and personal factors”.

They found that:

"…After adjusting for age and gender, the most significant factor associated with symptoms of ULDs was the length of time the subjects spent at the keyboard during the week (highly correlated with the length of time spent keying without a break)…"

In other words, the most important risk factor was using a computer for long periods without taking breaks.

How effective can breaks be?

In a 1986 paper [Hagberg and Sundelin] examining the benefit of micropauses, the researchers found they contributed to a reduction in discomfort ratings. Later Henning et al. [1989] found that ‘microbreaks’ were

“instrumental in reducing fatigue and associated performance decrements…”

In the more recent NIOSH study [Galinsky et al. 2000] described earlier, the authors looked at the effects of introducing supplementary breaks to a working regime which previously included only a few breaks each day. They concluded:

“In addition to their positive effects on ratings of musculoskeletal discomfort, supplementary rest breaks also led to decreased levels of eye soreness and visual blurring.”

The authors also found:

“Increases in discomfort of the right forearm, wrist and hand over the course of the work week under the conventional schedule were eliminated under the supplementary schedule.”

A very important finding was that:

“These beneficial effects were obtained without reductions in data-entry performance.”

In fact, it was found that there was actually a slight increase in work rate after the rest breaks, which more than compensated for any time lost taking the break.

Another recent study [McLean et al. 2001], looked at the introduction of 30 second microbreaks at intervals of 20 minutes and 40 minutes, compared to a control group in which breaks were left to the user’s discretion. The results of the study, which included EMG muscle monitoring as well as discomfort questionnaires, were positive with the authors concluding

“The benefit of ‘microbreaks’ in terms of their effect on slowing the development of discomfort in the neck, low back, shoulder, and wrist areas is indisputable based on the findings of this work. At the end of a 3 hour computer terminal work session, all of the above areas showed less discomfort when 'microbreaks' were taken (p<0.001).”

They also found that

“The introduction of a microbreak strategy had increased benefit as the duration of the computer terminal work increased.”

In other words, the longer the person used the computer, the more benefit the microbreaks provided. Comparing the two break regimes used (20 minutes versus 40 minutes) it was found that the higher frequency microbreaks provided the greatest benefit.

These studies selected are a sample of a growing body of evidence showing the effectiveness of breaks in reducing musculoskeletal discomfort and eyestrain among computer users. Two documents by research physiotherapist Nicola Green on breaks and micropauses [1999] also provide a comprehensive overview of the scientific papers that have been published on this topic. Several of the studies that were done using actual break software are discussed in detail in the Niche Software White Paper “The current scientific evidence for the effectiveness of break software” [Taylor 2002].

How often should breaks be?

Early work conducted on muscular fatigue by Rohmert [1973] found an exponential relationship between fatigue and recovery. This meant that a doubling of the fatigue level required a quadrupling of the recovery time. Based on these results his recommendations for rest breaks were "little and often". This research and that of many others has culminated in the general recommendation that breaks should be taken "before the onset of fatigue, not in order to recover" (from UK guidance on VDU regulations). Out of this has arisen the concept of the 'micropause' or 'microbreak'. These are short breaks of between approximately 5 to 25 seconds taken every 5 to 20 minutes of continuous computer use. The effectiveness of these microbreaks has been studied in detail [Hagberg and Sundelin 1986, Henning et al. 1989, Bystrom, Mathiassen and Fransson-Hall 1991, Luczah, Cakir and Cakir 1992, Genaidy, Delgado and Bustos 1995, McLean et al. 2001]

Overall, there is still not a consensus on exactly what sort of break regime is ideal, although the concept of micropauses is gaining more and more support. In general, it appears that the more often breaks are taken, the more effective they can be (which matches with the underlying theory of muscle fatigue and recovery). Anecdotal evidence and the experience of the author suggests that quite different regimes may be needed for recovery and prevention. For example, there is strong anecdotal evidence suggesting that break regimes with micropauses up to 30 seconds after 3 to 5 minutes usage, and a 20 minute break every 20 minutes of computer usage, are needed to obtain maximum effectiveness in assisting rehabilitation from significant VDU related MSD injuries.

Should breaks be prompted or left to discretion?

Computer users are not good at regulating their own breaks. If not reminded, a VDU user is likely to only take a break once significant fatigue and discomfort has arisen. One study documenting this problem was conducted by Henning et al. [1989], who found that rest breaks were not regulated effectively by users if left entirely to their own discretion. A Canadian study [MacLean et al. 2001] also found that:

"In terms of reduced discomfort … scheduled breaks were found to be generally more effective than allowing the worker to take breaks on their own"

What is the impact of breaks on productivity?

Many studies have shown that additional introduced breaks do not impact negatively on productivity. As mentioned earlier a finding of the NIOSH study [Galinsky et al. 2000] was that:

"…beneficial effects were obtained without reductions in data-entry performance".

In a 1989 review paper "The design of rest breaks for video terminal work: a review of literature" [Swanson et al. 1989], the authors concluded from the evidence that frequent rest breaks benefit production and comfort in VDU work.

In the McLean et al. study [2001] on microbreaks referred to earlier it was found that:

"Microbreaks showed no evidence of a detrimental effect on worker productivity"

There is growing evidence that the introduction of break regimes actually improves productivity. The paper "The effect of different work rest schedules on fatigue and performance of a simulated directory assistant operators task" [Koparadekar and Mital 1994], found a performance deterioration after 120 minutes of continuous VDU work with error rates increasing by almost 80% towards the end of the period. The introduction of rest breaks reversed this performance deterioration.

A recent research study [van den Heuvel et al. 2002] using a break software tool found statistically significant improvements in productivity of up to 20% among VDU users with complaints. (Productivity was calculated from number of keystrokes per day). How could the introduction of breaks increase

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productivity by so much? One suggestion is that people with pre-existing complaints are working with a productivity deficit - their complaints are causing them to reduce the amount of work they do at the computer. An intervention which helps alleviate their complaints therefore allows them to spend more time at the computer, regaining the previously lost productivity.

Overall, the evidence increasingly shows that the effects of introducing break regimes ranges from at the very least neutral to positive effects on productivity.

How important is prevention?

Recent evidence suggests that some of the musculoskeletal disorders arising from VDU use may arise as a cumulative effect of ‘microtrauma’ over a period of time.

A paper from the University College of London “Vibration sense in the upper limbs of patients with repetitive strain injury and a group of at risk office workers” [Greening and Lynn 1998], caused debate in international medical circles by providing evidence of actual nerve damage in people suffering from pain syndromes as a result of VDU use. Perhaps even more concerning to VDU users was the finding of similar indications of nerve damages in otherwise symptom-free intensive VDU users. The implication of this finding was that a VDU user may begin to accumulate damage before symptoms are apparent – providing an even greater impetus for prevention. Once significant symptoms become apparent it may be too late for effective action to be taken.

This issue was also discussed in the NIOSH paper [Galinsky et al. 2000],

“Theories of cumulative trauma propose that chronic disorders result from the cumulative effects of repeated ‘microtraumas’ manifested as small to moderate increments in discomfort during work.”

If a disorder is the result of a buildup of ‘cumulative trauma’ then prevention is therefore especially important. By the time symptoms appear considerable cumulative ‘damage’ may already have occurred, meaning recovery may be a very slow process.

Does awareness increase reporting?

A paper published in the Journal of Environmental Medicine (JOEM) [Melhorn 1999] examined whether educating employees about Work-related Musculoskeletal Disorders contributed to any increase in reported injuries and compensation. The paper concluded that it did not. This negates fears on the part of some employers that educating employees and making an issue of Cumulative Trauma Disorders (CTDs) might result in increased problems and costs for the employer.

The abstract stated that:

“…there was no increase in the number of OSHA 200 events and no increase in the incidence of workers’ compensation claims after completion of an individual risk screening program that included education and employee awareness about work-related musculoskeletal pain.”

Conclusion

This paper shows the increasing evidence that common computer-related MSD’s can be both prevented and remedied by adopting a regular regime of breaks and micropauses. This has the effect of both reducing the user’s muscle fatigue which contributes to the initial development of symptoms, and also cancels the associated reduction in performance caused by the fatigue. As a preventative measure, this protects the user from sustaining long-term injury at a reduced cost to the employer.

Further reading

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Full copies of some of the references in this article may be obtained from Niche Software Ltd. For further information please refer to the references below.

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