Keystrokes vs Time as a risk factor for musculoskeletal discomfort & MSDs

A review of the literature

Wellnomics® White Paper

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Introduction

Repetitive work is generally viewed as risk factor for the development of musculoskeletal disorders[1]. This means the number of keystrokes an office worker does has historically been seen as a potential risk factor for injury, with the presumption being that more keystrokes and higher typing rates could be correlated with higher risks.

This paper looks at how much support there in the published literature for a relationship between keystrokes and risks in office workers and discusses why time using the computer is likely to be a much better risk exposure measure than keystrokes.

Studies measuring keystrokes

A review has been conducted of the published literature to identify studies with statistically significant results on the relationship between discomfort or injury amongst computer users and keystrokes. There is not a huge number of published studies on this particular issue, but four reasonable quality studies have been found and are reviewed below.

by Hales et al (1994)[2], looked at the relationship between video display terminals (VDT) workplace factors and musculoskeletal disorders in a cross-sectional study. As part of the study they examined keystroke information for a group (n= 174) of directory assistance operators (DAO) who handled approximately 1,200 calls per an 8 hour day. The level of keystrokes was calculated from the number of calls per day and the total number of searches required to find the correct telephone number. The estimated average number of keystrokes per day was 15,950 (range 11,304, SD 2,410), or about 2,000 per hour. At this level the number of keystrokes was not found to be a risk factor for musculoskeletal disorders. However, the authors noted:

> *' [the typing by DAO employees] is equivalent to typing less than eight-words-per-minute over a typical 8 h workday. This finding, therefore, cannot be generalised to other VDT workers such as dedicated work processing or data entry employees who perform significantly more keystrokes per day.' p 1615*

Anderson et al (2003)[3] looked at a subgroup (n=2,146) of their larger cohort study who performed technical drawing, graphical and administrative tasks. Subjects reporting symptoms were clinically evaluated for carpal tunnel syndrome (CTS). They found that the keying speed in the 75th percentile was 8,000 to 22,000 keystrokes per hour. They did not link this with an increased risk for carpal tunnel syndrome (CTS) though there were too few cases in the highest exposure groups to make generalisations. They went on to state:

> *'Can keyboard use then be considered an occupational risk for developing CTS? From our data it seems unlikely, but based on other studies, we cannot exclude the possibility that very intensive and repetitive keyboard use could be a risk factor for CTS. However, our opinion is that this is not an important one.' p 2969*

This study is perhaps somewhat limited by its focus on clinically diagnosed carpal tunnel syndrome (CTS), rather than the more general issue of user-reported complaints and discomfort. CTS is generally regarded as a being a relatively uncommon musculoskeletal disorder amongst computer users (see Wellnomics White Paper *Top 10 Myths about RSI in Computer Users*).

Szeto et al (2005)[4,5] looked more generalised discomfort symptoms and high keystroke rates. Their study assessed two groups of office workers, one asymptomatic (n=21) and the second symptomatic (n=20) under three typing conditions where the subjects where told to type "Normally" or "Faster" or "Harder". These conditions ended up resulting in average keystroke rates of 229 per minute, 260 per minute and 250 per minute respectively (equivalent to 13,740, 15,600 and 15,000 keystrokes per hour), meaning the "type harder" group ended up typing faster as well as using more force. Subjects were asked to rate their discomfort scores on a verbal numerical scale of 0-10 at the beginning and end of the typing task (lasting 20 minutes). Results showed that subjects with existing symptoms reported significantly higher discomfort

scores for both the "Faster" and "Harder" conditions, with these increases being statistically significant. The authors concluded:

> *'The results may suggest a relationship between musculoskeletal discomforts and the speed and force control in keystroke actions.'*

Another study looking at user reported symptoms and higher keystroke levels is Richter et al (2012)[6]. This study analysed data from a prospective cohort study among 1,951 office workers over a period of two years, with periodic questionnaires and continuous measurements of levels of computer use by the Wellnomics WorkPace software. Results showed a statistically significant increase in the occurrence of neck shoulder symptoms correlated with high keystroke frequencies of >=160 keystrokes per minute (9,600 keystrokes per hour).

Although the research is not extensive and what there is shows somewhat mixed results there does appear some limited support for there being an increased risk of discomfort with very high keystroke rates, particularly greater than 10,000 keystrokes per hour.

The changing nature of computer tasks

It is likely that one of the reasons there's less research on keystrokes is because most modern epidemiology studies on office workers have used self-reported time spent using the computer as the key exposure measure rather than keystrokes (see Wellnomics White Paper *Computer use exposure as a key risk factor for musculoskeletal symptoms*). As English and Andre (1999)[7] explained:

> *'Personal computer use has changed dramatically over the past 15 years. Keyboard-intensive command-line navigation and control systems from the early 1980s … transitioned into mouse-based graphical user interfaces …. Reflecting this change, the primary hardware interface used for navigation and control of these systems also transitioned from the keyboard alone to a keyboard and mouse combination. Traditional activities of computer users primarily involved keyboard-centric data input and manipulation. Those activities are rapidly changing to include the information search and entertainment-based browsing activities associated with the Internet' p 126*

In addition, Faucett and Rempel (1996)[8] suggest that the mix of job tasks for which VDTs are used are likely to be modifying factors in the relationship between VDT use and musculoskeletal disorders , for example, data entry, e-mail, graphics all require different actions and inputs. Also, many jobs involve non-computer based tasks such as meetings, telephone use and other clerical tasks.

These changes in computer use are supported by a cross-sectional analysis of data from 60 organisations using the Wellnomics® WorkPace® software undertaken by Wellnomics Limited[9] in 2004. Although data entry tasks involve keystroke rates of 8,000-22,000 keystrokes per hour (see earlier references), the average computer user in the 60 organisations surveyed was found to have a far lower rate of just 2,000 keystrokes per hour. This is supports the idea that the majority of computer use today does not involve highly keystroke intensive work. Some of this reduction in keyboard use may be countered by an increased level of mouse use – mouse use was found to account for over 50% of time at the computer for the average user. However, although mouse use is high, the rate of mouse clicks was found to be about 600 per hour, giving a combined activity level of 2,600 keystrokes + mouse-clicks per hour, still much lower than the high levels of repetitive keying found in intensive data entry or copy typing work.

Dose-response studies looking at time exposure

Many of the epidemiological studies that have used questionnaires to determine exposure to computer use have indicated a dose-response relationship between the number of hours using the computer and

the risk of developing musculoskeletal discomfort or disorders. For example, Karlqvist et al (2002)[10] found that duration of computer work was associated with musculoskeletal symptoms among both men and women and duration of work with a non-keyboard computer input device was associated with symptoms for men. Jensen et al (2002)[11], in a cross-sectional study of computer users, found and stated

> *'The duration of computer use appears critical for the reporting of musculoskeletal symptom, but a further increase in hand/wrist and shoulder symptom prevalence may be due to intensive mouse use' p 273*

Blatter and Bongers (2002)[12] examined the association between musculoskeletal disorders and computer use duration in a cross-sectional study and found that working with a computer more than 6 hours per day was associated with musculoskeletal symptoms in all body regions. Conversely, Kryger et al (2003)[13] found that the main risk factor for forearm pain was intensive mouse use and to a lesser extent keyboard use. They suggest

> *'…preventive actions should include efforts to reduce weekly usage to less than 20 to 25 hours'*

For a more extensive review of studies on the relationship between time using the computer and risks see Wellnomics White Paper *Computer use exposure as a key risk factor for musculoskeletal symptoms*[14].

Summary

There doesn't appear to be good evidence to support the number of keystrokes being used as a way to measure risk exposure. Instead the research supports time using the computer as a more reliable indicator of risk exposure for musculoskeletal disorders. When most computer use was keyboard based the number of keystrokes may have been quite well correlated with the time using the computer and therefore been correlated with risk. Today, however, with the use of other input devices such as the mouse and the expanded use of computers for a wide range of tasks that don't require a lot of keystroke activity, keystroke levels are not likely to be a good indicator of risk exposure.

This said, there is still some evidence that very high numbers of keystrokes and very high keystroke rates, at levels above 10,000 keystrokes per hour, may cause an increased risk. With the average computer user today doing around 2,000 keystrokes per hour any high keystroke rates are only likely to be an issue for a small subset of office workers whose work is particularly keyboard intensive. Even then, considering the multi-factorial nature of musculoskeletal disorders very high keystroke rates would only be one risk to be weighed alongside many others. On this basis a work requirement for very high keystroke rates may still be a risk factor worth evaluating if being considered as part of a wider evaluation of multiple risk factors (such as time exposure) for an individual.

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