Speed & Intensity risk factors in Wellnomics Risk Management

Wellnomics® White Paper

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The research on "speed and intensity" of computer work

The risk algorithm within the Wellnomics Risk Management product was developed by a team of international experts at the TNO Research Institute in the Netherlands. This team analyzed data from over 50 scientific papers on musculoskeletal (MSD) risks in office workers. Based upon the scientific literature and expert opinion over 40 different risk factors were identified.

These risk factors can be loosely grouped into a number of different "risk categories", such as posture, workstation setup, exposure (time at the computer), psychosocial factors and individual factors. Additionally, the intensity and precision of work was also identified as correlated with increased risk. Grouped under the heading of "Speed and Intensity" five different risk factors were identified as measuring different aspects of the intensity and precision of computer work:

- High typing speed
- High level of mouse clicks
- High level of mouse movements (i.e. a high rate of direction changes per minute)
- High use of mouse drag (holding down a mouse button whilst moving the mouse)
- High level of precise mouse work (making many very small mouse movements, as might be required in CAD or graphic design work)

In evaluating the scientific evidence for these risk factors there are two types of study that were analyzed.

First are epidemiological studies, which aim to study real world populations and identify correlations between the incidence of certain risk factors (such as high typing speed) and negative outcomes (such as discomfort or injury). After controlling for confounding factors (other factors in the environment that could also be causing these negative outcomes) the studies try to determine whether a specific risk factor is correlated with the negative outcomes, and if so, how strong its correlation is[1]. This allows us to then use these risk factors as future predictors of discomfort or injury.

Epidemiological studies don't necessarily make any attempt to understand the mechanisms behind the correlations between risk factors and negative outcomes i.e. why high typing speed should cause higher levels of discomfort or injury. They simply identify factors that are either correlated with or predictors for the negative outcomes.

The second type of study is experimental. Often conducted in a laboratory setting these studies are normally based upon an understanding of the underlying pathology or causes of injury. For example, it is believed that high levels of muscle tension and insufficient muscle recovery are a key cause of the development of pain and discomfort in MSDs. Therefore, anything that results in increased muscle tension (or insufficient muscle recovery) may increase the likelihood of injury and be a "risk factor" for MSD.

In an experimental study the effect of different environmental factors upon muscle tension can be studied. For example, muscle tension can be measured directly using electromyography (EMG). This means that in a laboratory setting the effects of, for example, high typing speed upon muscle tension can be studied. If higher typing speeds result in increased muscle tension it may be postulated that high typing speeds will result in an increased risk of discomfort or injury.

The level of research that has been done on different risk factors varies greatly. For example, postural risk factors have been studied extensively but the intensity and precision of computer work has been studied far less. This is possibly due to the fact that measuring the intensity and precision of office work is relatively difficult. When it comes to epidemiological studies it's only with the development of automated monitoring tools like WorkPace that extensive measurement of these aspects of office work has become possible.

[1] Often expressed as an Odds Ratio, or Relative Risk. An Odds Ratio of 3, for example, means that workers with this risk factor present are 3 times more likely to report discomfort.

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To date typing speed is the main factor that has been studied in the epidemiological literature, with a number of studies finding higher typing speeds correlated with increased symptoms. For example a 1990 NIOSH study by Burt et al[2] found increased odds of shoulder pain with moderate and high typing speeds. Studies have also found that data entry tasks, which often involve relatively high typing speeds, show increased risks (Aronsson 1992[3]).

There is little in the way of published epidemiological studies on other risk factors, such as mouse clicks or mouse movement. However, there is experimental literature looking at these. For example, Laursen et al (1988)[4] looked at a hand and finger task and the effects of varying speed and precision on shoulder muscle tension as measured by EMG. The study found significant increases in muscle activity for high speed and precision (for example, greater than 100 to 160 movements/minute or 1.5-2.5x per second). Keir (1999)[5] found that carpal tunnel pressures were higher during repeated mouse dragging tasks. Overall the research shows a correlation between increased speed and intensity/precision of computer work and increased risks.

Choosing risk thresholds

The five risk factors in the Speed & Intensity risk category in Wellnomics Risk Management have been chosen as being representative of the speed and precision demands of computer work. Although the research supports these factors being correlated with symptoms there is not enough information to identify "safe" levels. In reality, as with other risk factors such as exposure[6] there is more likely to be a somewhat linear dose-response relationship rather than a specific threshold for typing speed, or rate of mouse clicks at which a risk of symptoms suddenly appears. This means that the higher the typing speed or use of mouse drag, the higher the risk of symptoms, and those workers with the highest speed and precision requirements are likely to have the highest level of increase in risk (especially if both high speed and precision are required together).

Because of this Wellnomics Risk Management focuses on identifying workers with very high speed and intensity work compared to the normal population average, on the basis that these workers are likely to have an increased risk compared to the normal population. A threshold for each risk factor is set based upon the 90th percentile – identifying workers whose speed and intensity is in the top 10% of the population.

Wellnomics has one of the largest databases of population data for computer use in the world – with a dataset from over 50,000 office workers from nearly 100 organizations in 5 countries[7]. This has allowed Wellnomics to calculate accurate population distributions for each risk factor, and thereby identify the correct 90th percentile thresholds.

[2] Burt, S., Hornung, R. and Fine, L.J., *NIOSH Health Hazard Evaluation Report*, HETA, 1990, 89-250-2046

[3] Aronsson G, Berqvist U, Almers S., *Work organisation and musculoskeletal discomforts in VDT work*, in Swedish. Arbete och Hälsa 1992;4:1-40

[4] Laursen, B., B.R. Jensen and G. Sjogaard, *Shoulder Muscle EMG during Repetitive Work Tasks with Varying Speed and Precision Demands*, Kumar, S. (Ed.) Advances in Occupational Ergonomics and Safety, 1998, 210-13.

[5] Keir, P.Jl, Bacha, J.M., Rempel, D., *Effects of computer mouse design and task on carpal tunnel pressure*, 1999, Ergonomics, Vol 42, Issue 10, 1350-1360

[6] Taylor, K., Green, N., *Computer Use Exposure as a Risk Factor for RSI Symptoms*, Wellnomics White Paper, 2006

[7] Taylor, K., *Comparison of Computer Use across different Countries*, PREMUS 2007 Conference Proceedings, 2007, Boston, MA, USA

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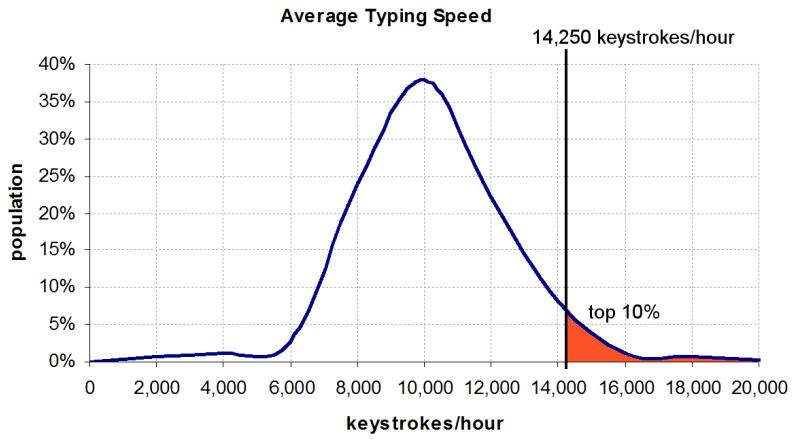
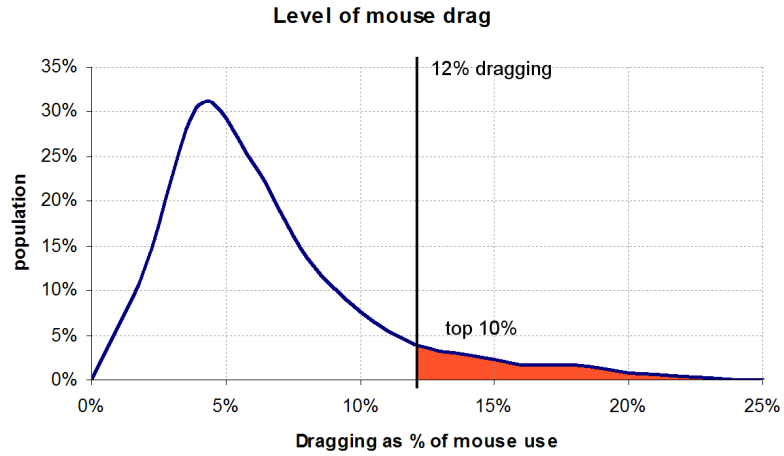


Population distribution for typing speed (cross-sectional sample from 95 organizations)[7]



Population distribution for mouse drag (cross-sectional sample from 95 organizations)[7]

Based upon this analysis the 90th percentile thresholds for each risk factor are shown below.

Risk Factor	90th percentile threshold
High typing speed	14,250 keystrokes/hour
High level of mouse clicks	1,250 clicks/hour
High use of mouse drag	12% of time using mouse
High level of mouse movements	1,850 movements/hour
High level of precise mouse work	mouse precision factor[8] of 26

[8] Mouse precision is calculated by a formula that weights mouse movements according to their size, with many small (precise) movements giving rise to a larger mouse precision factor.

A risk factor in the Speed and Intensity risk category will therefore be present if a user's average typing speed is more than 14,250 keystrokes/hour, or average use of mouse drag is greater than 12% of time using the mouse.

When it comes to identifying high risk workers (the ultimate goal of Wellnomics Risk Management), it is important to distinguish between workers who have short periods of high speed and intensity, and those whose work requires a sustained level of high intensity over many hours.

For this reason these risk factors are only activated if the worker's average computer (or mouse) use is in the 50th percentile (i.e. in the top 50% of computer users). This means workers have to have minimum computer use of 13 hours a week (or mouse use of 5 hours a week) before these risk factors can be activated. If you have high typing speed, but only work 1 hour a day at the computer, then these risk factors won't be activated.

Additionally, the risk factors are based upon averages over the prior 4 week period. Once again, this ensures that only workers with a sustained level of speed and intensity will be flagged as being at risk. Occasional short periods of high typing speed, or precise mouse work will not activate the risk factor.

Implications of Speed & Intensity risk factors being present

It is important to note that the 90th percentile thresholds used in Wellnomics Risk Management are not intended as guidelines on "safe" levels i.e. levels that should not be exceeded. Rather they help to identify workers who are likely to have higher risks than the average.

As the very nature of an employee's job may require high speed or precision (such as data entry, CAD or graphic design) it will often not be practical (or necessary) to reduce the speed or precision requirements of their work. Instead, the increased risks clearly inherent in this work can be compensated for by greater attention to other areas, such as taking sufficient breaks, or improving posture and workstation design. This is where the power of the multi-factorial approach of the Wellnomics Risk Management solution comes to the fore. Instead of having to eliminate all risk factors, the requirement becomes simply to balance the risks present for each worker so as to minimize their overall risk. Ultimately, with Wellnomics Risk Management, a worker can have multiple speed & intensity risk factors present, but still achieve an overall low risk level so long as the number of risk factors in other areas are kept low.

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