Abstracts

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Turning the Computer Mouse and Keyboard into Exposure Assessment Devices

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Purpose: Our goal was to use Exposure Variation Analysis (EVA) based methodologies to compare the continuous force exposures measured with a force-sensing mouse and keyboard to the non-invasively measured exposure information collected by continuously monitoring the digital signals of a worker's computer keyboard and mouse.

Methods: Using a repeated measures design, 13 subjects randomly performed three different computer tasks, a text typing task (keyboard only), a text editing task (mouse and keyboard) and a graphics task (mouse only). While performing the computer tasks, force exposures were continuously measured using a force-sensing mouse and keyboard. Simultaneously, using the subject's own computer, a computer input-device usage monitoring program recorded the duration of every episode of mouse and keyboard activity and inactivity. Using EVA based methods, the distributions of the actual mouse and keyboard force exposures (Gold Standard) were compared to the exposure information measured by the computer input-device usage monitoring program. Based on physiologically relevant force levels and durations, the forces applied to the mouse and keyboard were divided into five groups: 1) dynamic (forces applied for 100ms or less), 2) quasi static (forces > 0.4N applied between 100ms - 12.5 seconds), 3) static (forces > 0.4N applied for longer than 12.5 seconds), 4) microbreaks (periods with forces < 0.4 N lasting between 100ms - 3 seconds) and 5) rest (periods with forces < 0.4 N lasting longer than 3 seconds). The digital signal from the mouse and keyboard computer input-device usage monitoring program was analyzed in a parallel fashion based on the same duration demarcations except dynamic, quasi static, and static activity were based on when the keys were depressed (digital signal = ON) and inactivity when the keys were not depressed (digital signal = OFF). The percent time subjects were exposed to each type of activity (dynamic, quasi-static, static, microbreaks, rest) was calculated and compared for each computer task.

Results: As shown in Table 1, the exposure distributions derived from the actual forces applied to the mouse and keyboard (Gold Standard) were similar to the exposure distributions measured by the computer input-device usage monitoring program using the digital signal from the subject's own keyboard and mouse. Absolute mean errors between the two methods were no greater than 7%.

Table 1 - Task distributions based on the EVA analysis of the force and computer odometer (Odom) data. [n = 13]

	Typing		Text Editing		Graphics	
	Force	Odom	Force	Odom	Force	Odom
Dynamic	54%	59%	13%	6%	8%	1%
Quasi Static	21%	5%	48%	48%	71%	72%
Static	0%	0%	0%	0%	0%	0%

Microbreaks

24%

28%

33%

34%

14%

8%

Rest

2%

8%

6%

11%

6%

19%

Mean Error

± 4.8%

± 3.2%

± 6.8%

Conclusions and Applications: The digital signal from the mouse and keyboard as collected by the computer input-device monitoring program can be used to measure the actual force exposures during work (dynamic, quasi-static, static, microbreaks and rest) without having to physically collect the forces using cumbersome, expensive force-sensing input devices. This creates a simple, inexpensive, continuous and non-invasive means to indirectly, but accurately determine a computer worker's force exposure information. This tool could be used to collect a continuous record of exposure data from service industry employees, a NORA Second Decade focus sector, and may be suitable for use in large scale, prospective, epidemiological studies in order to better understand factors leading to computer related musculoskeletal disorders.

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