ERGONOMIC ASPECTS OF PERSONAL DIGITAL ASSISTANT (PDA) AND LAPTOP USE

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Objectives

To assess the ergonomic impact of PDAs and laptops, and their characteristics of use that places a continuous strain on business executives and students.

Methods

Two similar but separate surveys, each consisting of 39 questions, were conducted among 37 laptop users and 34 PDA users. The survey participants constituted a convenience sample from a group of business professionals and graduate students. The survey questions were designed to evaluate characteristics of use, design adequacy of keyboard and screen, hand-forearm and neck postures, discomfort level and health complaints that derive from the use of these devices. In a separate laboratory experiment, electromyography (EMG) signals were recorded using skin electrodes from six hand and forearm muscles (abductor pollicis brevis, flexor pollicis brevis, the portion of the first dorsal interosseus closer to the index finger, extensor digitorum, abductor digiti minimi, and flexor digitorum superficialis) while two participants used a laptop for 30 minute word processing and one participant used a PDA for 15 minute typing e-mails.

Results

Among the PDA users, 59% reported that they were using PDA for more than a year. As opposed to this, 89% of laptop users reported using laptop for more than a year. The reported average daily usages of PDAs and laptops were 1.1 and 2.3 hours, respectively. Ninety-seven percent PDA users reported that they use laptop or desktop for an average of 5.1 hrs daily. In contrast, only 54% of laptop users use PDA for an average of 1.2 hours daily. In a numeric scale, 1 being strongly disagree and 5 being strongly agree, the average rating given for the keyboard design adequacy (in terms of size, spacing and pressure) was 3.1 by the PDA group and 4.0 by the laptop group. Among the keyboard design attributes, key spacing obtained the lowest average score of 2.6 from the PDA group. The average display design adequacy (in terms of size, resolution and color) scores were 3.7 for the PDA group and 4.1 for the laptop group. Among the screen design attributes, size of the screen received the lowest average score of 3.5 for the PDA group. Thirty percent of the PDA respondents reported that they assume a bent wrist (>15^{0}) during PDA use, 9% suffered wrist pain/discomfort after PDA use, with an average discomfort level of 2.7 in scale 1 – no discomfort and 5 – severe discomfort. For the laptop group, the corresponding figures were 65%, 38% and 3.5, respectively. Using a self administered Finkelstein's test, which is a diagnostic test for DeQuervain's tenosynovitis, 39% and 51% from PDA and laptop groups, respectively reported a discomfort level of 2 or more in the wrist area. For the neck posture during the device use, 79% from the PDA group and 62% of the laptop group reported they assume flexed (>15^{0}) neck posture. Approximately 21% from both the groups reported neck discomfort, with an average severity of discomfort 2.5. Out of all respondent, one PDA user reported high level of discomfort in hand-forearm which interfered with daily activity, but did not received medical treatment. Fatigue analysis of the muscle EMG, revealed no significant change in RMS values in any of the muscles, over the period of the test. However, the median frequency of the EMG for each of the muscle groups, dropped significantly between the first five minutes and the last five minutes of the test, for both PDA and laptop use.

Conclusions

Extensive use of keyboards generate static muscle stress in hand-arm-neck region (Szeto and Lee 2002), and the survey shows that the advent PDA, the daily keyboard use is significantly increasing. The preliminary EMG analysis shows distinct muscle fatigue from 15-30 minutes continuous keyboarding, and muscle fatigue is believed to be a precursor of MSD. Small key spacing and small size visual display of PDA can put more static strain on hand-arm and neck muscles, compared to those in conventional laptop or desktop work. Small and narrow spacing of the keys and data entry using thumb can be more fatiguing and injurious to the thumb muscles, which are not meant for repetitive motion.

References

Szeto, G.P., and Lee, R., 2002. An ergonomic evaluation comparing desktop, notebook and subnotebook computers. Arch. Phys. Med. Rehabil. 83, 527-532.