Adjustable sit-stand tables in office settings: development of a system for controlled posture changes

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Abstract

Sit-stand tables have been suggested to increase variation and prevent disorders among office workers. However, it is a challenge to ensure their proper use.

Therefore, we developed a system reminding workers to change the height of their sit-stand table at regular intervals. The system consists of three devices: (1) table legs that can be controlled in height by an electric drive; (2) remote control for basic settings; (3) remote control with software allowing the user an ongoing interaction with the table. The entire system is controlled through the worker's computer, and can be programmed to rise and lower the desk at pre-set intervals. Furthermore, the software stores two variables describing the use of the table during a full workday, i.e. time proportions of each table position, and the frequency of position changes.

Summary

Excessive computer use at work is associated with musculoskeletal disorders, likely caused, to some extent, by too little variation of muscle activity and postures (Mathiassen, 2006; Straker and Mathiassen, 2009). In a previous study, we found that office tasks performed while standing or walking represented the largest exposure contrast from computer work, and thus a potential for increased variation (Barbieri et al., 2014). Thus, our study added to findings from other studies that the introduction of activity-permitting work-stations, such as tables allowing shifts between sitting and standing work, may have positive results on variables important to health (Karakolis et al, 2014; Neuhaus et al, 2014; Macewen et al., 2015). Few studies have, however, investigated the effect of sit-stand tables in real work settings. It is likely a major challenge to effectively and sustainably make workers aware about the proper use of sit-stand tables and to secure sustained use after an initial period of observance (Straker et al., 2013).

The present paper describes the development of a system designed, (A) to control the adjustment of sit-stand tables, allowing the worker to interact with pre-scheduled changes of the position of the table (to sit or stand), (B) to prompt the worker on recommended changes of table position and, (C) to record data regarding the actual use of different table positions. The table is furnished with three devices (figure 1): (1) lifting table legs with an electric drive; (2) remote control for basic settings; (3) remote control with software, allowing the user an ongoing interaction with the table. A graphical user interface software operating on the worker's computer was developed in MATLAB® to control the table (figure 2). The interface allows the worker to set reference positions for sitting and standing, and to pre-set the duration of periods in each table position, i.e. the sequence of table position shifts (Figure 2A). Moreover, the software generates an auditory warning signal 30s prior to each pre-set shift, and an alert window appears on the computer screen, which the worker is required to respond to (Figure 2B).

The worker then has three options: "yes" - the adjustable table will change to the next programmed position according to the pre-set schedule; "delay 2 min" - the table will not change position, but the alert window will appear again after 2 minutes; "no" – the table will remain in its current position, and the software will resume counting down on a completely new period according to the pre-set schedule (Figure 2B). Whenever the table changes position according to the pre-set schedule, as possibly modified by the worker, this will happen automatically, without the worker needing to take action. In addition, the software stores the actual position of the table, and calculates two summary variables, i.e. the time proportion of each position

(sit and stand), and the frequency of table position changes. Those data are stored in a text file at the end of each day, and saved on the worker's computer.

We currently use this integrated system in an intervention study investigating the effect of introducing sit-stand tables accompanied by different incentives for their use on the biomechanical exposure of office workers. The superior aim is to identify initiatives that will increase variation in general and, thus, improve exposures believed to be of importance to cardiometabolic outcomes and musculoskeletal disorders.

Preliminary results suggest a good acceptability of the adjustable table with the prescribed change pattern (the system was programmed to encourage standing for 10 minutes for every 50 minutes of sitting). For one illustrative office worker, the system gave an alert on changing the table height 175 times in total in fifteen days (mean 11.7 times per day). The worker accepted 72.8% of these changes by replying "yes" on the computer screen (cf. figure 2B). The worker delayed 2.9% of the changes, and refused the change 24.3% of the times, replying "no" on the screen.

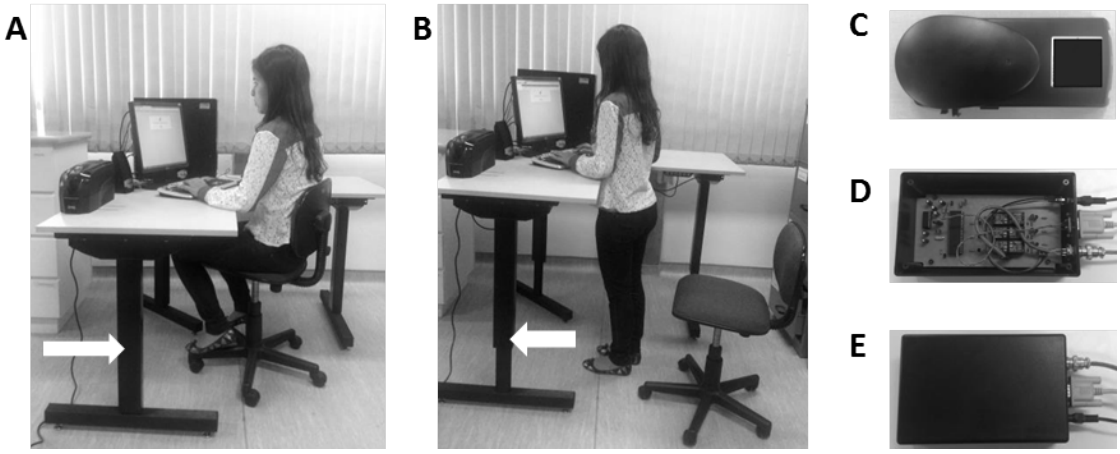

Figure 1. (A-B) Electric lifting legs (arrow) of the sit-stand table; (C) remote control for basic settings and (D-E) remote control for ongoing interaction.

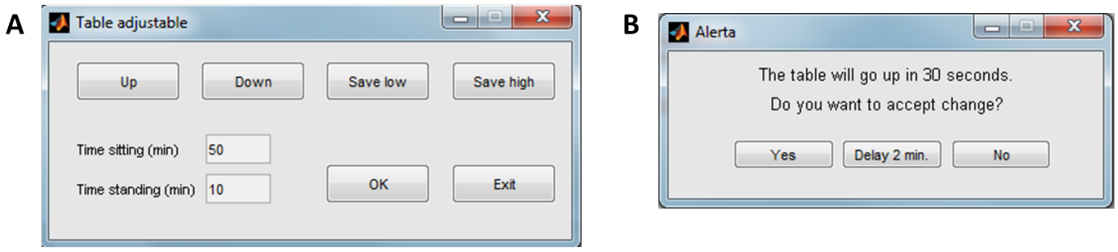

Figure 2. (A) Interface to set the reference position for both sit (low, save low) and stand (up, save high), and save the time for each position (Time sitting and Time standing); (B) Interface to warn the workers about changing the position of the table.

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