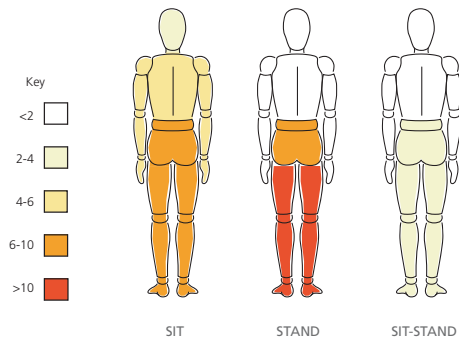


CASE STUDY: SIT VERSUS STAND

“Alternating between sitting and standing resulted in the least discomfort and was reported as the preferred posture by 70% of subjects.”

MEAN MUSCULOSKELETAL DISCOMFORT FOR BODY REGION AND POSTURE



Excerpts from “The Experience of Musculoskeletal Discomfort Amongst Bank Tellers Who Just Sit, Just Stand or Sit and Stand at Work” Dr. Leon Straker, School of Physiotherapy, Curtin University of Technology (Perth, Western Australia) <http://physiotherapy.curtin.edu.au/staff/straker/?year=All>

Literature suggests that constrained sitting or constrained standing are risk factors and that alternating work postures may be preferable.

Bank tellers are an occupational group at risk of musculoskeletal disorders due to the physical and mental task demands. Bank telling provides limited opportunity for tellers to move away from their work stations. Consequently, tellers are required to maintain constrained postures for prolonged periods and undertake tasks that are essentially repetitive in nature.

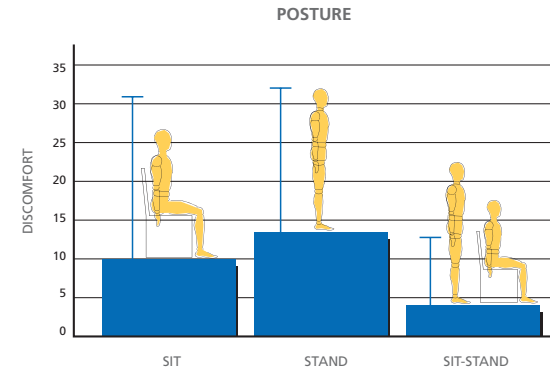
This study aimed to compare the experience of discomfort amongst bank tellers to determine whether greater postural

variability in sit and stand environments impacted upon the experience of musculoskeletal discomfort.

METHODS

Musculoskeletal discomfort was collected from subjects that assumed just sit, just stand and sit-stand work postures.

Subjects were full-time bank tellers between 18 and 52 years of age. There were twenty-four females and six males and the mean height was 5'6" (168 cm) [4'10"–6'1" (149–188 cm)]. They didn't have MSD conditions that required treatment within the preceding three months.



VARIABLES & PROCEDURE

The study included two independent variables; posture and time. The posture variable had three levels, 'just sit', 'just stand' and 'sit-stand.' The 'sit-stand' posture required subjects to alternate between a sit and a stand posture every thirty minutes.

The main dependent variable was body part discomfort. Body part discomfort data was collected through use of a Visual Analogue Discomfort Scale (VADS). This allowed specific body part discomfort to be recorded from thirteen body areas.

Subjects were instructed in the ergonomic principles and were advised as to the postures that were required of them, and how to complete the VADS ratings in each of the three postures.

RESULTS

Study results provide evidence that postural variation is effective in reducing the experience of musculoskeletal discomfort for total body, back, lower limb and upper limb areas and that the duration for which a posture is maintained affects the experience of musculoskeletal discomfort experienced by bank tellers.

The experience of musculoskeletal discomfort reported by subjects was found to increase across all three body regions over the course of the day.

The mean total body discomfort rating for subjects was highest in the 'just stand' posture, followed by 'just sit' and then 'sit-stand.' The greatest discomfort in the upper limb was noted in the just sitting posture and the greatest discomfort in the lower limb and back was reported for the just standing posture.

“Study results provide evidence that postural variation is effective in reducing the experience of musculoskeletal discomfort.”

This finding offers support to the notion that a constrained sitting posture is more likely to impact upon the musculoskeletal health of the upper body whereas constrained standing is more likely to impact upon the musculoskeletal health of the lower body.

Alternating between sitting and standing resulted in least discomfort and was reported as the preferred posture by 70% of subjects, with 'just sit' being rated as most preferred by 20% and 'just stand' by 10%. These results support a move away from constrained work postures amongst bank tellers within the finance industry and toward the introduction of systematic postural variation.

SUPPORTING STUDIES

- Graf et al. (1995) identified work tasks with less frequent and less marked opportunity for postural change as being associated with a higher prevalence of Musculoskeletal Disorders (MSDs).
- While MSDs have traditionally been associated with physically strenuous occupations, there is increasing evidence that sedentary office work and other constrained sitting or standing postures are associated with a high incidence of MSDs (Attwood, 1989; Westgaard and Winkel, 1996).
- Visser and Straker (1994) identified in a study that breaking up constrained work postures allowed for increased postural change which assisted in delaying the onset of musculoskeletal discomfort and fatigue in most body areas.
- Hagberg and Sundelin (1986) proposed benefits of rest intervals, reporting that frequent rest intervals can assist in reducing the perception of postural discomfort, supporting that postural variation and breaks from constrained postures can reduce or delay musculoskeletal discomfort.
- Workstations which allowed both sitting and standing were introduced to postal workers by Nehood and Thompson (1994), with a subsequent reduction in discomfort reported.

CASE STUDY: INCREASED PRODUCTIVITY

Excerpts from: "The Effect of Ergonomic Work Tools on Productivity In Today's Automated Workstation Design" Dr. Marvin J. Dainoff, Center for Ergonomic Research, Miami University (Oxford, Ohio) <http://www.units.muohio.edu/psychology/people/dainofmj.html>.

As the primary tool in the office, the personal computer (PC) has enormous impact on organizational output. It is the focal point of office work today, directing most tasks.

Traditional routine breaks from prolonged sitting such as retrieving files, faxing and inter-office communicating are today routinely performed at the automated workstation. Consequently, the principal source of productivity in the modern office is the human in front of a PC, resulting in a large percentage of employees' workdays spent sitting in one basic posture in front of the computer.

To take advantage of new automated technologies, today's organizations must address static muscle fatigue in addition to resolving the strains and injuries that result from constant computer use. By enhancing the efficiency (and sense of well being) of the employee sitting in front of the PC, we improve individual and organizational productivity.

The study assessed the effectiveness of periodically standing throughout the day as a means of providing the essential breaks from sitting in prolonged static postures. This would determine whether intermittent standing, while working, relieves fatigue without repetitively departing from the work area or from task accomplishment.

On day one, directly following the training session, the subjects were asked to use the adjustable equipment to relieve fatigue while they worked. On day two, the subjects worked with the same ergonomic work tools, however, they were directed to stand several times throughout the day while working. On day three, the subjects were given no direction and told to work in whatever manner they choose.

RESULTS

Over one-third of the subjects (36%) stood on day one. Of those subjects who stood on day one, frequency of standing increased about 40% on day three, after the directed standing of day two. The subjects revealed that the benefits experienced by standing reinforced the action and resulted in an increased rate of standing.

This data provides strong evidence that the provision of stand-up capability, with an effective training program, with a participatory approach, can affect periodic standing throughout the workday.

Over half (57%) of the subjects who did not stand on day one stood on day three, after being directed to stand on day two. This further supports the premise that work routines can be modified through positive reinforcement in the experience. In fact, the subjects periodically stood almost 2.5 times more on day three than on day one (147% increase).

Analysis of the duration of each stand-up also supports this conclusion. The average duration of each stand-up increased from day one to day two by 65% and remained essentially the same on day three.

Eighty-two percent of the subjects had positive comments about standing in terms of providing relief and stated that they would stand in the future if their equipment adjusted to stand up height.



INCREASED PRODUCTIVITY VIA REDUCED WORK BREAKS

Analysis of this data provides strong evidence that intermittent standing increases productivity through a reduction in work break time; through fewer and shorter breaks throughout the day. These results demonstrated that standing while working at the automated workstation (stand-up working breaks from sitting) can substitute for the traditional work break (away from the work area).

The Non-standers took an average of 47% more work breaks, over the three

days, than the Standers, and the average duration of each work break was 56% longer than that of the Standers. The effect on productivity is apparent as the Non-Standers took over twice as much total time on work breaks as the Standers did during the three days.

On day three alone, which reflects a three-day cumulative effect of this data entry work effort, Non-Standers spent almost four times more on breaks than Standers (288% increase in break time).

"There is strong evidence that intermittent standing increases productivity."

"The Non-Standers took an average of 47% more work breaks...and the average duration of each work break was 56% longer than that of the Standers."

INCREASED USABILITY

Part One of the study identified specific characteristics in the actuation of ergonomic work tools that encourage regular adjusting. Analysis of the study provided the basis for an expanded definition of usability and the features required to promote regular adjustments (postural changes) throughout the workday. In this context, usability is defined as:

- A minimum number of individual steps required for operation of controls
- The ability to make the adjustment with one hand
- The ability to make the adjustment rapidly
- Keeping the adjustment mechanisms in close proximity to the keying position
- Keeping the adjustment mechanisms visible from the keying position

STATISTICS TELL THE STORY

- Prolonged periods at the computer result in two criteria for efficient work: getting into an optimum initial posture and being able to move during the workday while accomplishing tasks.
- Using the right ergonomic work tools provides the ability to get into and maintain ergonomically correct postures. Meeting this first criterion for efficient work, along with an effective training program, will help reduce the incidence of CTDs.
- The data from this study strongly suggests that standing work breaks (from sitting) substitute for non-productive work breaks (away from work area) in alleviating fatigue. The result is decreased time away from task accomplishment and, thus, increased productivity.
- The second criterion for efficient work, providing movement throughout the day while accomplishing tasks, promotes blood flow to relieve fatigue resulting from static exertion.

The impact of fatigue can be more costly to organizations than CTDs, through decreased productivity.

CASE STUDY: DECREASED DISCOMFORT

With electric height adjustable workstations daily discomfort ratings were lower in the afternoon, productivity ratings improved, and there were significant decreases in the severity of MSDs.

Adapted from: "Effects of Electric Height Adjustable Work Surface on Self-Assessed Musculoskeletal Discomfort and Productivity in Computer Workers," Dr. Alan Hedge, Cornell University, Design & Environmental Analysis.²⁴ <http://ergo.human.cornell.edu>

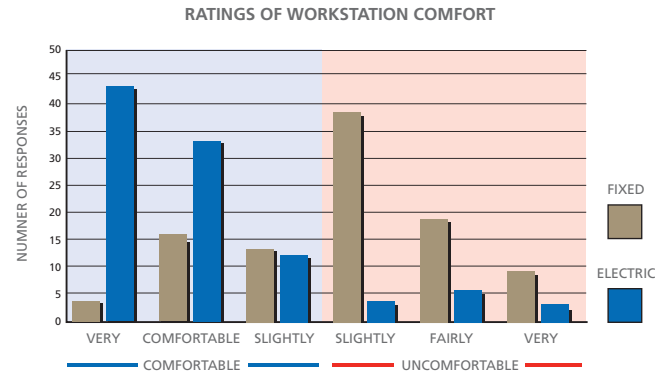
There is good evidence to indicate that adjustable furniture which supports sit-stand working may be beneficial to the health and performance of workers. The present study was conducted to test the effects of using electric height adjustable work surfaces in offices.

Height adjustable furniture designs initially required a user to manually crank a handle to position the height of the work surface. However, early designs of cranks suffered several limitations; crank handles were poorly located, they required effort to operate, especially when the surface was loaded with the weight of equipment, and they took considerable time to adjust. In the 1990s, electric height adjustment systems emerged that allowed for faster, easier changes in surface height, but these products were costly. Recent advances in the design of adjustment mechanisms have substantially reduced these costs, making electric height adjustable work surfaces a viable design option.

METHODS

Participants were recruited at two facilities, one was a high technology facility on the west coast and the other was an insurance company in the Midwest. Between these two facilities a group of fifty-three employees volunteered to participate in the study. All participants were full-time employees and intensive computer users. On average participants reported spending about 60% of the day using a mouse and over 50% of the day using a keyboard. Initially, all participants worked at a fixed height work surface (FHW), forty-five of the participants subsequently experienced working at an electric height adjustable work surface (EHAW).

comfort decreased by an average of 62% and the occurrence of injuries and illnesses decreased by more than half.



RESULTS

In the electric height adjustable workstation condition, daily discomfort ratings were lower in the afternoon and productivity ratings improved. Results showed significant decreases in the severity of musculoskeletal discomfort for most upper body regions and there was a reported increase in the daily time spent standing versus sitting.

There was a strong preference for using the electric height adjustable workstations.

- In a study reported by Paul (1995b) in offices with sit-stand adjustable furniture, subjects reported feeling more energetic and less tired by the end of the workday.
- Results from Paul (1995a) showed that the average right foot swelling in offices

Frequency of Sit vs. Stand

There was a significant increase in the daily time that subjects reported standing to do work with the electric height adjustable workstations.

- 81% of participants reported standing one or more times a day
- 45% of participants reported standing three or more times a day
- 18% of participants reported standing five or more times a day

Results agree with previous research demonstrating beneficial effects of using height adjustable work surfaces. Overall, participants reported standing for 21% of the day, which is comparable to the 23% reported by Nerhood and Thompson (1994).

with sit-stand adjustable furniture was significantly less than that in offices with non adjustable furniture. These results suggest that activity promoted using sit-stand workstations benefits sedentary office workers.

EXCERPTS FROM PARTICIPANTS...

"As soon as I started to get any pain I adjusted the table height and the pain either went away or got better. This is very necessary for working long hours. (I) need to have the ability and flexibility to adjust table height during the day."

"...It makes me (feel) so much better. My neck was suffering a severe pain, but after I got this table I am feeling much better..."

"...I wasn't in pain before, but with this table my sitting and working posture felt good. Before, I would start wriggling in the afternoon-I stopped squirming in my chair with this adjustable height workstation."

"I like the sit-stand configuration since it gives me the flexibility of standing up while typing. Also, it is easier for two people working and typing at the same time."

"...It definitely changed the way I work."

"The adjustable height work surface helps me to be more comfortable. I find that standing three to four times a day helps my neck and back (I usually stand for 20 to 30 minutes at a time). This allows me to stretch and move while continuing with my work..."

"I was able to adjust height the way I needed. It helped my elbow, forearm and wrist."

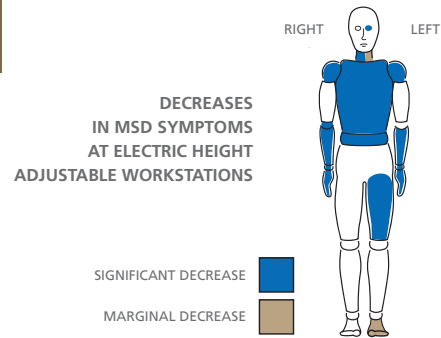
"The varying heights definitely helped avoid "repetitive stress" in a big way."

"Definitely better than fixed height work surface also helps me remember to take breaks and stretch and I adjust the height."

SUPPORTING STUDIES

- Nerhood and Thompson (1994) studied the introduction of sit-stand workstations in United Parcel Service (UPS). Results showed that workers averaged 3.6 adjustments to standing positions per day and spent an average of twenty-three minutes per day in a standing position. Body dis-

CASE STUDY: DECREASED DISCOMFORT



Musculoskeletal Discomfort (MSD)

Use of the Electric Height Adjustable Workstations (EHAW) resulted in significant decreases in the severity of MSD symptoms for most upper body segments. The mean musculoskeletal discomfort index score was 43.1 for the fixed height workstation (FHW) and 35.1 for the EHAW, which is almost a 20% decrease, and the difference was statistically significant. Discomfort ratings were significantly lower for the EHAW condition for mid-morning and throughout the afternoon until the evening. Having lower discomfort ratings by the end of the workday agrees with previous research (Paul, 1995b).

Comfort and Productivity

There were significant improvements in comfort ratings for the Electric Height Adjustable Workstations (EHAW). Further, there were significant improvements in comfort ratings for the keyboard, mouse and chair when used with the EHAW.

Participants reported improvements in their personal work productivity. They also reported an increase in the frequency of taking short breaks from computer work when they were using the Electric Height Adjustable Workstations. Productivity ratings for "somewhat helped and definitely helped" were significantly higher for the EHAWs compared with the FHWs (57.5% vs. 20.0%; $Z(30) = -3.23, p = 0.001$).

"There was a strong preference for using the electric height adjustable workstations."

Over 81% of participants reported standing one or more times a day to work with the EHAW and 18% reported standing five or more times.

in fifteen minute sessions. Office workers with spinal disorders showed a greater variability in the shrinkage pattern.

- A controlled field study by Paul and Helander (1995a) measuring spinal shrinkage showed significantly less shrinkage for office workers who stood in thirty minute sessions compared to those who stood



CONCLUSION

The results of this study suggest that there may be a number of benefits associated with using the EHAWs. These changes occurred over a relatively short timescale of four to six weeks, which suggests that the potential benefits may be even greater after longer time periods of use. There was almost a unanimous preference for the EHAWs rather than the FHWs. Most written survey comments were positive about the EHAWs and three participants refused to relinquish their EHAW during the study. Overall, 82.4% preferred the EHAW and 64.7% indicated a definite preference for this arrangement.

- In another similar study, Paul and Helander (1995b) found office workers with sedentary jobs showed significant spinal shrinkage that occurred continuously throughout the day. The office employees with non-sedentary jobs

SURVEY SAYS...

"MOST EMPLOYEES LINK WORKSPACE DESIGN TO PRODUCTIVITY"²²

A new survey initiated by Microsoft Hardware found the U.S. workforce is spending more time in front of the computer than ever. Nearly half of office computer users indicated they were spending eight or more hours a day at the computer. These survey results reflect the current workplace trend of employers placing greater demands on their existing workforce to drive productivity and profits.

The U.S. Department of Labor statistics show productivity gains in the past two years marking the best back-to-back growth in worker output in five decades while hiring remained stagnant. This change in focus has employers and their employees seeking new ways to work more efficiently as they strive to meet business goals.

Consider the following:

- 9 out of 10 said the design setup of their workstation directly affects their ability to be most productive at work.
- Nearly two-thirds of office computer users tie the fatigue they experience during the week to working at the computer for long periods.
- More than 50% of those surveyed said one of the best ways employers can show their commitment to employees' success is to provide them with the latest technologies so they can do their jobs more efficiently.
- Researchers have found that individual performance increases by 25% when employees use an ergonomically designed workstation.

showed significantly less spinal shrinkage than those with sedentary jobs.

STATISTICS TELL THE STORY