THE PRODUCTIVITY IMPACTS OF TWO OFFICE ERGONOMIC INTERVENTIONS: A HIGHLY ADJUSTABLE CHAIR AND AN OFFICE ERGONOMICS TRAINING

Kelly DeRango, Ph.D.[1], Benjamin C. Amick III, Ph.D.[2,3], Michelle Robertson, Ph.D., CPE.[4], Lianna Bazzani, MPH[5], Ted Rooney, MPH[5], Ron Harrist, Ph.D.[2], Anne Moore, Ph.D.[6]

[1]The Upjohn Research Institute, Kalamazoo, MI, USA, [2]The University of Texas School of Public Health, Houston, TX, USA, [3]The Institute for Work and Health, Toronto, Canada, [4]Liberty Mutual Research Institute for Safety, Hopkinton, MA, USA, [5]Health and Work Outcomes, Brunswick, ME, USA, [6]York University, Toronto, Canada

derango@upjohninst.org

In 2001 it was estimated 1 million individuals in the US lost time from work due to work-related musculoskeletal disorders. The purpose of this study was to use a well-designed office ergonomics intervention to validly demonstrate productivity improvements. Workers at a tax revenue office were divided into three groups: one group received a highly adjustable chair with office ergonomics training, a second group received only the office ergonomics training, and a third group received the office ergonomics training at the end of the study. The workers were followed over 16 months. Multivariate statistical modeling was used to test hypotheses. It was found that the chair with training group had a productivity increase of 17.7%. The benefit-to-cost ratio was 24.6:1. These findings provide strong evidence of the benefits to using well-designed cost-effective ergonomic interventions in improving worker productivity.

INTRODUCTION

The National Research Council and the Institute of Medicine (2001:17) estimate that nearly 1 million individuals in the United States lose time from work each year due to work-related musculoskeletal disorders (MSDs), with an associated $45 - 54 billion annual cost. Yet, despite these costs, recent proposals for government mandated ergonomic work standards have either failed to pass or have been repealed at the state and federal level. Furthermore, business leaders have become increasingly focused on the productivity of office workers as the employment share of the manufacturing sector of the economy declines. These two factors – the failure of government action and the increased urgency of the underlying problem - have renewed interest in the “business case” for ergonomic interventions.

This paper presents data from a quasi-experimental field study to estimate the impact of two ergonomic interventions on objectives measures of on-the-job employee performance

and absenteeism (DeRango, 2003). Using these estimates, the ratio of benefit flows to the company after one year were calculated and then compared to the intervention costs. A more complete discussion can be found in DeRango et al (2003).

Intervention

The intervention consists of a highly adjustable chair and a one-time office ergonomics training workshop conducted concurrently with the chair distribution followed by a series of educational follow-ups.

Key design elements of the chair are: (1) adjustable armrests in height, width and pivot; (2) a flexible back support conforming to the shape and movement of the users back; (3) a gliding mechanism that allows the seat to slide forward as the user reclines.

A 90-minute training workshop was designed with the goals to improve worker understanding of office ergonomic principles, create the ability to perform ergonomic self-evaluations, promote the adjustment and rearrangement of the office workstation layout.

METHODS

Employees from a state department of revenue services were invited to participate. Workers were non-randomly assigned to one of three groups: a control group, a group who received training only (TO) and a group who received a new highly adjustable chair with training (CWT).

Data collection occurred 2 and 1 month before intervention and 2, 6 and 12 months post-intervention. During each round a short daily symptom survey was completed at the beginning, middle and end of the workday for 5 days during a workweek to measure total bodily pain growth over the workday. Multilevel statistical models were used to test health hypotheses (MLWIN, 2000).

Individual-level productivity was measured as collections (in dollars) per effective workday (8 hours). Actual hours worked from personnel files served as the denominator. Productivity and health-related sick hours data were obtained for 11 months pre-intervention and 12 months post- intervention. Difference-in-difference equations were estimated with fixed and random effects.

The Liberty Mutual Research Institute for Safety IRB approved the study protocol.

RESULTS

Three-hundred and sixteen employees were invited to participate and 219 provided informed consent (69.3%). 11 part-time and 15 employees with incomplete symptom data were excluded. Of the 192 remaining persons at baseline (87 in the CWT group, 52 in the TO group, 53 in the control group) 88% provided information at 12 months. Pre-intervention there was no standard workstation or chair, but all chairs had some adjustable features.

Health Results Post-intervention, the CWT group had a lower level of symptom growth over the day compared to either the TO or the control groups after adjusting for significant group differences (daily time in office chair, amount of repetitive hand/wrist activity) and independent predictors of pain (general health status and job level) ($p<0.05$). The TO group was not

statistically different than the control group (p > 0.1).

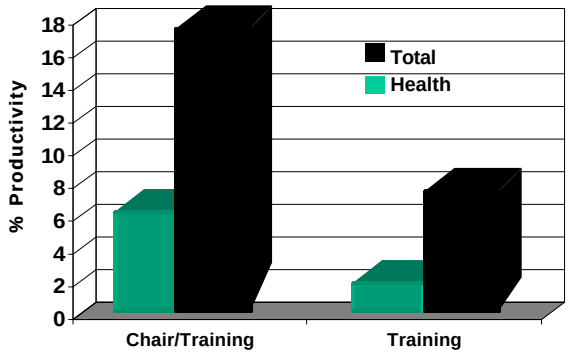

Figure 1. Percent of productivity improvement compared with health improvement for chair with training group and training only group.

Productivity Results As described in Figure 1, the productivity increase (black bar) for the CWT group was $353 per worker per day compared to the control group after adjusting for job characteristics, demographic descriptors, pre-intervention production and health measures ($p<0.05$). This is a 17.7% increase over an average pre-intervention production of $1,994. While the TO group increased the results are non-significant ($p>0.1$). Productivity increase attributable to health gains (measured by the SF-36 pain scale) was $119 per worker per day (green bar). This is about 6% of the total production gain. There were no significant effects with sick hours.

Cost-Effectiveness Results The costs are $800 per chair plus $200 per person training plus $32 salary per person or $1,032. The benefit flow is $119.24 per worker per workday times 17.75 workdays per month times 12 months per year or $25,398.12. Thus the benefit-to-cost ratio is 24.6:1.

DISCUSSION

These are the first results using a well-designed field study showing a highly adjustable ergonomic chair and office ergonomics training improve health. Using a novel symptom diary, both the average symptom level and symptom growth are reduced. The results suggest that unless workers are provided with the appropriate tools to easily implement knowledge obtained through training the full training benefits may not be achieved. The productivity findings are the first evidence from a well-designed field quasi-experiment and provide overwhelmingly positive support for a business case. The cost-benefit ratio is a conservative estimate with a high chair cost and low benefit flow. The fact that the health-related productivity effects are smaller and in the same direction as the total productivity effects enhances the findings validity.

REFERENCES

Amick III BC, Robertson MM, Bazzani, L, et al. Effects of an Office Ergonomic Intervention on Musculoskeletal Symptoms. *SPINE* 2003; Volume 28 (24): 2706–2711.

DeRango K, Amick III BC, Robertson MM, et al. The Productivity Consequences of Two Ergonomic Interventions. Institute for Work and Health Working Paper #286, Toronto, Canada, 2003.

Karsh B, Moro FBP, Smith MJ. The efficacy of

workplace ergonomic interventions to control musculoskeletal disorders: a critical examination of the peer-reviewed literature. *Theoretical Issues in Ergonomic Science* 2001; 2(1):23-96.

MLwiN [software]. Version 1.10. London: Multilevel Models Project Institute of Education, 2001.

National Research Council and Institute of Medicine. *Musculoskeletal Disorders and the Workplace: Low Back and Upper Extremities*. Washington DC: National Academy Press, 2001.

Acknowledgements: This research was funded by grants from Steelcase, Inc. to the University of Texas, The Upjohn Research Institute, York University and Health and Work Outcomes and through the support of the Liberty Mutual Research Institute for Safety. Noe Palacios and Paul Allie of Steelcase, Inc. contributed to data collection. Arden Brink of Health and Work Outcomes designed the web-based data collection system.