Limited Economic Evaluation to Assess the Effectiveness of a University-Wide Office Ergonomics Program

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Abstract

The objectives of this study were to assess the effectiveness of an university-based office ergonomics program (OEP) by identifying the costs and economic benefits from the implementation and documentation of the tangible and non-tangible factors contributing to its success. The goal of this study was to guide future development of a university-wide OEP. The OEP tracked the incidence rates, costs of musculoskeletal injuries, and costs of getting office furniture with ergonomics adjustment features so that participants' posture and work stations could be optimized to improve the quality and the quantity of office work from 1995-2007. The two datasets analyzed were OSHA 200/300 logs (1991-2007) and Workers' Compensation (WC) paid (1999-2007). Since the beginning of the OEP, the number of office cumulative trauma disorders (CTDs) cases decreased by 53%. Also, since the start (in 1999) of a 50-50 cost share agreement where the university's Safety and Health Department (SHD) pays half and the department or school pays the other half for furniture with ergonomics features. It was observed that the CTD incident rate decreased by 63%, Days Away/Restrict or Transfer rate (DART) decreased by 41%, lost time case rate decreased by 71%, and office-related carpal tunnel syndrome decreased by 50%. Incident cost (IC) was used as the financial measure of a cost-justification analysis to determine the net OEP value created or lost rather than focusing on profit or loss. A stepwise regression model showed that there is a linear relationship between IC; the DART rate ($p < 0.007$), average experience ($p < 0.03$) and average WC paid ($p < 0.003$); explaining 93.4% of variation in the IC. To increase the employee and management ownership of an OEP, 50-50 cost share agreement appears to be an important sustainable feature that drives the macro-ergonomics of decreasing both CTDs and costs in large organizations, such as universities.

Research Purpose

An OEP provided a means to keep musculoskeletal injuries and illnesses in control and to justify sustaining the program to prevent future occurrences. Key factors were to determine if the OEP (including the purchasing of furniture) was less expensive than not having one at all. To determine this, the study had to look at the trend of the musculoskeletal injury and the cost after the OEP began. The study population was faculty and staff members who are compensated by the university and are covered by the university's WC insurance (excluding adjunct faculty whose compensation is external to the university).

Office Ergonomics Program

The OEP is made up of two parts: no Cost Share Agreement (CSA) and a 50-50 CSA. The safety and health department (SDH) first educates university employees regarding the basics of office ergonomics via the program's website. The website (accessible to all faculty and staff) provides a description about the working postures which should be maintained at a computer work station in order to prevent or alleviate symptoms or injuries attributed to an office setup.

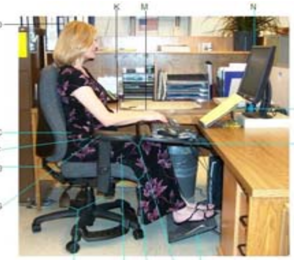
The three areas where individuals are encouraged to be proactive in maintaining good working postures are: 1) sitting posture and chair height, 2) wrist posture and keyboard height, and 3) monitor distance and height.

The OEP include:

1. *Administering and consolidating the OEP Questionnaire.* Any university employee could voluntarily complete and submit the questionnaire to the SHD.
2. *Conduct on-site assessment for employee after questionnaire is received by SDH.* During the assessment, the safety representative would discuss with the employee the basics of office ergonomics, focusing on the three areas of good working postures; different workstation layouts which suit the employee's needs when performing daily work tasks; and demonstrate adjustments to existing equipment in order to create an optimum office workstation layout.
3. *Recommend equipment changes.* Employee would be referred to a catalog and guided by the safety and health representative during the selection of equipment.
4. *Market survey.* Research, catalog, standardize, compile customized list of office equipment consistent with office ergonomics concepts from various vendors. Employees can choose from this standardized equipment list.
5. *Process equipment purchase and funds transfer.* The SHD developed a 50-50 CSA for office ergonomics in fiscal year (FY) 1999 with all the departments in the university. This is considered a co-intervention taking place from 1999-present. SHD presented to the university the furniture purchase history and how this cost is was related to the standard.

Tips for setting up an Ergonomically Sound Office

The following is a short description of the postures that should be maintained, placement of ergonomic equipment, and sound ergonomic habits used while working at a computer work station. (Letters in parentheses refer to the photo below



Start with the chair: Learn to use your chair's adjustments to make small changes in body position throughout the day and take "microbreaks" to stand or stretch, once an hour to minimize fatigue from static postures.

A. Set the chair at a height that allows the feet to be placed flat on the floor with the thighs level or slightly pointed down. There should be no pressure on the back of the thigh.
B. If the chair has seat depth adjustment (seat slider or back depth adjustment), set the depth of the seat pan so there is a small gap, up to 3 inches, between the front of the chair and the calf.
C. Many chairs have height and pressure adjustable lumbar support. The "hump" of the lumbar support should fit into the small of the back.
D. If the chair has an inflatable lumbar support, use the bulb or lever to pump up the bladder to desired firmness.
E. Using the rocking and/or back angle adjustment to adjust the seat pan and back angle.
F. The thigh to trunk angle should 90-110 degrees.
G. Armrest height should be set so that when resting the arms, the shoulders should be neither shrugged nor sloped.
H. Use of a footrest helps maintain proper posture .

Keyboard and Mouse Height:

I. Keyboard trays with wrist rests on height, tilt and swivel adjusting articulating arms are highly recommended. The height of the tray should be set so the wrist rest and armrest are about the same.
J. The tray should be set at a negative tilt (downhill away from the user) of about 5 degrees. The negative tilt helps maintain straight wrist posture.
K. When using the computer keyboard, the arms should be a natural extension from the "neutral" posture shown above. Let the arms hang naturally at the sides and bring the forearms up until they are parallel with the floor.
M. With the hands extending naturally from the wrists, move up to the keyboard, the hands should lay naturally on the keys. This is the proper keying height with the wrists maintaining a straight line from the top of the forearm across the back of the hand .
   i. When typing, the hands should hover above the wrist rest. When resting the hands on the rest, the palms, not wrist should contact the rest. Do not rest the wrists on the sharp edge of the work station surface while keying. If desk or tabletop is at proper height (do not have to lift or arms or shoulder to use keyboard), desktop wrist & mouse rests may be used to provide wrist support. D not pound keys. Use only light pushing force.
   ii. The mouse should be at or slightly above the height of the keyboard. Try not to "power grip" the mouse. When moving the mouse pivot from the elbow, not the wrist.

Monitor Distance and Height:

N. Sitting in the keying position, set the distance to the monitor screen at arms length or a distance that allows user to clearly view screen when sitting back in the chair (this can vary depending on the user's visual acuity).
O. The height of the monitor should be where the eyes look naturally at the top 1/3 of the screen when the head is held level. If the user wears bi or trifocals, the monitor will usually be positioned at a lower level so the user does not have to tilt the head up to view the screen.
P. When transcribing or referring to documents while using the computer, the documents should be placed in front or to the side of the monitor. By using a document holder to keep a similar distance from the eye to screen and document, eye strain from constant refocusing and neck movement is minimized.

Results

- Top three musculoskeletal injuries were carpal tunnel syndrome (63% of the cases; 71% of the cost), tendinitis/tenosynovitis (21% of the cases, 17% of the cost) and strain/sprain (16% of the cases, 12% of the cost).
- Downward trend (R^2=0.8353) in the recordable incident rate. ANOVA result indicates a statistical significant difference among the three stages of the study (F=12.47; $p \le 0.001$; R^2=64.04%). The 50-50 CSA does have an impact on the number of recordable incident due to office-related CTDs that the university experiences per 100 full-time employees in any given time frame.
- Downward trend in the Days Away/Restricted or Transfer (DART) rate with moderate variability (R^2=0.4876).
- Downward trend in Lost Time Case (LTC) rate with moderate variability (R^2=0.6911).
- Positive and increasing trend found for severity rate (R^2=0.403).
- Incident cost follows trend of DART Rate, LTC rate, LWD rate, severity rate .
- Regression equation below explains 93.4% of variation in the incident cost observations ($p < .002$) and models the statistically significant linear relationship between the incident cost, DART Rate ($p < 0.007$), average experience tenure in years ($p < 0.03$) and average WC paid per claim ($p < 0.003$). The goal of the regression model is to bridge the gap through a cost-justification analysis by implying that if the OEP has an impact on reducing the DART rate and if DART rate is a predictive variable in the regression equation that has an impact on incident cost, then the OEP has a financial impact on reducing the cost of injuries and illnesses.

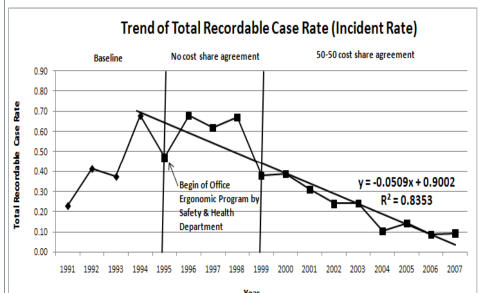
$$\text{Incident Cost (\$/hr)} = -0.00109 + (0.0109 \times \text{DART Rate}) + (0.000105 \times \text{Average Experience}) + (0.00000029 \times \text{Average WC paid per claim})$$

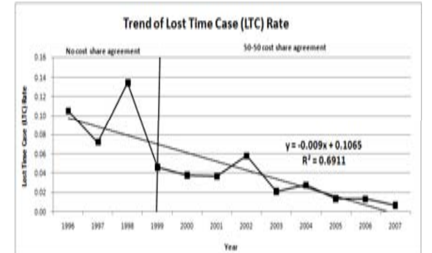
Predictor	Coef	SE Coef	T	P
Constant	-0.0010899	0.0003501	-3.11	0.026
DART Rate	0.010860	0.002447	4.44	0.007
Average Experience (tenure)	0.00010468	0.00003480	3.01	0.030
Average WC paid per claim	0.00000029	0.00000005	5.40	0.003

S = 0.000204473 R-Sq = 93.4% R-Sq(adj) = 89.5%

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	3	2.97574E-06	9.91913E-07	23.72	0.002
Residual Error	5	2.09046E-07	4.18092E-08		
Total	8	3.18478E-06			





Discussion

The result confirms two findings of Robertson, Robinson and Chen, (2000) that 1) ergonomic interventions including work system design changes can result in lower WC claims paid, fewer lost work days, and reduced work-related CTDs, injury and illness rates and 2) when a successful office ergonomic intervention program is implemented, one of the many results is an increased ability for the worker to change his/her work environment, leading to enhanced individual and organizational effectiveness in several ways. The significant decrease in the rate of claims filed would suggest that the OEP had a significant effect over the 17 year study. This supports the findings reported by Lewis et al., (2002) who also found a decrease in the injury rate among office workers after a training program was implemented. It also indicates that the OEP (provide knowledge and equipment needed to reduced office workers' discomfort and pain) may be having a positive effect on the health and well being of the employees. This research supports Marcus et al., (2002) who suggested that the risk of musculoskeletal strain (MSS) and CTD may be reduced by encouraging specific seated postures. A reduction in median cost per injury per year, indicating a reduction in the severity which supports the results from Lewis et al., (2002) study, that the average cost of the claims decreased after training. The financial measure (incident cost) used in this study attempts to 1) determine the net (OEP) value created/lost rather than simply look at profit/loss and 2) determine contributing variables to the financial impact of the OEP.

Conclusion

A direct result of the OEP is a decrease (almost 61% over the 13-year period) in the number of office-related CTD cases. One of the most effective ways of sustaining the program was the implementation of the 50-50 equipment cost share effort. This effort not only have increased the awareness of office ergonomics throughout the university, it also have led to increased pro-activeness from university employees in engaging in good ergonomics practices by first ensuring that they have proper office equipment in their work environment. A major contributing factor to the success of the office ergonomics program is the voluntary nature of submitting the 'Office Worker Questionnaire' and requesting an on-site assessment. This voluntary and participatory approach ensures that an individual has ownership in his/her own work environment, leading to increased pro-activeness in creating and maintaining an 'ergonomically sound' office environment. One enhancement to the existing university program is a feedback mechanism to participants in order to provide a means of continuously improving and monitoring the impact of such programs. This feedback mechanism could be in the form of symptoms surveys conducted pre- and post-participation in ergonomics program as a direct reflection of the impact of ergonomics on an individual's health and physical wellness, as well as a suggestion forum to promote participatory contributions and pro-activeness of ensuring one's SHD in and out of the workplace.

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Acknowledgements

The authors would like to acknowledge Mr. Alan Gerth of Purdue's Radiological and Environmental Management (REM) office for his assistance in helping with the Office Ergonomics Program. Also, the authors wish to thank Ms. Teresa Wesner from Purdue's Human Resource office, and Ms. Kristina Evans and Mr. Steve Gauger from REM for their assistance in organizing and providing OSHA 300 logs, and Workers' Compensation data.