An Atlas Ergonomics White Paper

13601 Forest Park Drive
Grand Haven, MI 49417
(616) 844-6322
www.atlasergo.com

Product Knowledge and the Effect on Reducing Office Employee Discomfort

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Bibliography

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INTRODUCTION

If you were to make a mental list of some of the top manufacturers of ergonomics furniture in the Office Furniture Industry, names like Steelcase, Herman Miller, and Knoll come to mind, to name but a few. If you were to make a list of some of the best ergonomics chairs that are available on the market it might include models such as Aeron, Leap, and Life. What would you say if you walked into an office of over 1000 employees who all had these great chairs from these great manufacturers and 69% of your employees were experiencing discomfort? Is there something wrong with the design of the chairs? No, but there is definitely something wrong with this equation.

When performing an office ergonomics assessment the most common solutions you will see are products (i.e. furniture, accessories), stretching and breaks, and employee awareness training. As in most ergonomics assessments the emphasis for solutions in the office environment is placed on engineering controls, which usually results in purchasing products in the expectation that ergonomically designed furniture and accessories will allow employees to adopt the best possible posture for work. So, if furniture and accessories is the key to a healthy office workplace, then why are so many of these employees experiencing discomfort?

Research into the impact of new ergonomics furniture and training has provided insight into this question. In a study by Green and Briggs (1989) it was noted that the availability of ergonomics furniture did not prevent the onset of discomfort. In fact, the study noted that those employees who were given new furniture without any training expressed a higher level of discomfort. Robertson and O'Neill (2003) provided excellent insight into this situation when they found that a test group that was given new equipment experienced a 27% reduction in employees experiencing symptoms, while a group that received training and new equipment experienced a 46% reduction. For the office environment, many studies have clearly shown that ergonomics awareness training has a positive effect on employee discomfort (Brisson et al, 1999; Robertson and O'Neill, 2003; Green and Briggs, 1989). Critical components of the improvements seen in the office environment due to training are changes in the behaviors of the employees and increases in their knowledge of how to properly use ergonomic products (Rizzo et al, 1997; Harrington and Walker, 2004).

In many of these research studies that have been performed in the area of office ergonomics the primary dependent variable of interest is employee discomfort. Due to the relatively low injury rates experienced in the office environment, discomfort is a useful measure of the impact of ergonomics stressors on the musculoskeletal system. Additionally, discomfort is a simple measure to collect and can be tracked over time with subsequent surveys of employees.

Atlas Ergonomics collects data on employee discomfort and surveys equipment use during its evaluation of every individual's office. It is from these surveys of over 1000 employees that it became evident that the best furniture was not the final solution. A key factor that was highlighted in the surveys was the employee's knowledge of the features and use of the products in their office. When employees were asked about the furniture and equipment that are present in their office they are allowed to answer the question with three responses: yes, no, and I don't know. If an individual answers "I don't know", it means they are unsure whether they have that product in their office. Additional questions were asked about the employee's knowledge of how to use their equipment, and they were instructed to provide one of the same three responses.

On average, 33% of the responses to questions about product features resulted in an answer of "I don't know". The employees simply did not know if they were using a product with an ergonomic, adjustable feature. When asked about the features of their chair 14% of the respondents did not know they had a chair that is height adjustable. The less intuitive the product feature, the greater the level of confusion with the presence of that feature (see Figure 1).

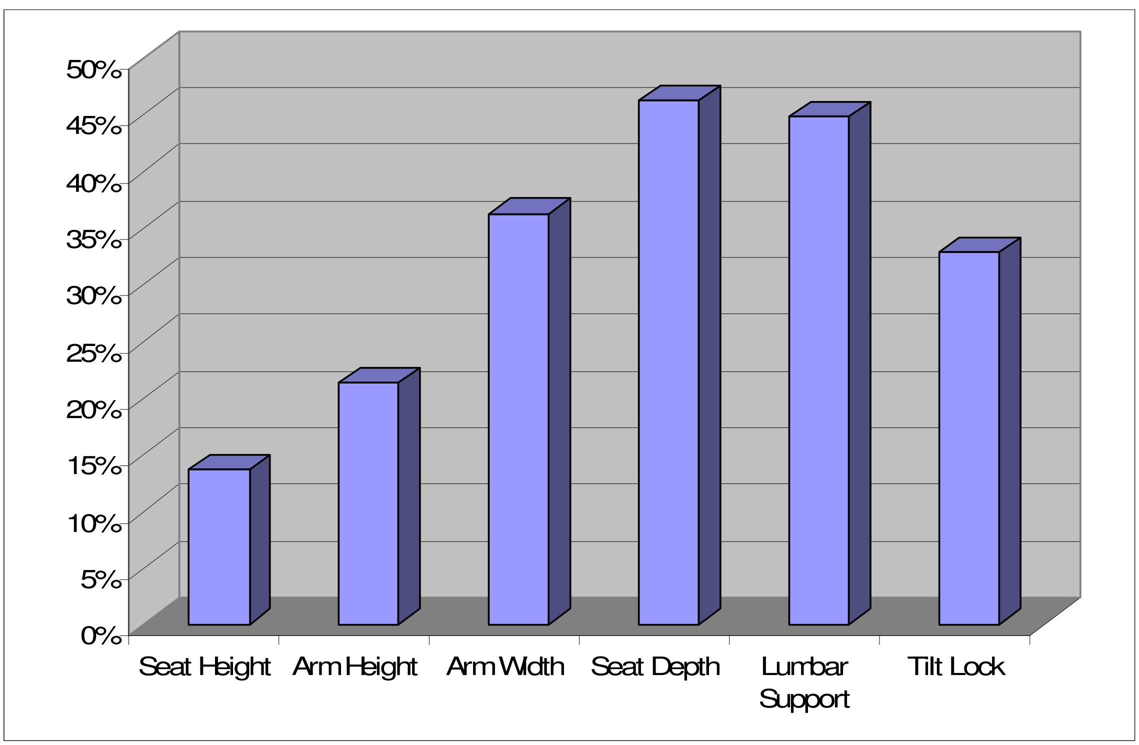

Figure 1: Percentage of employees who are unaware of chair features

In looking at the research regarding chair features the majority of reported discomfort while seated occurs in the back (Bendix et al., 1988; Bendix et al., 1996; Coleman et al., 1998; Dieen et al., 1997). The main features of the chair that have been associated with discomfort were found to be backrest inclination, seat pan inclination, lumbar support, and arm support. Of these chair features lumbar supports have been a prime area of focus in the evaluation of musculoskeletal discomfort (Bendix et al., 1996; Coleman et al., 1998; Hermans et al., 1999; Porter and Norris, 1987; Vergara and Page, 2000; Vergara and Page, 2002). Research as a whole indicates that people have different needs for lumbar supports depending on certain characteristics such as height, weight, health, and gender. This need for adjustability within the design of the backrest of an ergonomics chair is a key feature in many of the good ergonomics chairs on the market.

The chairs that were reviewed during the surveys performed by Atlas Ergonomics included many of the top manufacturers and their models. All of these chairs had the core adjustable features recommended by BIFMA, including a method of providing support for the lumbar region of the back. In the initial surveys performed by Atlas 40% of employees had low back discomfort and 25% had moderate to high levels of discomfort. As seen in Figure 1, approximately 45% of the employees surveyed did not even know if their chairs had lumbar support.

The data clearly indicates that there is a critical gap in the knowledge that employees have regarding the ergonomic products they are given to improve their health. Research has shown that providing quality equipment without an employee training program limits the potential benefit of the new equipment (Robertson and O'Neill, 2003). Consider the impact of this information – when an individual sitting in an Aeron chair is unaware of its most basic feature of height adjustability, how effective was this investment? How can an employee achieve the full benefit of their ergonomics control if they don't use it or even know it exists?

This paper presents a case study of companies that have implemented an ergonomics process that incorporates both engineering controls and extensive employee training. The participants in this case study, given their current tasks and products, provide a compelling argument that an effective office ergonomics program requires more than just quality equipment. Product knowledge will be shown to have a clear influence on the discomfort of employees in the office environment.

TRAINING AND DATA COLLECTION

Data collection was completed using a combination of software and one-on-one interaction to prioritize concerns, pinpoint causal factors, implement solutions, and measure outcomes to show improvement.

Figure 2 provides a graphical representation of the system Atlas used to assess employees in an office environment. The system is divided into six phases that are followed in a cyclical fashion to ensure all employees are addressed with the appropriate control for their level of risk.

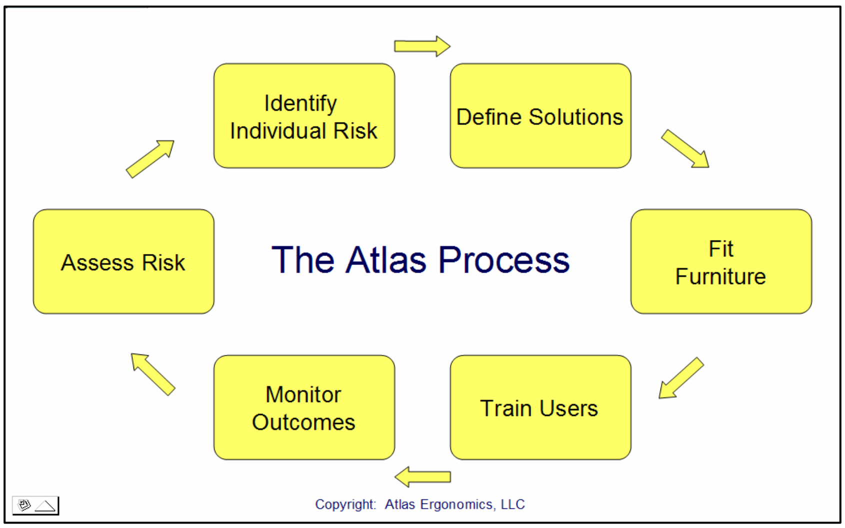

Figure 2: Atlas Ergonomics Office Assessment Process

Phase I – Assess Risk: The Atlas system starts with an assessment of risk which is performed using an online employee survey. This survey addresses both workplace conditions and employee discomfort in an attempt to gather data relevant to ergonomic risk in the office environment. Each question within the survey was designed to assess different elements of office ergonomic risk, and has been chosen based on current research and standards. All responses by employees are verified by a trained analyst with an onsite visit and interview.

Phase II – Identify Individual Risk: The Atlas system contains an algorithm that categorizes employees into three levels of risk: low, moderate, and high. These levels are assigned based on responses in three areas: discomfort, ergonomics, and other factors. Discomfort is assessed using a health index which is a combination of frequency and severity of symptoms on a 5-point scale using 2 decimal points of accuracy. The multiplicative value of these discomfort variables (F x S) is rated as low, moderate, high, and extreme. Ergonomics is assessed by comparing questions related to personal and task variables (e.g. height, weight, hours of work, etc.) to an audit of the products that are present in the office and their features. Using a logic table, any gaps in product availability and design are identified. Depending on the size of the gap and the exposure level of the employee, a risk level of low, moderate, or high is assigned. The final indicator of individual risk (other factors) allows an employee to indicate if there are any conditions that may place them at increased risk of developing symptoms of MSDs (e.g. recent accident, previous injury to body part, etc.). These factors are not rated on a scale, but simply the presence of any of these conditions highlights an employee as potentially higher risk. Of these three categories, discomfort is used as the primary metric for sorting levels of risk. Ergonomic risk is used as a secondary sort, and other factors are used as a tertiary sort.

Phase III – Define Solutions: With all the data collected and verified, standard engineering controls are defined to ensure that all employees have the appropriate equipment, furniture, and accessories to fit them correctly and meet the needs of their job. A time gap will occur at this point as the process will allow for ordering and installation of all engineering controls.

Phase IV – Fit Furniture: A second on-site visit to the employee is performed to provide an initial level of training and to fit the workstation to the employee. In order to assist in the transfer and retention of ergonomics awareness training, Atlas has developed a system to mark furniture and fit employees within their workstation. Figure 3a and 3b illustrate a furniture marking system and the report provided to employees to help them to reproduce the settings that place them in an optimum position.

(A) (B)

Figure 3: (A) Labeling of ergonomic furniture; (B) Fit Report© for individual employee

Atlas installs color-coded labels on the critical adjustment features of an employee's office (i.e. seat height, arm rest height, work surface height, etc.). The labels are used in conjunction with fitting and training to help strengthen the training process and guide an employee to maintain their settings over time.

Phase V – Train Employees: In addition to the personalized training provided in Phase IV employees are educated in a classroom setting and through a web-based refresher. Various approaches to training are used to address different modes of learning that may be present within the employee population. Additionally, providing the key information in multiple formats at different points in time is designed to provide continuous reinforcement of the training in an effort to enhance retention and utilization of the recommended behaviors; this type of training has been found to be critical for long-term effectiveness of an ergonomics intervention (Faucett et al, 2002)

Phase VI – Monitor Outcomes: Follow-up surveys are provided to employees through a similar system used in the initial online questionnaire. The goal of the follow-up survey is to monitor the health index (frequency x severity of symptoms) of individuals, assess retention of key educational information, and identify where additional resources may be required to address at-risk employees. Employees are provided with the first follow-up survey one month after intervention, a second survey at the 3-month interval, and subsequent surveys are administered every three months. Any employees whose survey indicates an elevated level of risk are placed into the cyclical process as needed.

The data from the surveys collected in Phase I and VI were analyzed to determine the impact of the ergonomics controls implemented over the course of a 9-month period. A discussion of the participants, controls, and results is provided in the remainder of this report.

PARTICIPANTS

This case study included a population of 1008 employees who had participated in the Atlas process. These employees were pooled from six companies that were assessed within a 2-year period. The majority of the population (65%) worked in the customer service job category, with the remaining 35% distributed relatively evenly between seven other administrative and management categories. The average age of the employees was 37 with a range of 18-70. The distribution of gender was 25% male and 75% female. The average tenure within the companies was 3-5 years. All of the employees reviewed worked full-time with 82% of population working 6-8 hrs per day on the computer.

Each of the companies that implemented the Atlas Ergonomics process had previously purchased and installed ergonomics furniture and accessories into their work environments. The following details describe the furniture inventory of the companies at the time of the initial survey:

Table 1: Inventory of furniture from initial survey of companies

Standard Chair	Big & Tall Chair	Keyboard Trays	Height Adjustable Tables
Herman Miller: Aeron, Ambi	Nightengale	Herman Miller: Accents	Details- electric
Steelcase: Leap, Criterion	Steelcase: Criterion Plus	Details: Various	Steelcase: 9000- electric
Knoll: Life, RPM	Knoll: Bulldog	Knoll Extra	Knoll: Currents

Depending on the situation, a company may have received anywhere from 2 to 4 follow-up surveys. For some of the results discussed, a subset of companies that received four follow-up surveys will be used to provide additional details. These companies will be referred to as Company A (78 employees), Company B (38 employees), and Company C (114 employees).

ENGINEERING CONTROLS

During Phase III of the process the goal was to identify any products that needed to be purchased to ensure an employee can adjust the workstation to fit them. As noted in Table 1 the companies that went through the Atlas process already had an excellent inventory of the core ergonomic furniture and accessories (i.e. chairs, keyboard trays, and height adjustable furniture). Upon completion of the initial survey and onsite visit, Atlas was able to identify the following engineering controls for the six companies (values represent percent of population receiving item):

Chair:	2%
Alternative keyboard:	7%
Trackball:	7%
Footrest:	16%
Document holder:	6%
Wrist rest:	1%
Headset:	1%

For the chairs, the 2% value refers to employees who required a different chair to fit their stature. Given the types of chairs that were already present within the companies, the majority of employees could be properly fit with their existing furniture. For those companies that were using the Herman Miller Aeron chair, approximately 10% of employees were moved between the different sizes of chairs (i.e. A, B, C). The change in seat size generally occurred for those individuals requiring a size A or C chair. Alternative keyboards were provided to those employees whose stature and hand dimensions did not allow for proper wrist positioning using a standard keyboard. The Microsoft Natural keyboard was the main product of choice for this category. A trackball was recommended for employees based on hand/wrist symptoms and the relative fit of their current input device to their hand. Footrests were primarily recommended for those employees whose stature could not be accommodated by the chair and keyboard tray adjustments. Document holders were recommended based on symptoms within the neck and shoulder regions, and on the requirements of the tasks performed by the employee. Wrist rests were recommended primarily due to hand/wrist symptoms.

Given that 65% of the population is employed in the role of customer service within a call center environment, it was not surprising that a small number of headsets were recommended. For the employees working in customer service 92% were already using headsets. In total, 65% of all employees reviewed were already using headsets.

The Product-Knowledge Gap

The audit performed during Phase I indicated that the participants in this case study had a high-quality baseline inventory of furniture and accessories. A review of the symptoms within the population during the Phase I survey further indicates that the employees had a fairly high prevalence of discomfort across key body parts. Of particular interest are the high levels of discomfort found in the head/neck, elbows, hand/wrists, and lower back (see Table 2). Given the presence of ergonomic chairs, keyboard trays, and workstations, the high levels of discomfort in these body parts is an important data point. Additionally, with a predominantly customer service workforce with a high pervasiveness of headset use, the prevalence of head/neck discomfort is noteworthy. The headset is considered a critical control for call center employees with respect to head/neck discomfort. With 42% of employees experiencing discomfort in the head/neck, it is clear that the headset is not the only control required to address risk for this body part.

Table 2: Prevalence of Discomfort for Survey 1

Body Part	Percent with Discomfort
Head/Neck	42%
Shoulders	34%
Elbows	66%
Hands/Wrists	38%
Upper Back	18%
Lower Back	40%
Hips/Thighs	9%
Knees	10%
Ankles/Feet	9%

The engineering controls recommended in Phase III complimented the initial inventory. As presented in the previous section, the sum of these recommendations does not represent a significant impact on employee positioning, and therefore would not be considered a critical control for the ergonomics risk for the population.

A core product that is often recommended within an office assessment is a keyboard tray. For this case study, no keyboard trays were recommended; employees worked with the products that were present during the initial survey. The surveys of the employees indicated a relatively even distribution of those who worked with their keyboard on a tray versus on the work surface (see Figure 4). Interestingly, there was virtually no difference in the percentage of employees who experienced discomfort based on where their keyboard was located. The general expectation is that those employees who have access to keyboard trays, and therefore an ergonomic improvement to their workstation, will have an advantage for achieving a healthy posture. The surveys performed during this study illustrate that this benefit may not be automatically realized.

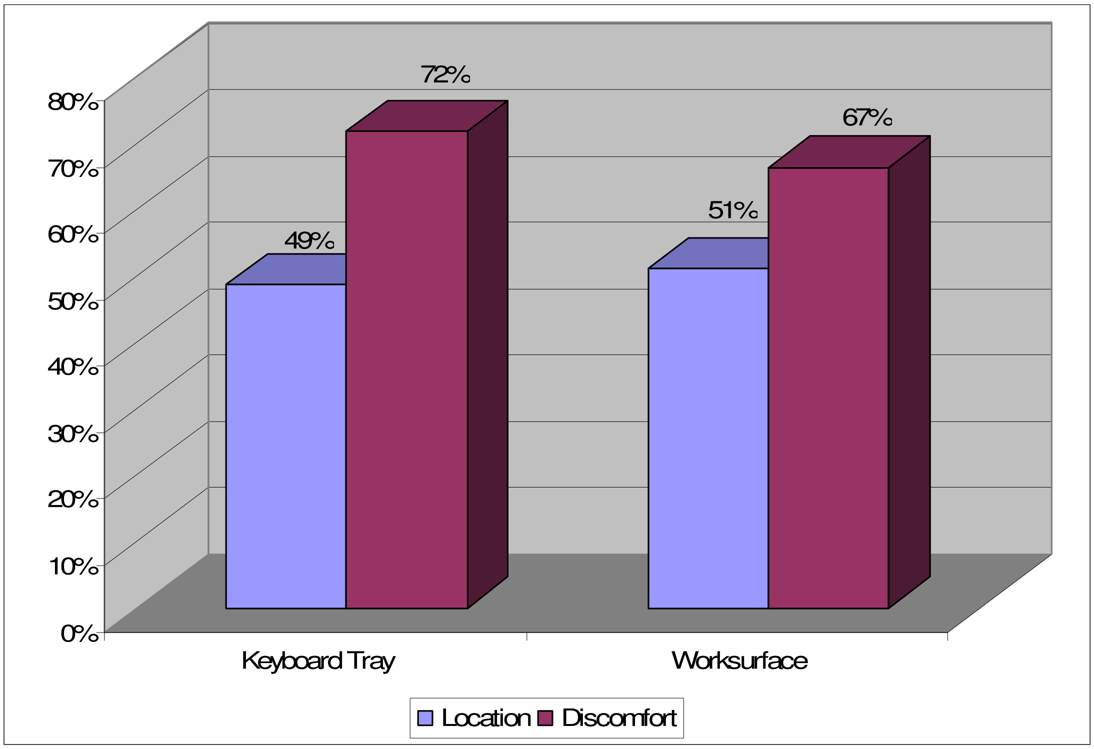

Figure 4: Location of keyboard and percentage of users experiencing discomfort

To further determine the differences between these two engineering controls, another question was posed during the survey: “While using a keyboard and input device are you able to maintain a relatively neutral (straight) wrist position?” The anticipated outcome of this question is that those individuals who can maintain a better wrist position will be less likely to experience discomfort in their hands/wrists. Figure 5 presents an interesting comparison of the relationship between product, posture, and discomfort. As seen in the graph, when employees can maintain a straight (neutral) wrist position they are 33% less likely to experience discomfort. This outcome makes logical sense given our knowledge of the impact of poor posture on discomfort. The intriguing outcome of this comparison is that there is no inherent benefit of using a keyboard tray versus the work surface to support the keyboard. Regardless of location, employees experienced discomfort more based on their posture versus the product they are using.

The conclusion to be made here is not that keyboard trays are ineffective, but simply that the engineering control that is relevant for the employee is whichever one will allow them to achieve a straight (neutral) wrist position.

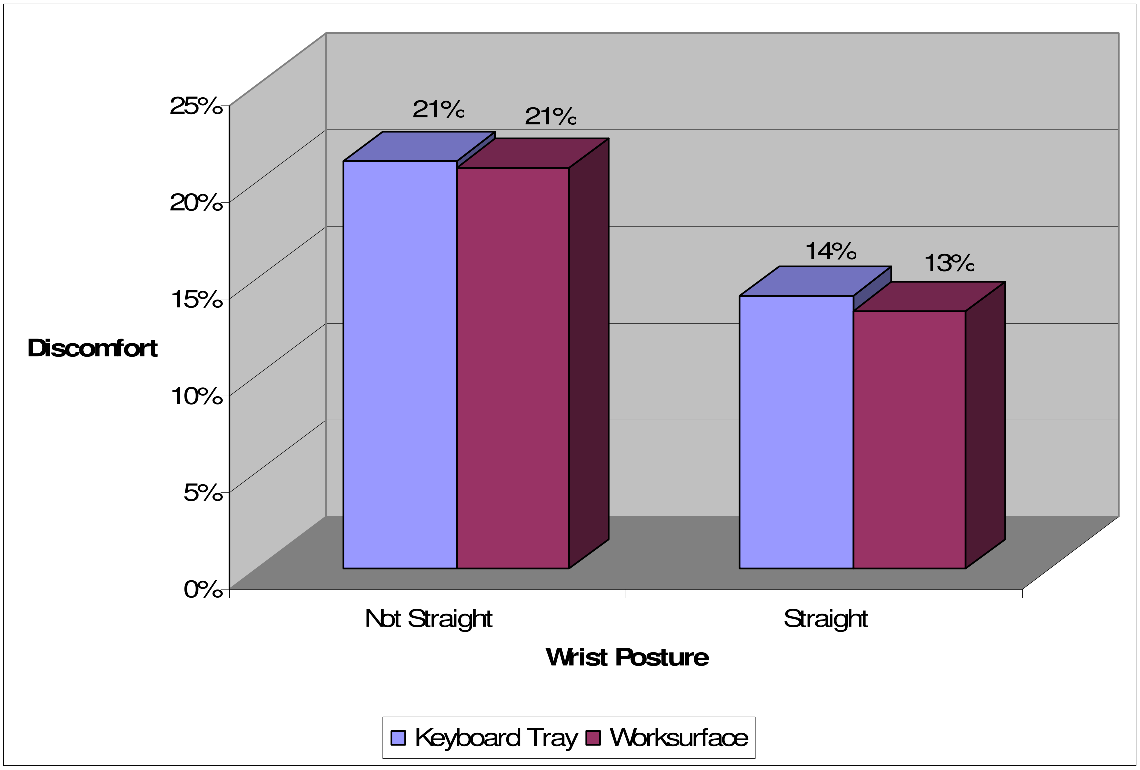

Figure 5: Relationship between keyboard location, wrist position, and discomfort

THE IMPACT OF PRODUCT KNOWLEDGE

The multiple layers of training that were provided to the employees included a training class that provides a basic introduction to office ergonomics, personal interaction with each employee at their workstation to discuss proper positioning and setup (includes fitting the workstation to the employee), providing a personalized Fit Report© to help the employee replicate the setup provided by the analyst, and online training materials to support all of the training provided. In addition to the core ergonomics information that is provided in Phase IV and V, the follow-up surveys required in Phase VI provide an indirect impact on the culture of the company by providing a continuous presence of the ergonomics program over time.

Given that the employees are in possession of all of the equipment and furniture they need by the end of Phase III, the goal of Phases IV and V of the process is to increase general knowledge so that employees will take more responsibility and control of their workstations and make the needed changes to improve their health. During each survey that is provided to employees (Phase I and VI), one of the key questions that are asked is whether the employees have improved their knowledge of ergonomics and its application to their workstation. As can be seen in Figure 6, there is a dramatic shift in the knowledge level of the employees from the initial survey through the subsequent surveys. The curves begin to skew dramatically to the right as the average knowledge of employees shifts to good or complete.

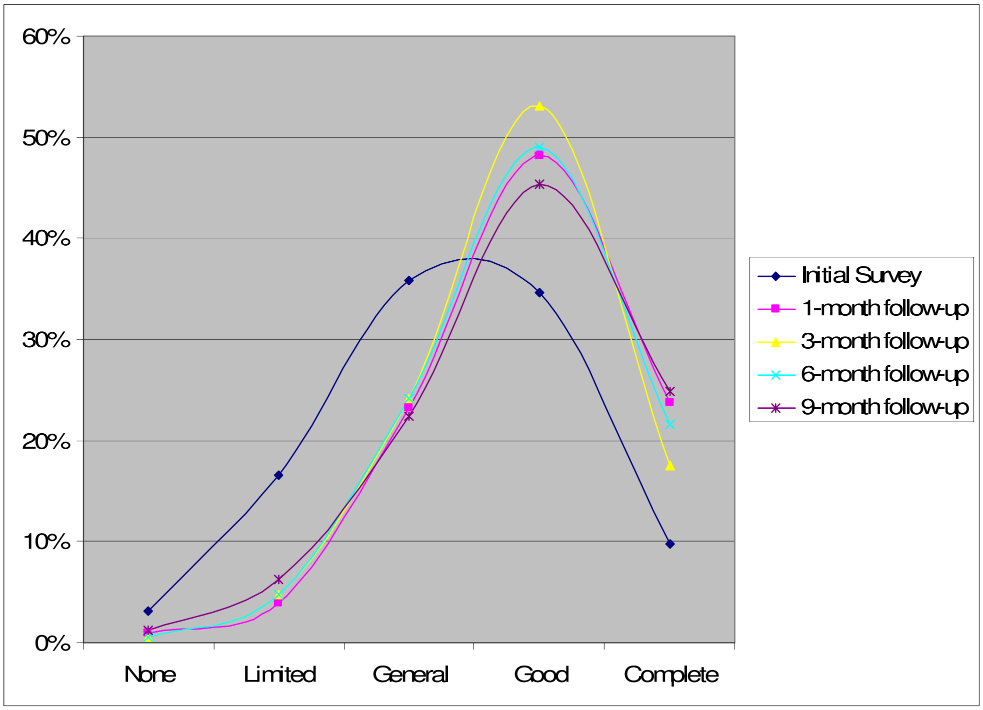

Figure 6: Employee knowledge of features of ergonomics products

Figure 7 illustrates the outcomes that the companies realized over the course of a 9-month period subsequent to the implementation of the Atlas process. Three individual companies and the overall performance of the 1008 employees is provided to show that the results are not the effect of an averaging process, but a true illustration of the steady and consistent downward trend. Whether a company had 38, 114, or 1008 employees, a steady reduction in those employees experiencing discomfort was evident after implementation of the process.

In addition to the frequency of employees experiencing discomfort, it is important to look at the impact on severity. Figure 7 illustrates the trends in maximum discomfort that were seen for three companies over the period of 9 months. Maximum discomfort refers to the average peak value (F x S) that is experienced within a single survey period. A reduction in maximum discomfort requires a reduction in the severity of symptoms across the entire population. As seen in Figure 8, the companies experienced anywhere from 18-33% reduction in maximum discomfort within 1 month, and 45-60% reduction within 9 months following implementation of the Atlas Ergonomics process.

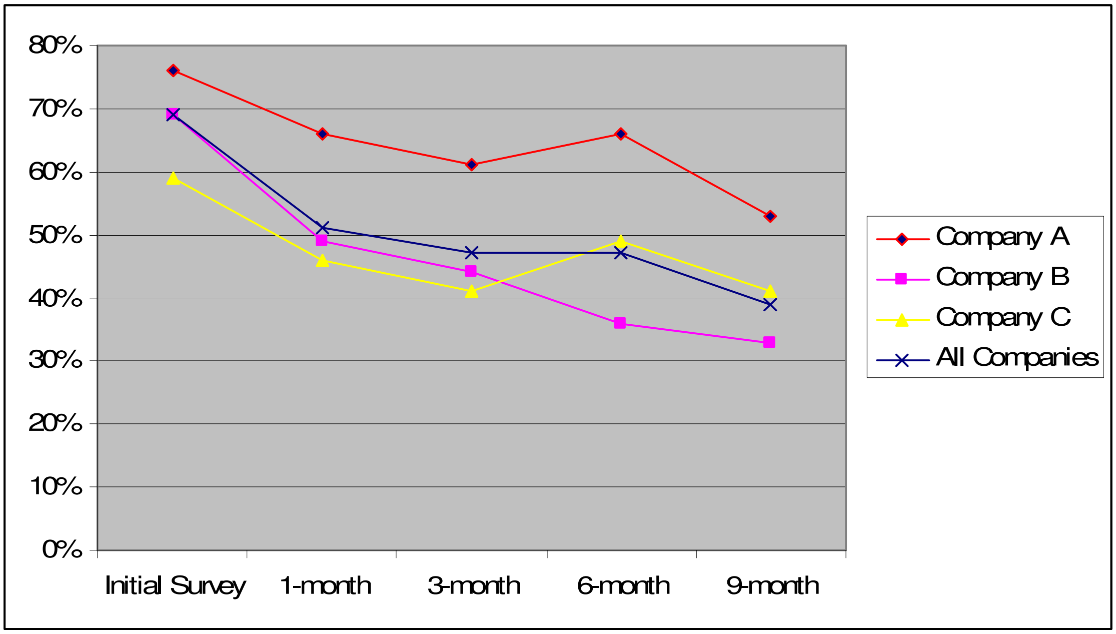

Figure 7: Percentage of employees experiencing discomfort

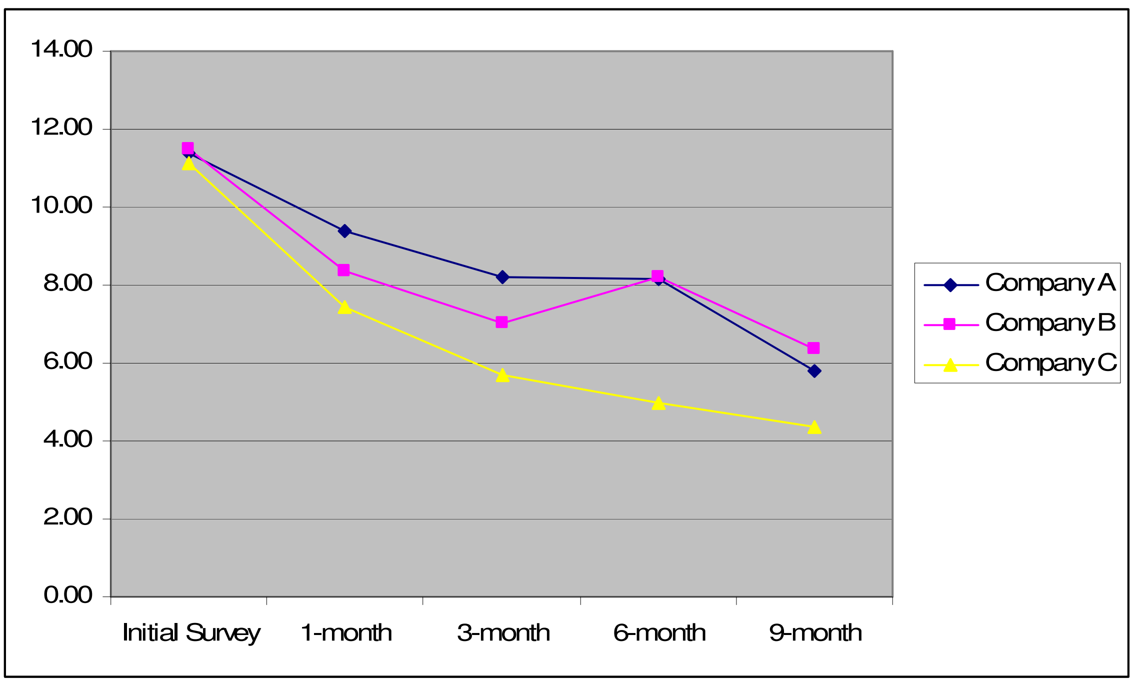

Figure 8: Trends in maximum discomfort

The primary interventions that occurred during the timeframe of these surveys were training. The training provided in Phases IV and V of the process in conjunction with the surveys provided in Phase VI contributed to a continuous shift in employee knowledge. The inferred benefit is that with this knowledge employees will focus on achieving a healthy working posture consistently over a period of time. The results of the surveys, both related to frequency and severity of symptoms, clearly indicate that an improvement in employee health was realized in the absence of any dramatic changes in workstation inventory.

SUMMARY

The results of the surveys and analyses performed during this project provide a valuable insight into the value of a full, effective ergonomics process. The companies involved in this case study began with good ergonomics furniture and accessories, and yet a significant percentage of the employees were experiencing discomfort. The recommendations provided in the course of a thorough analysis of the employees resulted in minor additions to their workstation with respect to products.

The primary controls that were implemented within this project were the many training opportunities. Phase IV of the process provided individual attention to the workstations were fitted to the employees, and the Fit Report© supplied to the employees provided a permanent reminder of this training. The classroom training provided in Phase V was supported by online video and training materials that again afford long-term access to the resources. The many training programs within the Atlas process provide continuous reinforcement of ergonomics principles. The constant presence created by the Atlas process follows the recommendations of Faucett et al (2002) whose research illustrated training employees using a 1-time event does not produce sustainable results. This recommendation provides a critical consideration for employers who are considering implementing an employee awareness training program for their employees. In order to ensure the long-term effectiveness and value of the training, a means of continuous reinforcement is a key element of the program.

In tracking the results of the employee surveys over a 9-month period, one of the primary changes noted was a continuous improvement in employee knowledge of their office products and their features. In the initial survey prior to any training or changes 20% of employees had little to no knowledge of their workstation features while 45% had good to complete knowledge; after a 9-month period 7% of employees had little to no knowledge of workstation features while 70% had good to complete knowledge. This shift in knowledge over time emphasizes the need to provide continuous access to information, and an emphasis on ergonomics that fosters empowerment of employees to take control of their workplace and their health. As employees' knowledge of ergonomic features increased there was a 43% reduction in the number of employees experiencing discomfort. Further, companies experienced as much as a 60% reduction in the maximum discomfort of their employees resulting from consistent adherence to good ergonomics principles.

These reductions in discomfort represent the untapped benefit that ergonomics furniture can have when it is properly used. This information clearly shows that a significant impact on employee discomfort can be achieved when good furniture is provided to employees, but this benefit cannot be realized without proper instruction or training.

The fact that the employees in this study were in possession of high-quality furniture does not allow this study to determine the impact of implementing individual engineering controls (i.e. chairs, headsets, etc.). This impact has been previously illustrated in literature (Robertson and O'Neill, 2003). This project used different types of training specified by the Atlas Ergonomics process. The contribution of these different types of training to employee knowledge of products should be assessed in future research to determine their individual impact, and hence the cost-benefit of each level of training.

With office ergonomics furniture and accessories, it is important to consider the potential impact of investing in these products. Many ergonomics products have sophisticated features to help fit a workstation to an employee better, and adjust more to how a person works. The results of this case study clearly illustrate that regardless of how well designed the product, if the employee is not provided with the knowledge to understand the features and the skills to effectively use them, the benefit of this investment is lost.

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