2007

A Work Injury Prevention Program for a Rural Manufacturing Company

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A WORK INJURY PREVENTION PROGRAM FOR A RURAL MANUFACTURING COMPANY

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A Scholarly Project
Submitted to the Graduate Faculty of the
Department of Physical Therapy
School of Medicine and Health Sciences
University of North Dakota
in partial fulfillment of the requirements
for the degree of
Doctor of Physical Therapy

Grand Forks, North Dakota
May
2007
This Scholarly Project, submitted by Peter Angell, Tara Copenhaver, Dustin Martinson, and Heather Martinson, in partial fulfillment of the requirements for the Degree of Doctor of Physical Therapy from the University of North Dakota, has been read by the Advisor and Chairperson of Physical Therapy under whom the work has been done and is hereby approved.

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Department Physical Therapy

Degree Doctor of Physical Therapy

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Date 12/12/06
TABLE OF CONTENTS

ACKNOWLEDGMENT ................................................................................................................ vi

ABSTRACT ................................................................................................................................... viii

CHAPTER

I REVIEW OF LITERATURE ........................................................................................................ 1

INTRODUCTION AND PURPOSE OF PROJECT ................................................................. 1

PREVELANCE OF INJURY ........................................................................................................... 2

COST OF INJURY ............................................................................................................................ 6

RISK FACTORS OF INJURY ......................................................................................................... 8

INJURY PREVENTION PROGRAMS .......................................................................................... 14

EVIDENCE BASED INTERVENTION ......................................................................................... 20

COST EFFECTIVENESS OF INJURY PREVENTION PROGRAMS ........................................... 30

CONCLUSION ............................................................................................................................... 32

II METHODOLOGY ..................................................................................................................... 33

III RESULTS ................................................................................................................................... 38

IV DISCUSSION .............................................................................................................................. 41

APPENDIX A ............................................................................................................................... 49

APPENDIX B ............................................................................................................................... 52

APPENDIX C ............................................................................................................................... 55

APPENDIX D ............................................................................................................................... 68
ACKNOWLEDGEMENTS

First and foremost, we would like to recognize Dr. Beverley Johnson for advising and mentoring us through this scholarly project. Thank you for your passion and knowledge in regards to work injury prevention, for your patience, and for giving your time so that four students could pursue their goals.

This project would not have been possible if it weren’t for the proactive agenda that the Steffes Corporation holds for injury prevention and management. Their Safety Specialist, Kent Mortenson, is a visionary in work safety which shows through the success of the programs that he has implemented. For this, thank you to the corporation, Kent, upper management personal, and the employees.

We also appreciate the time that Cory Ash from Rehab Visions took to be our local contact and advisor. We hope that they may benefit from this project and pursue endeavors with the Steffes Corporation. The office exercise template was made possible by the pictures from First Choice Physical Therapy, Inc. Also for the time of Bryce Kelly who, with his thesaurus like mind and passion for grammar helped critique parts of the project.

Let us not forget our Savior, as many prayers for strength, confidence, patience and safety were answered throughout this project. Also we thank our families for supporting us in all the ways that they do.
Thank you to the faculty and staff of UND Physical Therapy. The knowledge and experiences that you have bestowed upon us is the stepping stone into our aspirations and goals.

Lastly, thank you to the UND Physical Therapy Class of 2007. We began as fifty individuals and through success and failure we have become one family that we are proud to be apart of.
ABSTRACT

Purpose: This article discusses how a group of four physical therapy students built upon traditional ergonomic and biomechanical programs and applied it to a rural manufacturing company of 160 employees.

Methods: Meetings were held with the corporation’s Safety Specialist and upper management. Based on research supported by evidence and suggestions from the company’s administration, the students constructed an injury prevention program consisting of two presentations for office and production workers, exercise programs, a lifting and posture DVD and assessment, and a modified office assessment.

Results: Seventy-one employees attended the production lecture. Thirty-six workers took part in the office presentation. Sixty-four production individuals took part in the posture and lifting screen. Thirty-three employees demonstrated a decreased forward head, twenty-two brought their shoulders back, and twenty-four corrected excessive pelvic tilts post lecture. Seventeen individuals didn’t change their posture. Post lecture all individuals bent their knees correctly and 56 brought the box close enough to lift the box properly. Only one person twisted his/her back post lecture to move the box. Twelve worker’s offices were evaluated after the office lecture. Some of the common problems were fixed during the assessment. Recommendations were made for different equipment or equipment modification. These modification changes are the responsibility of the company.
Discussion: Although, improvements were made initially with both the office workers in their desk set-up and the production with standing posture and lifting techniques, a long term follow-up needs to be done to assess the retention rates among the employees. This program provides a plan of what could to be done initially to produce an evidence-based injury prevention program within a manufacturing company.
CHAPTER I

INTRODUCTION AND PURPOSE OF PROJECT

This literature review gives a research base for a University of North Dakota physical therapy scholarly project in the area of work-related injury prevention programs. A large component of this scholarly project was working with a rural North Dakota manufacturing company. They allowed us, a group of four physical therapy students, to evaluate their environment and the needs of injury prevention education, and develop evidence-based educational lectures/teaching labs customized to the job demands of the company’s employees. There are a variety of jobs in this company ranging from secretarial to welding to paint line to material handling resulting in multiple job descriptions. When compiled, the employees can be split into two groups, production and office. Focus throughout this company is injury prevention.

The purpose of developing these educational lectures is to build upon the traditional ergonomic and biomechanical programs found in literature. In this, the goal is to educate and motivate the employees and employer. The employee will be empowered in his or her own injury prevention and management. After the employee has attended the lecture/teaching lab, they will have basic knowledge to be empowered as the first line of defense against injury. The company managers, faculty advisor and area clinician worked with the group to develop the program and promote it in the work environment.
Adherence of the employee is directly related to the compliance of the employer to support and enforce the program.¹

Many industrial populations have implemented some kind of injury prevention program but how much of the program is based on evidence-based literature? This literature review will define and shape our injury prevention program, and will be based on research articles found in common databases. The focus of the research is the importance of injury prevention in relation to prevalence of injury, cost of injury, risk of injury, elements and effectiveness of injury prevention programs, intervention and exercises that prevent injury, and the overall cost benefit of implementing an injury prevention program.

It is important to reinforce that the following review of articles is what supports and makes our injury prevention lectures evidence-based. The field of physical therapy is growing in many ways. There is an emphasis toward prevention and wellness. There is also a focus that treatments should be based on evidence-based medicine. The injury prevention PowerPoint lectures for the rural manufacturing company are composed of pertinent information that is supported by this review of literature.

PREVALENCE OF INJURY

The U.S. Department of Labor defines musculoskeletal disorders (MSDs) as an injury or disorder of the muscles, nerves, tendons, joints, cartilage, or spinal discs. MSDs do not include disorders caused by slips, trips, falls, motor vehicle accidents, or similar accidents.² Work-related musculoskeletal disorders (WMSDs) are musculoskeletal disorders caused or made worse by the work environment. WMSDs can cause severe and
debilitating symptoms such as pain, numbness, and tingling, reduced worker productivity, 
lost time from work, temporary or permanent disability, inability to perform job tasks, 
and an increase in workers’ compensation costs.³

Nationally in 2004, MSDs accounted for 402,700, or 32 percent, of the injuries 
and illnesses with days away from work.² This statistic is consistent with findings from 
two other sources stating work related musculoskeletal disorders that require time away 
from work account for one third of all occupational injuries.³,⁴

The state of North Dakota, in 2004, had 4845 injuries and illnesses out of a work 
force of 318,000 people requiring days away from work.⁵ When put into a ratio, the 
results are for every 66 employees in the workforce, one was injured.

The rural manufacturing company, in 2004, had 12 reported injuries out of a work 
force of 156 people. When put into a ratio, this means for every 13 employees in the 
corporation, one was injured. Reported injuries peaked in 2005 to 17 reported injuries out 
of a work force of 156 equaling a ratio of 9:1 for employee injury.

When injury rates of the rural manufacturing company are compared to North 
Dakota’s, there is a significant difference when looking at the year 2004 and considering 
2005. Employees at the company are five to seven times more likely to be injured when 
compared to the general work force of North Dakota. This increased risk is expected, 
because manufacturing has the second highest non-fatal injury rate in North Dakota at 5.4 
out of 100 compared to the average injury for all North Dakota’s workforce at 1.5 out of 
100.⁵ If these numbers are correct, then the corporation should have an increased risk 3.5 
times the general workforce.
In the literature, it shows that work-related musculoskeletal disorders are declining, but there is significant evidence to show that they are being under-reported. Specifically, in manufacturing, it has been found that only 6.7% of musculoskeletal disorders are reported.

Through interviews with the company's Safety Manager, the corporation has become more proactive with injury prevention in the past couple years. From 2005 when reported work injuries were at their peak in the company, to present day 2006, the company decreased reportable injuries by 71%. The safety supervisor stated in an interview on June 16, 2006, that some changes had been made at the company in that time period. These changes include the addition of a full-time safety manager and an increase in new employer training time from under an hour to over four hours with an emphasis on injury prevention as described in the companies ergonomic policy.

This decrease has great benefits to the company as long as injury is being reported properly. If it is not, the company will be following the trend of under-reporting injuries, which causes other parties to absorb the cost. Under reporting has an economic impact to the private sector as health insurance claims are pursued instead of workers' compensation claims, production is lost, and the rates of unexplained experienced worker turnover increases.

When looking through the injuries of the company from 2001 to present 2006, it was found that musculoskeletal disorders (any injury to muscle and bone including cumulative trauma and significant bruises) accounted for 29% of total injuries. Musculoskeletal disorder strictly caused by cumulative trauma, such as sprains and strains, represented 22% of total work-related injuries.
The work-related musculoskeletal injuries, specifically lower back pain, carpal tunnel syndrome and tendonitis are the leading cause of work-related disabilities and workers’ compensation claims and costs in the USA. Specific to manufacturing, national statistics state that incidence rates for amputations, tendonitis, carpal tunnel syndrome and repetitive motion cases were more than twice the rates for total private industry. Contact with objects and equipment, such as being struck by an object, was the leading cause of injuries and illnesses with days away from work in goods-producing industries such as this company. The most prevalent event for these industries involving days away from work was overexertion, especially in lifting and repetitive motion.

The prevalence of work-related musculoskeletal injuries can be classified as specific body parts. Specific to the back, statistics show that low back pain accounts for 15-25% of all work-related injuries and 40% of all workers’ compensation losses. Even “healthy” people have episodes of back pain. Fifty-five percent of healthy individuals had low back pain at least once in a two year span and 87% showed some level of disability due to low back pain when the Oswestry Disability Index (a functional assessment tool) was used. Low back pain is so significant that it is only second to respiratory problems for cause of physician visit. At the company, back injury represents 49% of work-related musculoskeletal disorders.

The prevalence of MSD of the upper extremity over an individual’s lifetime is 29%. There is also research showing a 4.5% risk to develop upper extremity trauma at some time. This number is shown to be as high as 21% with newly hired computer users. Upper extremity cumulative trauma represents 36% in the company. Lower extremity musculoskeletal disorders compose 15% of the injuries.
COST OF INJURY

Now that prevalence of injury has been discussed, one can look at the economic impact of injury. There are two types of costs when looking at injury, direct and indirect. Direct costs encompass lost earnings, health care costs, and workers’ compensation cost. Indirect costs cover any other economic draw such as additional hiring and training, decreased production, depletion of savings for injured individual, modifications needed at home, as well as increased use of social services program affecting the community. This is only a small list of direct and indirect costs of injury.

In the state of North Dakota, research shows that the median employee injury cost is $1,019. This cost ranks the state as 17th highest cost per injured employee in the United States. The total cost of North Dakota’s 4845 injuries was $135,000,000. When mathematics are applied to these numbers it results in direct and indirect costs amounting to an average of $28,000 per injured employee and $425 per each employee of the workforce.

Evaluations of the rural manufacturing company’s injuries in the area of lumbar spine, thoracic spine, and cervical spine can be expressed as per injury cost. The average paid per lumbar injury in 2005 was $6297 and the amount incurred was $9639 per injury. In comparison to the lumbar injuries, a thoracic injury cost the company $7366 for an average paid and incurred $11,292 per injury. The cervical spine had an average cost of $19,159 with a total incurred cost of $30,341 per injury.

The above is a general cost of injury that includes all incidents. Now, one can look at the breakdown of incidents into specific common injuries. All of the following injuries can be classified as non-traumatic disorders. Sometimes these disorders are
considered cumulative trauma disorders meaning they occur over time after many micro traumas. Micro trauma is the cumulative effect of repeated small stresses over a long period of time.\textsuperscript{15} This can be on joints, ligaments, tendons, muscles and other tissues.\textsuperscript{15}

Two main points will be discussed for each injury regarding the average cost per claim. These are direct costs and the average time lost or days away from work and indirect costs. The seven common injuries are non-traumatic injuries of the neck, back, and upper extremity, sciatica, rotator cuff syndrome, epicondylitis, and carpal tunnel syndrome.\textsuperscript{16}

In one study, the average time away from work for non-traumatic disorders of the neck, back and upper extremity are 170, 139, and 170 days respectively.\textsuperscript{16} The cost of the neck disorders is $7,514 per claim.\textsuperscript{16} The cost of non-traumatic disorders of the back and upper-extremities is similar at approximately $6,700.\textsuperscript{16}

Sciatica is the most significant injury in relation to economics. This injury has an average time loss of 449 days away from work.\textsuperscript{16} The cost per claim of sciatica is $46,553.\textsuperscript{16} Sciatic syndrome is very sensitive (95\%) of lumbar disc herniation associated with manually handling heavy loads.\textsuperscript{16}

Rotator cuff syndrome, such as tears and impingement causes an average time loss of 251 days away from work.\textsuperscript{16} It is also the second highest cost per claim at $17,410.\textsuperscript{16}

Carpal tunnel syndrome is another common cumulative trauma disorder. It causes a cost of $14,523 and on average 218 days away from work.\textsuperscript{16}
Epicondylitis encompasses injuries such as tennis elbow and golfers elbow. These types of injuries create lost time of 219 days away from work per claim and a cost of $8,099.¹⁶

**RISK FACTORS OF INJURY**

All the above show the costs of injury per diagnosis. The next logical step of this literature review is to define the risk factors of specific injuries. Knowing the causes of injury will give one an understanding and direction of where and what needs to be developed and addressed in the prevention program to decrease these risks. Preventing injury is much more effective than treating it after it occurs. This notion will be discussed in a later section.

A risk factor is an environmental, chemical, psychological, physiological or genetic element that predisposes an individual to the development of a disease, condition or injury.¹⁷ In this section of the review, the body will be broken down into individual areas and the risk factors for each area will be defined. Many people speculate what the risk factors are and there is a significant amount of research that goes into defining these factors. The National Institute for Occupational Safety and Health, NIOSH, released an article in 2006 describing musculoskeletal disorders and workplace factors. This article was a compilation of the up-to-date epidemiologic research.

A general overview found that 32% of injuries were caused by overexertion or repetitive motion.³ Overexertion was defined further relating to increasing risk for back injury: lifting (65%), pushing or pulling (52%), and holding, carrying, or turning objects (58%).³ This systemic review looked at each risk factor and the amount of evidence
available to support it’s correlation to injury was categorized in the following way:
“strong evidence,” “evidence,” or “insufficient evidence.” This information will be used
to define the risk factors of injury.3

The cervical spine (the neck) is an area in which stability has been sacrificed for
mobility.15 The greatest flexion-extension of the facet joints occurs between C5 and C6,
but C4-C5 and C6-C7 have almost as much movement.15 Because of this mobility,
degeneration is most likely to be seen at these levels.15 The facet joints may bear some
weight of the vertebrae above but this weight is minimal. Even this slight amount of
weight bearing can lead to spondylitic changes in these joints.15 Add in habitual poor
posturing to the already vulnerable cervical spine and one becomes a candidate for weak
muscles and temporomandibular joint problems.15 The above is a possible reason why in
the literature, there is “strong evidence” that posture is a risk factor for neck disorders.3

Looking at the lumbar region of the spine, we find many of the mechanics are
similar to the neck. Even though there are these similarities, the risk factors are different.
The lumbar spine supports the upper body and transmits weight of the upper body to the
pelvis and lower limbs. The facets carry about 20-25% of the axial load but this may
reach 70% with degeneration of the disc.15 Correct alignment of the spine is defined as an
“S” curve. This means the cervical spine concave, thoracic spine is convex, and lumbar
spine is concave. When the spine is in proper alignment, it acts as a shock absorber for
our body.15 When it is out of alignment it puts the structures of the back at risk because it
increases pressure on the intervertebral disc and puts stress on the facet joints, ligament,
and muscles.15 L5-S1 level is a common area of injury because the angle is greater
between the segments, and it has relatively greater amount of movement than compared to other levels of the lumbar spine.\textsuperscript{15}

Posture has its affect on the lumbar spine as it does on all joints and again there is “strong evidence” to support that poor posture is a risk factor.\textsuperscript{3} If a person has frequent poor posturing, muscle imbalances occur. Weak lengthened muscles and strong shortened muscles result in this imbalanced pattern leading to low back pain.\textsuperscript{15} Many people do not hold their spine in correct posture.

Another risk factor for back pain is improper lifting technique. It is a common habit to bend over at the waist instead of bending at the knees. This puts the low back into flexion which takes it out of the correct alignment explained above.

There is “strong evidence” to support that lifting is a risk factor for back injuries.\textsuperscript{3} One must distinguish between proper lifting techniques with correct alignment of the spine and poor lifting techniques. Proper technique will be described later in the intervention portion of this literature review.

Another risk factor that has “strong evidence” for back injury is vibration.\textsuperscript{3,18} A common occurrence of vibration is truck driving or heavy equipment operation. This puts the individual in a position for prolonged sitting which takes their spine out of correct alignment and it also adds the element of vibration. One study done on truck drivers, bus drivers and sedentary workers found that people with a higher total of long-term vibration time have a higher incidence reports of low back pain in the age group of 35-45 year olds.\textsuperscript{18} Drivers had more low back pain than sedentary workers not exposed to vibration.\textsuperscript{18}
Repetition and force of movement are risk factors supported by “evidence” in relation to all segments of the spine. When repetition is a possible risk factor, the biomechanics of muscle balance becomes a cause of injury. Activities for the specific demands of the job should maintain a balance of muscular strength across joints and between opposing muscle groups. If an imbalance is discovered, work activity modification is needed to restore an appropriate strength balance. For example, if a worker is always turning their head to the left, then the right sternocleidomastoid will become stronger than the left. If this occurs, the proper mechanics of the neck will be altered.

The force of movement is as relevant in the neck as it is in other joints of the body. Forceful movements can be caused by falls or accidents, but we ourselves can also cause forceful movement. For example, while driving the forklift one forcefully looks up to view the pallet of interest. There is a considerable amount of force created by the weight of the head, the muscles and the tissues of the neck with this motion.

Other risk factors for injury that are supported through “evidence” include awkward postures and heavy physical work. Although these are not as strongly supported as force of movement, they still can be looked at as risk factors for injury. Static work posture has limited evidence to be a risk factor for back injury, but when static posture is poor it adds another dimension. According to O’Sullivan, poor sitting posture can provoke low back pain. Low back pain subjects with flexion-provoked pain sat with the lumbar spine closer to end range flexion and with a greater posterior pelvic tilt than healthy controls. To add to the list of risk factors for low back pain, these
subjects also demonstrated decreased back muscle endurance, habitual passive sitting posture, reduced activity levels, and greater time spent sitting.20

Another article looked at more specific risk factors, and they concluded that there are five that could be used to estimate absences from work. Four of the five of these factors were indicative of back injury. They were: bending or twisting, working primarily in standing or squatting posture, lifting or carrying heavy loads, and pushing or pulling loads.21 Psychosocial risk factors of injury were also noted in this study. They were decision making authority, skill discretion, quantitative emotional demands, demands of hiding emotions, job security, social support, role conflict, meaning of work, rewards in work, predictability of work, and time demands of the job.21

There are no risk factors for shoulder injury that are supported by “strong evidence” in this article but there are risk factors that are supported by “evidence.” These two risk factors are; posture and repetition.3 There was no mention of overhead work in this article.

“Rounded shoulders” is a common shoulder posture in our society. The issue of muscle imbalance is applied once again. When the shoulders are rounded it shortens the chest muscles and elongates the muscles that support the scapulae. The longer this posture is attained, the weaker the lengthened muscles become. Abnormal shoulder postures can contribute to upper extremity musculoskeletal disorders. According to Werner et. al, shoulder discomfort and awkward shoulder postures are predicative of future upper extremity tendonitis.13 Not only is posture of the shoulders a risk factor for injury; when the neck is in flexion and poor posture, it changes the movement pattern of the shoulder through the levator scapulae.22
The shoulder joint is comprised of a ball (the head of the humerus) and the socket (the glenoid fossa). The relationship in this joint is comparable to a golf ball on a tee. There is minimal allowance for changes in the mechanics of the shoulder. Changes in these mechanics due to posture and can be a culprit for shoulder impingement and instability. According to Ludwig et. al., shoulder impingement is believed to be a primary mechanism of occupationally related shoulder pain. In poor posture, the greater tubercle of the humerus squeezes the supraspinatus tendon in between itself and the acromion. This is made worse with movement as there is friction between the two bones and the tendon.

Repetition is also a risk factor for shoulder injury. The affects of repetition were explained above in the spine section. An example of the shoulder is the act of continuously lifting your arm over your head. This will not only cause muscle imbalance but also be made worse by poor posture. The poor posture reduces the already minimal suprhumeral space. This reduced space may cause a lesion on the rotator cuff tendon that runs through it.

The above anatomical parts have specific risk factors that are either supported by “strong evidence” or “evidence.” The following body parts do not have single risk factors but rather a combination of risk factors that are supported by “strong evidence.” These body parts or conditions are elbow, wrist and general tendonitis. The strongest supported combination of risk factors is repetition, force, posture, and vibration.

The elbow is the attachment for muscles that create movement at the wrist. These muscles are responsible for wrist flexion, extension, radial and ulnar deviation, supination, and pronation. The muscles that create elbow flexion and extension also
have an attachment near the joint. There are seventeen total muscles in the forearm responsible for wrist action.\textsuperscript{24} With this amount of muscle presence at the elbow, it is evident why force of movement is supported by evidence as a risk factor for injury.\textsuperscript{3}

The wrist injuries and specifically carpal tunnel syndrome may be caused by repetition, force, and vibration.\textsuperscript{3} Carpal tunnel syndrome is caused by inflammation of one or more of the nine tendons that run through an enclosed space consisting of the carpal bones and a ligament. The injury occurs when the median nerve is compressed which may follow trauma, flexor tendonitis, a ganglion, arthritis or collagen disease.\textsuperscript{15} Repetition and force may cause this inflammation of the tendons causing the lesion. This inflammation is called tendonitis, and it has risk factors including repetition, force, and posture and exposure to vibration as previously mentioned.\textsuperscript{3,15}

\section*{INJURY PREVENTION PROGRAMS}

One of the purposes of this literature review was to investigate injury prevention programs that are already in existence and to look at their effectiveness. The intent of the current program is to capitalize on existing programs and add other dimensions that are supported by evidence to increase the quality of the product.

Ergonomics is defined as the science concerned with fitting a job to a person’s anatomical, physiological, and psychological characteristics in a way that enhances human efficiency and well-being.\textsuperscript{17} Ergonomic aides are one aspect of ergonomics. These aides are things such as proper chairs, wrist rests, anti-vibratory tools, or things as simple as paper holders to mention only a few. Ergonomics also looks at the work area such as heights of working surfaces, floor composite, and even lighting. Ergonomic programs
have had long lasting effects with 85% of the employees two years following intervention. This was indicated through injury free reports.4

Another component of an effective program that has many areas encompassing it is a back school. The original back school was created in 1969 in Sweden.25 It contained information on anatomy of the back, biomechanics, optimal posture, ergonomics, and back exercises.25 Today back schools are more evolved but the objective remains the same.25 One article stated the contents of the back school included instruction, therapeutic exercise including body mechanics and posture stabilization, functional training in self-care and home management, functional training in work, community and leisure.26

Individuals who went through the back schools were found to have improvement in functional status, quicker return to work, reduction of reoccurrence, and decreased severity of new low back pain.25,26 Implementation of the back schools in the occupational setting was shown to increase the effectiveness of the program.25

As stated above, back schools encompass most aspects of injury prevention. This next section will breakdown the parts of a back school and will look at the supportive evidence.

Education increases overall knowledge.27 This knowledge has been shown, specifically through posture, that it can be translated to proper posture. After the education, one study showed fifty percent of the participants had increased proper posture.27

The functional part of the job such as decreasing demands of work, eliminating ergonomic stressors, and a daily stretching programs are shown to be effective in the
reduction of injury.\textsuperscript{28} More specifically the above intervention reduced the total number of OSHA recordable injuries, reduced the overall incident rate, and assisted in reducing turnover.\textsuperscript{28} The creation of objective functional job descriptions and minimum strength criteria assisted in the above reductions.\textsuperscript{28}

The above components of an injury prevention program can not be conducted without research and prevention activities. When research and prevention is conducted in industries with high demands for manual handling and repetitive work, there should be a reduction of work related disorders.\textsuperscript{16}

There is a lack of research on injury prevention programs even though preventative measures have been taking place for 3500 years.\textsuperscript{29} As one article stated, there are too many preventable injuries occurring.\textsuperscript{29} Catastrophic events produce a high tide of concern in both the public and government.\textsuperscript{29} This concern creates legislation and regulations.\textsuperscript{29} Such legislation is represented through the beginning MSHA (Mine Safety and Health Act) which was created after catastrophic incident over ten years when there was an average of 2000 deaths in mining each year. In 1910 congress created the Bureau of Mines to research accidents in the industry. Many legislative acts have occurred since then developing the MSHA that we know today.\textsuperscript{30}

Now let's look at the ergonomic policy at the company. The corporation believes that communication is the key to fitting the job to the person and will stress employee-supervisor communication as a factor of the success of the program. Breaking the program into sections one comes up with employee knowledge, employee responsibility, administrative controls, and good work practices.
The rural manufacturing company mentioned earlier in this literature review expects the employee to understand (1) cumulative trauma and repetitive motion injuries, (2) proper body mechanics, posture, manual lifting techniques, tool design, and work station design, (3) work related stress, and (4) early symptoms of ergonomic related injuries with emphasis on reporting symptoms to supervisor.7

This manufacturing company’s employees are responsible to conduct an on-going ergonomic evaluation. The following concerns should be communicated immediately with their supervisor; existing hazards and conditions, operations that could create hazards, and areas where potential hazards may develop.7

Administrative controls include immediate notification of any ergonomic concerns, a maintenance program monitoring mechanical equipment and tools, employee training, reduction of number of repetitions performed within any given hour, short rest periods to relieve fatigue, and providing job rotation. Due to engineering expertise of the corporation, they can design ergonomic aides and eliminate risk factors.7

This rural manufacturing company encourages good work practices through proper work techniques. These practices are (1) proper lifting, correct use of tools, and knowledge to modify or adjust workstations, (2) employee conditioning whereby an employee works at a slower pace to become accustomed to the job, (3) consideration of the skill and pace when fitting the job to the person, and (4) inspection of safe operating procedure exam to assure employees have been tested and are following special safety instructions.7 Now as one goes through the elements of evidence-based programs one will see similarities to what the corporation emphasizes and the components supported through research.
The literature provides lists of what should be in an ergonomic or injury prevention program. NIOSH has a toolbox that has elements of ergonomic programs. This toolbox can be broken into components such as education and job modification.\textsuperscript{31} The following are some of the elements that could be addressed through education: avoid long periods of static loads, fixed work postures, leaning off center, fully extended positions, and tilting head forward more than fifteen degrees; avoid jerky arm motions and maintain neutral wrist posture.\textsuperscript{31} Other elements of education include: finger pinch grip is five times more stressful than power grip and replace pulling with pushing whenever possible for moving objects.\textsuperscript{31} Education is a key component to all elements of an ergonomic program whether it is job modification or intervention.\textsuperscript{31}

Job modification is another component that is represented in this toolbox. Materials should be in front of the worker to reduce twisting.\textsuperscript{31} The employee should only have to reach fifteen inches when working.\textsuperscript{31} The surface level of the work station should be changeable in height so that fine skills can be slightly above elbow level and skills that require power can be performed at a level slightly lower than the elbow.\textsuperscript{31} Material handling is also an emphasis in this section. Some of the elements include changing the shape of the load to allow closer proximity to the body when lifting, increase the weight of the load so that it must be handled mechanically, and avoid reaching above shoulder height, below waist level, or any twisting.\textsuperscript{31}

In manufacturing, repetition is inevitable, so the following are some elements that address repetition. Avoid repetitive work with arms in full extension, avoid repetitive trigger-finger action, reduce grip force, use power tools with limited vibration, use mats
or padded surfaces, have properly designed chairs, and allow workers to alternate between sitting and standing.\textsuperscript{31}

Injury prevention is not just the act of finding the risk factor and compiling knowledge on how to address it, but one must take into account awareness and attitudes.\textsuperscript{1} One article found that changing individual practices without changing the context of the work culture can be problematic.\textsuperscript{1} Management involvement, union involvement, skilled program leader (physical therapists are qualified to be this leader\textsuperscript{32}), research involvement, drive for productivity, organizational culture, economic climate, nature of work and nature of work-related musculoskeletal disorders all affect the implementation of the program.\textsuperscript{1,32} An effective way of addressing these problems is a program that includes comprehensive education and training orientation of staff.\textsuperscript{1} Some of the things that this orientation may include is workstation design, social support, upper management support, and education on injury risk factors.\textsuperscript{1,32}

Not only do employees need to be educated on injury prevention, they also must be instructed on the policy and procedure or simply stated the importance of reporting hazards to themselves and others to the supervisor.\textsuperscript{32} This communication is related to the importance of upper management involvement which in multiple articles is an important element of a program.\textsuperscript{1,32,33}

As already viewed, there is a wide array of what elements should be in a program. There are some simple but intricate solutions. The next article has taken the elements of the program and put it into a pseudo-mathematical form. Their emphasis is on grassroot ergonomics, fighting the problem where it starts.
Grassroots ergonomics (GE) equals participatory ergonomics (PE) plus exposure assessment (EA) plus creation of training (CT).\textsuperscript{33} Participatory ergonomics is the portion of the program that involves the employees. It is believed that the employees know more about their work than anyone else.\textsuperscript{33} Not only does participatory ergonomics address ergonomics it also focuses on psychosocial risk factors.\textsuperscript{33} Exposure assessment is what the workers are exposed to in their environment.\textsuperscript{33} The article recommends a checklist that would include posture, force, and repetition demands as the evaluation.\textsuperscript{33} The last part of the equation in grassroots ergonomics is creation of training. CT must be flexible and dynamic as well as have an input from the employees. Creation of training may also be considered intervention and this intervention should focus on injury prevention to reduce musculoskeletal disorders.\textsuperscript{33}

The grassroot ergonomics also addresses factors that affect the longevity of the program.\textsuperscript{33} The success depends upon management commitment, employee involvement, identification of problematic jobs, development of solutions for problems, training and education for employees, and appropriate medical management.\textsuperscript{33}

**EVIDENCE BASED INTERVENTION**

As described previously, education and proper training are important components to an injury prevention program which involve the implementation of interventions. The next section will discuss evidence-based interventions such as exercises and proper techniques. Exercises and proper techniques will cover the following areas: general exercise and physical activity, posture, upper extremity, spine, core strengthening, back extension principles, lifting and psychosocial.
There is evidence that physical conditioning programs are effective in the treatment and prevention of low back pain. In regard to the treatment aspect, a systematic review concluded evidence that a physical conditioning program that include a cognitive-behavioral approach plus intensive physical training (specific to the job or not) that are given and supervised by a physiotherapist or multidisciplinary team are effective in reducing the number of sick days of worker with chronic back pain when compared with usual care.\textsuperscript{34} Components include aerobic capacity, muscle strength, endurance and coordination that are in some way work-related.\textsuperscript{34} In regards to the prevention aspect, one study contained evidence that exercise activity had a moderate inverse association with back symptoms. The effects persisted when data on smoking, body mass index and stress symptoms were added.\textsuperscript{35} Another study related to the positive affects of physical activity implied that the activities do not need to be specific in order to reduce low back pain.\textsuperscript{36} In fact, participation in recreational activities were shown to reduce low back pain, related disability and psychological distress.\textsuperscript{36}

Posture is an important component to address at work and with all daily activities because the body is in many postures throughout the day; some prolonged and some awkward. A study was done, looking at poor posture and the proprioceptive effects that it has on posture correction in the lumbar spine.\textsuperscript{37} Both groups were educated on postures and were instructed to maintain slouched sitting posture. Group one for three seconds and group two for five minutes. For group two there was a significant decrease in the ability to find correct sitting posture. These findings support that postural education and the practice of proper posture will reduce proprioceptive loss and potential injury.\textsuperscript{37} Sitting
constantly at end range flexion can be a culprit in low back pain putting the structures at risk for injury or putting increased stress on the structures of the low back. 

Correct posture is the position in which minimum stress is applied to each joint. Proper postural alignment in standing is defined as a straight-line that passes through the ear lobe, bodies of the cervical vertebrae, tip of the shoulder, midway through the thorax, through the bodies of the lumbar vertebrae, slightly posterior to the hip joint, slightly anterior to the axis of the knee joint, and just anterior of the lateral malleolus. 

Proper postural alignment in sitting is reflected by back, hips, knees, ankles, and elbows at ninety degrees, with wrists in neutral. Feet should also be positioned flat on the floor or on a footstool. The workstation set up is also important to proper posture. The computer screen should have a distance of eighteen inches away from the user. The elements of a correct workstation are discussed in the elements of an ergonomic program section. Refer to that section for more information.

Posture affects all joints. One typically thinks of it related to the back but posture also affects the upper extremity. One study found when the body is in correct sitting posture there is a significant increase in shoulder range of motion with a mean increase of 17.67 degrees from slouched to erect posture. Muscle balance is also a factor. It is believed that prolonged slouched posture (forward head and shoulders) causes the elongated muscles (posterior scapula stabilizers) to become weaker and the shortened (pectoralis) to become stronger. If there are deficiencies in shoulder structures such as scapular position, scapulohumeral rhythm, and improper muscle balance this may lead to instability or impingement. It is believed that shoulder impingement is the primary mechanism of occupationally related shoulder pain. This is why work exercises
and/or a home exercise program (HEP) is an important component to an injury prevention program.

The following is a list used in a home exercise program that was shown to reduce symptoms and improve self reported functional status of the upper extremities.23

- Corner stretch for pectoralis muscle group23,39

[Diagram of corner stretch]

- Stretch for the posterior shoulder23

[Diagram of posterior shoulder stretch]
- Trap relaxation exercise doing arm elevation with mirror without shrugging shoulder

- Progressive resistive serratus anterior ceiling punches

- External rotation with theraband
The above exercises were used in a study and given in oral, written, and pictorial instructions. They were to be done for eight weeks. The exercises routine was progressive in duration as the first week was three sets of ten each day, the second week was three sets of fifteen, weeks three through six were three sets of twenty, and the rest of the weeks were intensified by increase in resistance. This program was effective in reducing symptoms and improving self reported functional status.

The serratus anterior, upper trapezius activity, and rotator cuff muscles are all critical muscles that are addressed through the program. The upper trapezius is involved with forward elevation of the arm. The exercise to target this muscle is to stand in front of a mirror to keep the shoulder depressed. The motor learning required to perform the above activity educates the trapezius which allows the shoulder to be depressed during the motion.

In addition to the above exercises, more can be added. Another study looked at exercises to address deficiencies in posture and muscle balances in shoulder structures that may lead to instability or impingement. All exercises were used with theraband. They included: scapular retraction, wall stretch, shoulder external rotation, shoulder shrugs, and shoulder abduction. The program lasted six weeks and was performed three times per week. The exercises promoted scapular stability, an increase in glenohumeral motion during humeral elevation, and a more upright posture of the thoracic spine. The following are the exercises used in the study mentioned above.
As physical therapists, we trust in strengthening and stretching, but what do medical doctors trust? Ninety percent believe in movement exercise and only sixty percent believed in stretching. Interesting percentages indicate that seventy percent trusted in ultrasound to treat pain, but systemic reviews conclude that ultrasound is not
effective.\textsuperscript{40} The evidence shows that exercise is beneficial in that the extracellular matrix of both tendons and muscles react in a dynamic manner.\textsuperscript{41} This in turn, increases collagen synthesis.\textsuperscript{41}

It is believed in physical therapy that distal mobility is a direct reflection of proximal stability. This proximal stability is currently referred to as “core stability” and is comprised of the spine and thorax as well as the muscles and structures that attach in these areas.

Trunk strengthening focuses on “the core” containing the paraspinal and abdominal muscle groups.\textsuperscript{42} The literature on core strengthening shows that strengthening of the core in low back cases reduces pain.\textsuperscript{43} Literature also shows the effectiveness of trunk strengthening in combination with education and motivation improved subject’s pain and functional level compared to no exercise.\textsuperscript{44}

The following are some of the exercises that were included in literature. This is not an exhausted list as core strengthening is only limited by imagination as long as a destabilization component is involved.\textsuperscript{45}

-Prone hip extension \textsuperscript{42}

-Bridging \textsuperscript{42}
- Sitting alternating shoulder flexion

- Standing alternating shoulder flexion

The above program exercises were performed at fifty percent of maximal voluntary contraction (MVC) and were found to be effective in activating both abdominals and paraspinal muscles. Even though the above exercises seem to be simple, simple exercises can lead to long-term improvements for back pain.

The following is a list of core muscle exercises that are supported through literature.

- Curl-up
-Side bridge 

-Bird dog exercise

-Bridging on a ball

(No Picture available)

Such graded activities can be moderately effective for subacute low back pain in occupational areas. Studies have shown that exercise is at least as effective as other types of conservative therapy when looking at chronic low back pain.

The above program is for strengthening the muscles. McKenzie mechanical diagnosis and treatment looks at the mechanics of the spine. McKenzie therapy is based upon the movement of the disc. If people are in flexion the majority of the time the disc tends to migrate posterior. Back extensions will aid in pushing the nucleus propulsus anterior and bringing homeostasis to the disc. McKenzie treatment is shown to be more effective than other methods of treatment including medication, educational booklet, strength training, and spinal mobilization. The following is an illustration of a proper back extension.
If injury prevention programs are put into place at the work place. Not only do the above interventions have to fit into the work culture, the program also has to be feasible. If there are no economic benefits of a program, what is the motivation for employers to implement them?

Injury prevention programs in manufacturing have shown an incidence rate reduction of 40\%\(^5\).\(^0\) Putting this reduction of injury into monetary gain to show the economic impact reveals a saving of almost nine billion dollars nationally.\(^5\).\(^0\) This is a very significant amount of money that now leads the literature review into the cost effectiveness of injury prevention.

**COST EFFECTIVENESS OF INJURY PREVENTION PROGRAMS**

Cost effectiveness of programs can be looked at in different ways. Through this next section cost effectiveness will be demonstrated in ratios and dollar figures. It is important to know that there is a range of years when these figures were found. They range from 1997 to 2005. Inflation has changed the value of the dollar so one must take that into account.

What is the criteria for cost effectiveness of training? The World Health Organization states that any intervention that has a cost to benefit ratio of one to three is worthwhile.\(^5\)\(^1\) Prevention and early interventions are more cost-effective when applied to a specific population that is at a higher risk for injury.\(^5\)\(^2\) The problem is that there are not enough outcome studies of workplace musculoskeletal disorder prevention programs.\(^5\)\(^2\) Most of the following results are case reports and represent what literature is available.
As a disclaimer one needs to look at the research in the implementation of a program and the trends that follow the implementation. Beginning a program may result in higher incidence rates but it will decrease total lost workdays, lost time incidence rate, lost time day severity rate and work's comp costs while increasing production and corporate profits.  

A four-year study was done on an aircraft manufacturing company to view the effects of an implemented extensive MSD intervention program. From pre-program period to the end of the four-year program, lost time decreased 71%. This program was effective, but now the question remains, what is the cost of such a program?

This particular program cost just over $76,000 dollars per year. In the first year, the cost benefit ratio was 1:6, the second year 1:9, the third year 1:25, and the fourth year 1:26. The average of the four years was 1:16.5. Adding to the significance of the numbers is the fact that they only accounted for direct costs. These direct cost savings accounted for five million dollars in the four years. That is a savings of 1.25 million dollars a year.

Another article that was reviewed did not show as large of numbers, in that, for every dollar spent on general health prevention, $3.40 was saved. Cost effectiveness can be increased when applied to specific segments of the population that are at increased risk of developing the disease of interest and when a program includes individual screenings at work.
CONCLUSION

This literature review has shown that the prevalence of work-related injury is significant and most of the injuries can be prevented. We have gone through an extensive discussion on the risk factors of general and specific injuries. The most prevalent of risk factors were repetitive motions, posture, lifting, and force of movement. Our research found that most risk factors can be addressed through the elements of the programs that were researched and had supportive evidence. The elements of the program were education, ergonomics and exercise. The economics of injury prevention programs were also visited and reflected that injury costs are large and increasing which makes the cost-benefit ratio in the employers favor. The prevalence and cost of injury have motivated us to complete this project. Utilization of education and ergonomic assessments will be used to address the risk factors. This literature review is reflected in the presentations, metrics, and exercises programs that were designed in this scholarly project. The use of evidence based material from this literature review was the backbone of the end product given to the manufacturing company directly involved.
CHAPTER II
METHODOLOGY

Research revealed a lack of literature in industrial injury prevention programs. For this reason and because of professional and personal contacts it was decided to design an injury prevention program for a rural North Dakota company. Initially a review of the literature was performed. The researchers discovered the seven most common non-traumatic injuries included injury to the back, neck, and upper extremity, as well as sciatica, rotator cuff syndrome, epicondylitis, and carpal tunnel syndrome. Some risk factors for possible on the job injuries included overexertion and repetitive motions. Overexertion activities include: lifting, pushing or pulling, and holding, carrying, or turning objects. Various resources also correlated some of the above injuries to awkward postures and/or muscle imbalances. These findings provided the foundation for the development of the program.

The university advisor contacted a Director of Physical Therapy Services in a rural community about the possibility of working with a local company on an injury prevention program. This director was chosen due to the good rapport between the clinic and the University of North Dakota Physical Therapy Department and its students. A referral was made to a local manufacturing corporation’s Safety Specialist. Another therapist, who works with the contact supervisor and specializes in manual therapy, became the on-sight advisor. This therapist reviewed and approved the proposal.
Once contacted, the Safety Specialist of the corporation expressed interest in the program design. He presented the proposal to the Board of Directors where it was also approved. An initial visit to the company, two weeks later, consisted of discussing the corporation’s goals for the program, injury statistics and prevalence, return to work possibilities, and the company’s current injury prevention agenda with the Safety Specialist. The existing program consists of a four-hour introduction to proper ergonomics for all veteran and new employees. All of the employees have access to a sheet of paper with numerous exercises on them. The researchers’ intentions were to customize the exercise selection by providing six to eight exercises along with instructions for proper technique (See Appendix A and B).

Observation of the employees working in their different job environments was accomplished during the first meeting. Different staff members voiced some of their concerns about the job they were working at. Observations of the strengths and possible areas of improvement in their present program were made. This gave the researchers direction to aid in the enhancement of their current injury prevention program.

Ten weeks later another conference was held to promote the program to 10-15 members of upper management in the business. The planned contents of the two lectures were discussed. Management personnel then guided the researchers to the main problem areas on the floor and within the office setting. Administration also gave suggestions as to what could be added or changed in the different components.

An agreement was made with the corporation to include the following components in the seminars: work injury presentations based on anatomy and proper body ergonomics (See Appendices C and D); DVD produced by the study group on
lifting and proper body mechanics (See sleeve on back cover); exercise programs for both job types that could be performed on the job; and a workplace assessment offered to the office employees (See Appendix E). The office exercise activities were developed based on a template given by another rural North Dakota physical therapy clinic. At the conclusion of the meeting, a date was arranged in which presentations would take place. The following two months were spent modifying and finishing the lecture portion of the project.

An assessment was put together to screen lifting techniques and standing posture both before and after the production presentation (See Appendix F). An office assessment was also developed based on a template provided by the study group’s advisor at the University of North Dakota Physical Therapy Department.

A one page seminar evaluation form was given to the employees to fill out at the end of the presentations (See Appendix G). At the top, the employee needed to indicate which class they attended. The ratings for the questions went from one to five. One was given if the individual strongly disagreed and a five was awarded if the person strongly agreed with the question. Each presenter was assessed by asking whether the individual was knowledgeable with the subject and if the content was easy to understand with the terminology and examples used. The total lecture content was then looked at by the employees. The questions included the conciseness and organization of the lecture; whether the main points were highlighted in the handouts; if the PowerPoint displayed the objectives effectively; and if the information was useful. A space was also given for any additional comments.
Presentations were given during a single day with the company. The on-site advisor was able to attend the morning sessions. The researchers were divided into teams of two. One team gave the presentation to the production workers. This team presented three times throughout the day. The lecture focused on basic anatomy and biomechanics, proper posture, correct lifting and push/pull techniques, exercises, and postures to be aware of while at work and home. Basic lifting, push/pull techniques, correct posture, and exercises were demonstrated to the employees. The employees had the opportunity to practice the techniques covered in the lecture.

A generalized pre and post lecture assessment of posture and lifting was administered. This consisted of observing the individuals standing sideways against a grid to analyze the difference in posture. The lifting station consisted of each employee lifting a box off a table, turning 180 degrees, setting the box on the floor and then placing the container back on the table. The same assessor observed employees at the lifting station in all three production groups to make the results and comments were consistent from one employee to the next. After the individual demonstrated the lift post lecture, the assessor helped the person correct any problem areas they observed during the lift. Any changes that could be made were indicated to the worker by the assessor. The modified lift was shown to accommodate the individual who experienced conditions that affected proper technique.

The other researchers presented to the office workers. This lecture was given to two sets of office individuals throughout the day. The lecture goals consisted of basic anatomy and biomechanics, correct posture, proper lifting, and an exercise program that can be applied in the home and at work. The exercise and lifting techniques were
demonstrated to the employees as well. Employees were given the opportunity to demonstrate the techniques covered in the lecture. In between lectures, individual office environments were assessed. Employees had an opportunity to discuss their office set-up and any unanswered questions, which were not addressed during the seminar. The workers were given recommendations which were noted and given to the Safety Specialist. Any of these changes will be made at the discretion of the Safety Specialist with possible consultation from the local on-site physical therapist advisor.

This project or injury prevention program was set up so the follow-ups with a qualified physical therapist can easily be accomplished with this company. The scope of this work injury prevention project was to develop interactive, educational lectures and activities built on evidence-based literature. Further consultation services may be provided by the professionals within the local physical therapy clinic.
CHAPTER III

RESULTS

The office assessment and production screen provided the researchers with summary of objective and performance measures. This gave the researchers a general assessment of the body mechanic and workstation set-up awareness displayed by the staff. There were a total of 107 employees who came to the lectures. Seventy-one individuals attended the production lectures, while 36 workers were at the office presentations.

Screening the production employees before and after the production lecture, provided the group with more objective measures to analyze any performance changes which were made. A grid was used with a dark line at a specific height to assist in the posture observations. This mark provided a type of standardization for any height changes pre and post presentation. Sixty-four workers were assessed and notes were taken of any changes in posture before and after. Forty-two persons increased their baseline height by correcting one or a combination of the following: thirty-three demonstrated a decrease forward head, twenty-two brought their shoulders back, and twenty-four adjusted pelvic tilts into a more neutral position. Seventeen corporate members didn’t have any change in their posture. Out of this population only four had correct posture before and after the assessment. One individual displayed a greater degree of rounded shoulders.

38
Prior to the lecture, five of the sixty-four workers assessed had a slight bend in their knees and nine kept their knees straight during the lift. Thirty individuals brought the box slightly closer and fourteen didn’t bring the box close enough to their bodies to properly lift the box pre lecture. The entire researched population displayed a less than ideal curve in their backs prior to the speech: twelve had a slight curve and fifty-two had no curve. Six people displayed a proper base of support to lift the container during the pre-screen. Fifty-four persons did not twist their backs when assessed prior to the lecture.

Post screen showed some significant changes compared to the pre screen. Each worker demonstrated ideal knee bending during the post screen. Fifty-six individuals brought the box close enough after the presentation to lift it properly. Fifteen of the populace corrected their curve enough for it to be considered ideal. After the seminar, forty corporate members demonstrated a proper base of support. Only one person displayed twisting during the post-screen lifting activity. All others moved their feet and didn’t display any twisting when they raised the box, turned, and lowered the container.

Out of the sixty-nine employees that attended the lecture, five were not able to completely finish the screens due to other job commitments. These subjects either came to the lecture late or left the seminar before it was over.

Onsite evaluations of the workstations were offered following the office ergonomic lectures. A total of twelve offices were evaluated. Some of the common problems that were easily fixed during the assessment included: eight monitor and keyboard height changes; three chair adjustments; and two employees had to adjust their mouse placements, i.e., moving it closer to the individual. Minor adjustments were made to only a couple workstations, i.e., calculator and phone positions on the desk.
Recommendations were made for different equipment or equipment modification. Some of the equipment recommended included: five under desk trays for the keyboard and mouse; four ball track mouse and foot rests; three adjustable chairs; and two headsets for phone use. There were a considerable number of individuals that discussed their non-reported aches and pains they experience throughout their work day. This included upper back pain, headaches, and periodic numbness and tingling experienced in their hands during their typical day. Observation was made that half of these individuals had forward heads while at their desks. The recommendations for equipment were given to the corporation’s Safety Specialist. The company will be responsible to make the changes.
CHAPTER IV
DISCUSSION

This project went outside of the university and into society. The main objective was to initiate or amend a current injury prevention program within a manufacturing company. The researchers applied their knowledge of the prevention of injury through proper ergonomics and body mechanics to the manufacturing community, particularly to a production company with 160 employees. This opportunity was influenced by the knowledge that the corporation had of the University of North Dakota’s (UND) Physical Therapy program, as well as the corporation’s pro-active need for a research based prevention program.

The University of North Dakota’s Department of Physical Therapy has a good rapport with the outpatient clinic involved in helping the researchers set up the meeting with the corporation. This clinic’s director had presented a consultation on proper body mechanics to the company prior to this plan, which initiated management’s further interest in ergonomic programs. These relationships facilitated a meeting with the Safety Specialist at the rural business.

Cooperation of upper management is essential to the immediate and future success of a program. The support works its way down the corporate ladder. After members of administration accepted our proposal, a cascade effect took place within the company, which went from the board of directors all the way to the employees in the...
production line and in the office. The Safety Specialist and middle managers readily shared areas of concerns, and ideas. They then provided the researchers with access to the manufacturing floor, workstations, and employees. Overall, the populace in the seminars displayed interest and improvement in the execution of requested techniques during the activities and assessments.

The vast majority of the project is backed by current literature. The presentation involving the office employees provided them with baseline knowledge of the basic anatomy of the spine, shoulder, elbow, and wrist. Anatomy and biomechanics were explained first which allowed for the listener to better understand the topics thereafter. The researchers explained that strains and muscle length imbalances may be caused by incorrect or awkward postures, and that sitting at end range flexion may induce low back pain as well. This information gave increased power in getting the employees attention with evidence-based, appropriate sitting positions that can prevent some of these issues. The employees were encouraged to work on achieving correct posture throughout the day, but it is unrealistic to maintain this alignment the entire workday. It is also imperative to change postures throughout the day to allow for increased nutrient flow to the static musculoskeletal areas. It is not realistic to maintain correct alignment the entire work day, but an individual should strive to maintain it the majority of the day.

The study group agreed that keeping the lectures active for the employees was an excellent way to provide hands on, real life learning. The employees demonstrated the exercises as well as the lifts, which allowed them to ask any questions about the proper execution of the activities at hand. The demonstrations were supervised to make sure
they did the activities safely and correctly before they performed it outside of the lecture. Feedback from the subjects indicated that they enjoyed and found the activities helpful.

Performing the lifts correctly is important for all the company’s employees, but it is vital for the production workers. Most of the company’s injuries are experienced in the production aspect of the corporation. Even though this company has had a significant decrease in employee reportable injuries in the last year, the administration felt that research-based injury prevention methods would further decrease the cumulative trauma disorders. The musculoskeletal injuries usually reported were sprains and strains, and they typically occurred with employees during their first two years of employment. If lifting is done incorrectly, it increases an individual’s risk of these injuries significantly. The injury sites may include but are not limited to the back and shoulder. The presenters emphasized that injury could not only occur on the job but in the home environment as well. The workers also needed to focus on their body mechanics while doing not only their daily job schedule but their at home routines as well. This was addressed through work/home exercise program.

The exercises provided focus on problem areas within the musculoskeletal system of the office employees and production workers. The goal was to provide them with options of activities they could do during their two to three minute breaks throughout the day. The exercises promoted increase blood flow to the inactive joints help maintain the joints’ health, and potentially improve muscle balance.

Prior to the production seminar some of areas of concern noted in the posture screen results included forward head, rounded shoulders, and posterior tilted pelvis. Post production lecture, significant changes and improvements were made in posture as well
as lifting mechanics. Many individuals decreased forward head posture and brought their shoulders back. Various subjects brought their pelvises into more neutral positions.

The lifting station gave a measure of any conscious changes made by the employees during the lifting process. This arrangement provided a measurement of proper knee bending, but it did not give an adequate assessment of possible issues with twisting the spine vs. moving the feet. Another screening area which would have had the individual place a box from one table onto another would have given us a better evaluation of improper twisting of the spine during a lift. However, the latter station would not have assessed knee bending as well as the initial station did. The results provided some of the feedback needed on the effectiveness the presentation by demonstrating the employee’s willingness to apply the techniques.

The screening provided an objective measure of the individuals’ performances based on the materials given in the lecture and not what they retained. Based on the screening results, this was an excellent starting point for assisting in making the employee more conscientious about his/her body mechanics. The screen and lecture aided in making the employee more aware of their individual areas that have the potential for improvement. It would be beneficial for the staff to set personal goals and take the action to change their less than ideal postural and/or lifting habits.

When the office assessments were made, a significant portion these workers had a forward head posture as well as rounded shoulders. Some of them also expressed concern about headaches and back pain. This displayed the need for some of the recommended adjustments in the workstations, as well as the importance of performing the exercises given during the lecture. The lecturers emphasized the importance of the
chin tucks, scapular retractions\textsuperscript{39}, and performing the 20/20/20 activity. Employees found the lecture beneficial, per evaluations, and their application of the material has the potential to lead to improved body mechanics, decreased pain, and injury.

Retaining an action occurs through practice and multiple repetitions.\textsuperscript{53} If these activities are not done on a regular conscientious basis, the skills will be lost. The practice of retaining an activity is like a muscle if it is not used consistently, it will atrophy. Follow-up screenings and program modifications, which will continue with the local physical therapy clinic and company Safety Specialist, will promote proper ergonomic actions. Follow-ups and program modifications are the responsibilities of the local physical therapy department. Other ways the company could utilize the physical therapy department include providing post screen offers to the employees. The ongoing consultation process will increase the probability of success. Theoretically, this has potential to continue to influence a decrease in the incidence of injury.

The project has given this rural manufacturing company a starting point for an ergonomic and prevention program. The addition of the DVD makes their current program more efficient and provides a source of current evidence-based body mechanics. The DVD supplies the current and future employees with a visual perception of correct posture and proper technique and also detailed voiced instructions of the various types of lifts and postures. The DVD moves slow enough so the kinesthetic individual can demonstrate the postures and lifts along with the instructor on the DVD. Research has shown that injury prevention programs have helped significantly decrease lost time within different companies.\textsuperscript{52}
Employees were provided with seminar evaluation forms to fill out after the lecture. The evaluations were later turned in to the Safety Specialist. He then mailed them to the researchers. Forty-five of the 51 employees who responded agreed or strongly agreed throughout the evaluation. Six of the evaluations received lower rankings. Some of these individuals indicated that they did not think that the points given in the lecture helped them with their specific job area. Another reason may be due to a misunderstanding of the rating system, which led them to rate one as strongly agree and a five as strongly disagree. Since the researchers were introduced as students, this may have also influenced the way some of the individuals rated the evaluations.

More feedback was given on the office seminar vs. the production lecture. This may have been due to the nature of the different work areas. Office workers tend to have more work that involves writing. Their workstation is also more conducive than the production work areas for writing tasks. Even though our project was activity based, some of the workers felt that even more demonstrations and less anatomy would have been more beneficial. On the other hand, notes were given on their appreciation for the seminar. Some office workers indicated that they applied what they learned right away to their workstations. Others stated how the seminar helped them find correct posture.

There were various strengths to this project. The local physical therapist and the clinic gave the project support when needed. This connection offered the company future support once the project was complete. The time and energy that the researchers have put into this project is a definite asset. The entirety of the program took approximately seven months to complete. Although the researchers were students, each them had at least six and a half years of college education, two and a half of those years include course work
in the physical therapy curriculum. The consultation with a faculty member, who has experience in this area, gave us guidance with in the visions of the finalized product.

This project included some limitations. The first one noted was the need for more standardization during the posture and lifting screenings. Some of the employees wore multiple layers or baggy clothing, which made it difficult to assess the posture or lifting positions. Having the employees change their clothing may not be conducive to their work environment, but it would have made our analysis more accurate.

Of the seven months it took to complete the project, one month was spent designing it. The time with the company added up to be approximately six months. This included meeting times with the company’s Safety Specialist and management, as well as, development of the project. The group was only able to schedule one day with the employees at the company. This day was focused on giving the presentations, screenings, and ergonomic assessments for the office workers. During that time, we were not able to get all of the office assessments completed. Some of this was due to the employee not being in his/her office during the scheduled assessment time as well as lack of time to finish them. If there was another day or two allotted for this portion of the project, more than likely the missed assessments would have been completed. At times, the size of room affected the efficiency of the executed presentation. If the groups were smaller or the room larger, the employees may have had more space to perform the activities. The application of the project covered a wide variety of employment positions at the company. More individualized presentations on the various work areas would have also facilitated the employees’ awareness of their individual problem areas, i.e., specific lifting techniques and more efficient workstation set-up.
In conclusion, the project is a start for a clinic or physical therapist to become more involved in this company's injury management program. This gives the opportunity to make a personal relationship and help the company decrease work injuries. This program also provides a baseline for other injury prevention programs in different manufacturing companies. Although, improvements were made initially with both the office workers in their desk set-up and the production with standing posture and lifting techniques, a long term follow-up needs to be done to assess the retention rates among the employees. This program provides a plan of what could to be done initially to produce a successful injury prevention program within a manufacturing company.
Personal Exercise Program

Provided for : Employees at Steffes Corporation
Provided by : Sample User

*These exercises should not cause pain. If any exercise causes pain, discontinue immediately. If you have been previously advised by a medical professional not to do these exercises, please do not do them. The focus of these exercises is to target areas that typically need strengthened or stretched for most individuals and especially individuals in the working environment.

*Activate core with all exercises in this program.

*Every individual is different. Progress as you are able to tolerate. Start progression by increasing repetitions from 8 on up to 15, then later resistance or difficulty.

1. Lie on back with knees bent
2. Place hands behind head
3. Without pulling with your hands, raise head and shoulders, curl trunk upward as shown
4. Hold ___ seconds
5. ___-15__ repetitions, ___-2__ times per day

*For MORE advanced: do on physio-ball with feet on the floor and the ball in the small of your back

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1. Assume hands and knees position
2. Keeping back level, and low abdominals lightened, raise one arm and opposite leg as shown
3. Hold ___ seconds, repeat with opposite arm and leg
4. ___-15__ repetitions, ___-2__ times per day
5. Be sure to keep back LEVEL like you are balancing a stick across it.

*For LESS advanced: do lying on your belly
*For MORE advanced: do lying over a physio-ball. Be sure ball is the right size. Hands and feet should easily touch the ground

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1. Lie on back with legs straight
2. Perform pelvic tilt to flatten back
3. Raise both knees toward chest as shown
4. Slowly straighten one leg, keeping the other knee bent and back flat; heel can touch floor
5. Hold ___ seconds, then slowly bend knee again
6. Repeat with other leg
7. ___-15__ repetitions, ___-2__ times per day

*For MORE advanced: do NOT let heel touch the floor

© The Saunders Group Inc.
1. Stand in a corner about 1-2 feet from wall with hands on wall as shown
2. Lean into corner so that you feel a stretch
3. Vary the stretch by moving arms higher or lower, or by standing farther away from wall
4. Hold _15_ seconds
5. _2-3_ repetitions, _1-2_ times per day

1. Anchor rubber tubing to solid object (door frame, solid object above)
2. Grasp tubing with arm across body as shown
3. Pull arm outward and downward, letting your head follow the full movement. Be sure to keep shoulder blades back through the movement
4. Notice that the hand rotates as the arm movement occurs
5. Hold _2_ seconds and slowly relax
6. _8-15_ repetitions each arm, _1-2_ times per day

1. Grasp rubber tubing in hands as shown
2. Keep elbows tucked in at your side
3. Rotate arms outward, keeping elbows bent
4. Hold _3_ seconds and slowly lower
5. _8-15_ repetitions, _1-2_ times per day

1. Anchor middle of rubber tubing to solid object
2. Hold tubing in both hands, arms straight in front of you as shown
3. Bend elbows and pull elbows straight backward and squeeze shoulder blades together (keep upper arm parallel to floor)
4. Hold _3_ seconds and slowly relax
5. _8-15_ repetitions, _1-2_ times per day
APPENDIX B
NECK RETRACTION
Looking straight ahead, bring your head straight back so that your ears are in line with your shoulders. Do not tip your chin up or down when doing this exercise.

BACKBEND
Place your hands on your hips or the small of your back. Lean back from the waist.

CHEST
Interlace fingers behind head and pull elbows apart, squeezing shoulder blades together.
Do exercises 8-15 times each throughout the day. Do not do any of the activities if a physician has instructed you not to. If you experience any pain, stop and contact your physician.

**ABDOMINAL PRESS**
With shoulders back in chair, press lower back into back of chair. Hold 10 sec.

**WRIST AND FINGERS**
Circle hand clockwise as if following the face of a clock. Then reverse and circle counter-clockwise. Also, open and close fingers.

**LEG SQUAT**
Stand with back to wall and feet 12 inches away. Slide down wall until legs bend slightly, slowly return to standing position.
Objectives

Following this presentation the employee will:

- Be aware of the common types of injuries at Steffes
  - The risk factors
  - Most common Causes
- Have a basic understanding of the anatomy and biomechanics
  - Back
  - Neck
  - Shoulder
  - Through that understand the effects of faulty body mechanics with activity
- Understand that work related musculoskeletal injuries can be PREVENTED!

Ergonomics

- Environment
  - Fitting the workstation to the worker
    - Rearrange
    - Equipment
    - Job rotation
- The Human Factor
  - Equipping the worker for the workstation
    - Education and follow through
      - Posture
      - Techniques
      - Exercises
    - Remember: every individual is different
- (This is applied to work, home and leisure activities)

Introduction to Ergonomics

- What is Ergonomics?
  - The science of fitting the job to the employee, not the employee to the job.
  - Way of thinking about the design of tools, equipment, and environment.
    - Safe and efficient work
- Two Components

What is “Empowerment”

- It is the process of equipping yourself with the ability and knowledge to act!
- Knowledge is powerful!
- But, it is useless if you don't apply it

Introduction to Ergonomics

- Why should ergonomics be of interest to you?
  - In 2004 (OSHA), ND had 4445 injuries
    - Out of a work force of 318,000
    - Rate of injury: 1.66
  - You (moderately sized manufacturing companies) are 6 to 7 times more likely to sustain a work related injury
Steffes Current Ergonomic Policy

- What is Steffes doing about this?
  - Kent Mortenson (Full-time safety manager)
  - Has worked to decrease the incidence of injury here at Steffes
  - Done so by implementing:
    - New Employee training, gloves and eye wear, etc
    - The number of OSHA recordable claims have decreased by 53% since 2005.

Injuries at Steffes

- Previous years medical cases compared to 2006 YTD. Goal was to reduce by 10%. We're on pace to reduce by 53%.

So why are us students here?

- When looking through the injury records at Steffes from 2001-2006
  - We found that 29% of the total injuries were musculoskeletal injuries.
  - 22% result of sprains and strains
  - Doesnt seem like a large number, does it?
  - In fact, it is when these types of injuries can be PREVENTED!
  - And that is why we are here.

YOU ARE THE FIRST LINE OF DEFENSE!

Work-Related Injury and Steffes

- The 4 most common work-related injuries at Steffes
  - Lacerations
  - Bruises
  - Objects in the eye
  - Sprains and Strain (WRMSD's)
    - Back-936%
    - Neck
    - Shoulder
    - Combined with neck-936%

Work Related Injury Risk Factors

- AGE
  - Older more at risk
- Gender
  - Females more at risk
- Job Demands
  - Prolonged posture
  - Lifting
  - Repetition
- Work Experience

Injuries and Work Experience

- Chart showing injuries and work experience from 2003 to 2006.
3 Main Causes of Injury

- Awkward Posture
  - Include prolonged:
    - Bending, twisting, overhead activities.
    - Weight bearing duties
  - Can lead to:
    - Joint instability
    - Muscle imbalances
    - Abnormal joint wearing

- Repetition
  - Over uses specific muscles
  - Severity of risk depends on:
    - Posture of movement
    - Speed of movement
    - Number of muscles required
  - Leads to:
    - Muscle imbalances
    - Decreased flexibility
    - Diminished posture awareness

- Lifting
  - The severity of risk depends on:
    - Type of grip
    - Body posture
    - The weight of the objects
    - Type of activity and duration
  - Lifting places greater pressure on the spine, shoulders, and neck
  - Technique is very important
    - Lever arms
    - Joint position (elbow exercise)

Specific's. What are the chances of having back pain?

- 8/10 of you will experience back pain sometime in your life
  - Most of these cases will resolve within two weeks
  - Research and prevalence
  - Why? → Symptom vs. Problem

Cost
- Monetary
  - 50 million dollars/year
- Non-monetary
  - Leading causes of missed days at work
  - Diminished quality of life
    - Leisure activities
    - Psychological impact

But wait, there is good news!
The Good News

- Work-related musculoskeletal injuries are curable!
- The best cure is **PREVENTION**!
- Can be done through addressing the 2 components of Ergonomics
  - Work Site and activity Modification
  - Preventative exercises
  - Posture awareness
  - Correct lifting techniques
  - General health and wellness
- Understand that work activities and home activities are similar.

---

Spinal Anatomy

- Functional Segments
  - Vertebra
    - Size
    - Shape
    - S-Curve
    - Function
  - Nerves
  - Muscles/Ligaments
    - Stability and support
  - The Disc

---

Spine and Function

- Different segments allow different movements based on their design (mechanical advantage)
  - Neck region=all movements
  - Low back= Forward Flexion and extension
  - Activities that go against the mechanical advantage is what causes injury
    - Poor/pronounced postures in the neck and back
    - Rotation in the lumbar

---

Spine

- The Disc
  - 23 disc (1 b/w each pair of vertebra)
  - 80% water (important)
- Two Main Functions
  - Clearance for movement
  - Act as a shock absorber
    - Material Impinges on Spinal Nerves
    - "Slipped Disc"

---

So How Might One Prevent Work-Related Cumulative Trauma Injuries?

- Abnormal Movements and their effect on the spine.
  - Changes the dynamic of vertebral movements
  - Compresses the disc
  - Stretches support structures
  - Compresses neural structures
Strategies for Work-Related Injuries

- Addressing the two components of Ergonomics
  - What is good posture?
    - The position where your supporting muscles and ligaments have to work the least
    - At it's greatest Mechanical Advantage.
  - Prevents:
    - Sprains/Strains
    - Muscle Fatigue
    - Abnormal Wear and Tear on Joint Structures

Spine and Posture

- What is required in order to maintain correct posture?
  - Good Muscle Balance
    - Equal strength between postural and functional muscles
  - Flexibility
    - Proper joint motion
  - Body Awareness
    - Neutral Spine

Spine and Movement

- Core activation is the PRECURSOR to any movement!
  - Also important for posture/ control
- What is your core?
  - Weight belt, back, abdomen, pelvic, and postural musculature
- When activated the core...
  - Stabilizes the spine
  - Protects structures
  - Controls technique throughout movement

Spine

- What are the symptoms of poor posture?
  - Fatigue or burning pain
  - Excessively bent knees when standing or walking
  - Full body aches or pains
  - Potbelly
  - Sharp pain into legs and buttocks

Neck and Shoulder

- Neck and Shoulder Injuries account for 3% of all work related injury.
- Common symptoms
  - Burning
  - Aching
  - Pain
  - Loss of Grip Strength
  - Loss of hand sensation
  - Increased Fatigue

Anatomy of the Neck and Shoulder

- Bones
  - Shoulder Blade, Neck, Vertebra
- Muscle and Ligaments
  - Smaller, designed to move the head
  - Visual tracking, balance, functional activities
- Nerves
- The Disc
- Biomechanics
  - Designed for mobility
Anatomy of the Shoulder Girdle

Shoulder Girdle and Neck

- So what happens when your shoulders become rounded?
  - Your body acts as a chain
  - Head moves forward
  - Lower arm
  - Spaces are narrowed
    - Frayed tendons
    - Impingement
    - Pinching of structures
  - Back, hips, and knees are all taken out of alignment

Shoulder Girdle and Neck

- Job tasks that increase the risk of shoulder girdle and neck injury
  - Conveyer Belt Assembly
  - Packaging
  - Carrying load on shoulders
  - Over head activity
  - Punch Press operator
  - Working with arms away from body
- WHY are they grouped together?
  - Poor habitual head postures can lead to shoulder injuries
  - And Vice versa

Shoulder Girdle and Neck

- Same concepts as the spine.
- Most injuries are caused by WMSI's
  - MS's are caused by:
    - Repetition
    - Forward Movement
    - Inward/Poor posture
  - Core Stabilization is a precursor to any movement
    - Low Back and shoulder Blades
Putting it all Together

- You are the 1st line of defense against injury
  - Posture awareness
  - Correct lifting Technique
  - Ask for help
  - Preventive exercises
  - Healthy lifestyle
  - Minimize risk factors

Objectives

- By the end of this presentation, participants should:
  - Have an understanding of body awareness in their working environment
  - Demonstrate proper posture and body mechanics to decrease stress and risk of injury
  - Know how to perform basic work and home exercises that they can do to counteract daily stresses and prevent injury

Body Awareness

- What are the duties of your job and what method do you use to complete the job?
  - How many times do you do the same movement?
  - Is there an object involved and how heavy is it?
  - Are you bending or twisting?
  - How far are you reaching?
  - How long are you standing? Sitting?

Environment

- Economy of motion
  - Use energy and time efficiently
  - Minimize stress on body
  - Example: reaching into box on floor vs. table 100 times

Environment and Repetition

- Keep reaching within 10 inches (25 cm)
- Symmetrical workstation
  - What you do to one side, do to the other
Environment & Standing Work
- Light, fine work
  - Table at elbow level or slightly above elbow
  - For power and downward pressure
  - Table slightly below elbow level
  - Foot rests to unweight back
- Cushioned mats
- Scissor tables

Sitting Posture
- Proper posture
- Improper posture

Poor Standing Posture

Ideal Standing Posture
- Ear, shoulder, hip and knee, and ankle line up
- "S" curve

Wrist Posture
- Neutral
  - Relaxed fist

Avoid These Postures
**Lifting**

Acronym "LIFT"

- **"L"**
  - LEGS
    - Bend knees
  - LOAD
    - Keep load close
  - LIMITS
    - Know your limits, ask when you need help

- **"I"**
  - Initiate
    - Core
    - Curve ("S")

- **"T"**
  - TILT box
  - No TWISTING

- **"F"**
  - Feet
    - Wide
    - Staggered
    - Moving

---

**Lifting Rules**

- "L" legs, load, limit
- "I" initiate core and curve
- "F" feet (staggered, wide and moving)
- "T" tilt and NO twist
- And don't forget to breath
Lifting Techniques

- Disclaimer: If you have been advised by a physician not to do any of the following activities, do not do them. If you have pain with any of these activities, discontinue doing them.

Lifting Techniques

- Floor to Waist
  - "LIFT" principles
  - Look straight ahead

Lifting Techniques

- Overhead
  - "LIFT" principles
  - Keep chin tucked
  - Eye level
  - Look straight ahead

Push Technique

- Preferred over pulling
- Bend knees, use legs
- Power fingers
- Bend elbows initially, keep tucked in
- Movement is a weight shifting; no jerking

Pull Technique

- Bend knees, use legs
- Power fingers
- Initiate core and squeeze shoulder blades together
- Elbows in, straighten after initial pull
- Slow and controlled movement
Exercises: Back
- Change positions
- Take walk breaks
- Back Extensions
  - 5-10 every hour

Exercises: Neck
- Chin tucks (15 every hour)
- Stretches (hold for 15 seconds)

Exercises: Shoulder
- Scapula Retractions
  - 2-3 times per day, 15 repetitions
  - After prolonged postures of rounded shoulders/looking down

Exercise your eyes
- 20/20/20 Rule

Daily Activities
- Poor body mechanics
- Good body mechanics

Daily Activities
- Poor body mechanics
- Good body mechanics
Daily Activities

Empowerment

Empowerment: “To invest with power; being equipped with ability”
- Knowledge is power
- The 3 “A”s
  - Awareness
  - Attitude
  - Action

Sleeping posture

The person should keep your neck straight and your head in a “neutral” position.

Thank you for your time and attention

Any Questions?

References

- See literature review for list of references
APPENDIX D
Getting Started
- Slump over in very poor posture
- Sit-up as tall as you can
- Slump over again
- Sit-up tall again
- Relax 10%
- This position is good posture
- There is no correct posture for the whole day

Steffes Ergonomic Program
- Employee-supervisor communication
  - Immediately report symptoms
  - Communicate concerns
- Education and training is important
  - Cumulative trauma
  - Work related stress
- Short rest periods
- Job rotation

A Quick Return to Work
- Bed rest is not shown in research to decrease injury severity or time
- Job modification/ accommodation

Disclaimer
- If the activity hurts stop and consult a physician
- This seminar does not provide you the knowledge to diagnosis a disease
- Talk to your supervisor with any concerns

Objectives
- Instruct on and reinforce good posture through presentation
- Reinforce Steffes Corporation's ergonomic policy
- Explain cumulative trauma disorder
- Give you the knowledge to understand part two of this series by presenting the anatomy and biomechanics of the:
  - Spine
  - Shoulder Girdle
  - Elbow
  - Wrist
What is CTD and how does it affect you?

Cumulative Trauma Disorders

Why do you need to know anatomy and biomechanics?

- Knowledge is power!
- Understanding your body will allow you to run it properly
- You will be more informed when dealing with healthcare providers

The Spine

- The functional segment
  - Vertebra
  - Spinal cord/nerve
  - Intervertebral Disc
  - Muscles
  - Ligaments

The Spine Movements

- Cervical
  - Rotation
  - Forward/backward bending
  - Side Bending
- Thoracic
  - Limited due to ribs
- Lumbar
  - Forward bending
  - Backward bending

Intervertebral Disc

- Anulus fibrosis
- Nucleus pulposus

Our “Natural Weight Belt”

Activate the transverse abdominals by pulling your belly button to your spine and make a hiss sound.
Pressure in the Disc

Muscles of the shoulder

Elbow

Shoulder Girdle

Shoulder Activity

Wrist

Muscle balance is important for proper function of the body and to reduce injury.

- Raise your arms above head
- Note how far you can go
- Check your posture
- Raise your arms above head
- Can you go farther?

Carpal Tunnel
- Caused from irritated tendons
- There are nine tendons that go through the tunnel
- There is one nerve
- Tunnel composed of bones and a ligament
Objectives
- Name 2 reasons why "good" posture is important
- Successfully accommodate work area with proper ergonomics in the seated position
- Demonstrate proper lifting techniques
- Name 4 exercises/stretches to do on the job

Thoughts to Ponder
- How long do you stay in one position throughout the day?
- How many stand up breaks do you take?
- Do you feel efficient in your daily routine?
  - At work and at home?
- Is exercise a part of your life?

Why Good Posture???
- Injury and long-term pain
  - Shoulder Impingement
  - LBP is the second leading reason why people visit the doctor!
- Decrease risk muscle imbalance
- Strain on ligaments, muscles, and discs
- Optimize body performance with correct alignment
- Confidence Level

Standing Posture
Sitting Posture

Elbows:
- 90 degree angle
- Parallel to spine
- Armrests should take some strain off and keep shoulders relaxed

Wrist Positioning
- Keep in line
- Stretch frequently
- Don't put pressure on palms for prolonged period

Desk Ergonomics
- Head
  - Monitor arms length away
  - In line with shoulder
  - Top of computer at eye level with a downward gaze
  - 20/20/20 Rule

Back
- Chair back should be 90-100 degrees
- Press bottom against back of the chair
- Low back should arch slightly

Avoid These Postures

Figure 1
Desk Ergonomics
- Thighs
  - Parallel with floor
- Knees
  - Fist width between front of chair and back of knee
  - Same level as thighs or a little higher

Desk Ergonomics
- Feet
  - Flat on surface
  - Floor
  - Foot stool
  - No dangling or tippy toes!!

Injury Prevention
- Keep reaching within 10 inches (25 cm)

Other Tips
- Use a paper holder and place close to monitor
- Answer phone with the nondominant hand
- Store heavy books upside-down

Lifting Techniques
- "LIFT"
  - L: Legs—bend knees
  - Load—keep load close
  - Limit—know limits
  - I: Initiate—core and curve
  - F: Feet—wide, staggered, and moving
  - T: Tilt Box
  - No Twisting

Floor to Chest
- Look Straight Ahead
- "LIFT" Principles
Chest to Eye Level/Overhead
- "Lift Principles"
- Eye Level
- Chin Tucked
- Look Straight Ahead

Benefits of Stretching and Exercise
- Nourishes joints, ligaments, and muscles
- Maintains range of motion
- Decreases likelihood of muscle imbalance
- Reduces risk of strain and stress on body structures
- Increases Quality of Life

Possible Consequences of Not Stretching
- Rounded Back -> Stress on vertebrae and discs
- Rounded Shoulders -> Shoulder Impingement
- Neck and Back Pain
- Hip and Leg Pain

Tips
- Exercising
  - 8-10 repetitions
  - 3-4 times a day or whenever your body needs it
- Stretching
  - 3-4 repetitions
  - Hold for 10-30 seconds
  - 2-3 times a day or whenever your body needs it

Neck
- Chin Tucks
- Side bending

Shoulder
- Shoulder Blade Squeezes
  - With or Without Theraband
- Overhead Arm Stretch
- Shoulder Rolling

75
Wrist and Fingers
- Open/Close Fingers
- Prayer Position
- Wrist Rotations

In Conclusion
- Important to change posture throughout the day
- Prevention on the job and at home
- Correct exercises can help prevent injury
- Empowerment
  - Awareness
  - Attitude
  - Action

Back and Legs
- Standing Back Extensions
- Abdominal Contractions
- Toe Raises
- Walk Around
- Change Posture

Thank You!
Questions/Comments???
APPENDIX E
Name: __________________________ Date: ____________________
Department: __________________________ Job Task: __________________________

Brief Description of Job: FILL IN SHADEd BOX

Job Component Frequency:

<table>
<thead>
<tr>
<th>%</th>
<th>Monitor</th>
<th>Keyboard</th>
<th>Mouse</th>
<th>Writing</th>
<th>%</th>
<th>Phone use</th>
<th>Calculator</th>
<th>Other (Specify)</th>
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</table>

Equipment:

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<tr>
<th>Chair:</th>
<th>Improper</th>
<th>Proper</th>
<th>Adjusted/ Recommendation</th>
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<tr>
<td>Height</td>
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<td></td>
</tr>
<tr>
<td>Seat pan</td>
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<td></td>
</tr>
<tr>
<td>Arm rest</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lumbar support</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Leg clearance</td>
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<td></td>
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</table>

Employee awareness of chair adjustability  Y   N

Work Station:

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<th>Keyboard</th>
<th>Wrist rest</th>
<th>Foot rest</th>
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<th></th>
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</table>

Other recommendations for equipment:

Posture:

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<tr>
<th>Picture #</th>
<th>Ear over shoulder</th>
<th>Shoulder over hip</th>
<th>Wrist neutral</th>
<th>Feet on floor</th>
<th>Overall posture</th>
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<tbody>
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<td>Y    N</td>
<td>Y    N</td>
<td>Y    N</td>
<td>G    F    P</td>
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</table>

Recommendations/ concerns for posture:

Completed by: __________________________ Date: ____________________
APPENDIX F
Name: ___________________________ Date: ___________________ 
Department: ___________________________ Job Task: _______________________

Brief Description of Job: FILL IN SHADED BOX

Job Component Frequency:

<table>
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<th>Component</th>
<th>%</th>
<th>Working overhead</th>
<th>%</th>
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<tbody>
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<td>Standing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sitting</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lifting from floor</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hand tool use</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Specify tools:</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Quick Screen:

Posture: _______ _______ _______ _______ Comments: _______ _______ _______ _______

Picture #: _______ _______ _______ _______

Lifting Station:

<table>
<thead>
<tr>
<th>Component</th>
<th>Proper</th>
<th>Improper</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Legs:</td>
<td>Bent</td>
<td>Slightly Bent</td>
<td>Straight</td>
</tr>
<tr>
<td>Load:</td>
<td>Close</td>
<td>Fairly close</td>
<td>Not close</td>
</tr>
<tr>
<td>Curve:</td>
<td>Curve</td>
<td>Slight curve</td>
<td>No curve</td>
</tr>
<tr>
<td>BOS/Feet:</td>
<td>Good</td>
<td>Fair</td>
<td>Poor</td>
</tr>
<tr>
<td>Twisting:</td>
<td>None</td>
<td>Slight</td>
<td>Significant</td>
</tr>
</tbody>
</table>

Recommendations/ concerns:

Administered by: ___________________________ Date: ___________________
“Empowering the Employee” Steffes Corporation
Seminar Evaluation

Please assess the following aspects of today’s seminar. Rate your responses to the following questions from 1-5, with 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree and 5 = strongly agree.

Seminar you attended (circle one): Office Production

First Presenter:
   The presenter demonstrates knowledge of the subject matter.
   1  2  3  4  5
   The presenter used words and examples that were easy for me to understand and relate to.
   1  2  3  4  5
   Comments:

Second Presenter:
   The presenter demonstrates knowledge of the subject matter.
   1  2  3  4  5
   The presenter used words and examples that were easy for me to understand and relate to.
   1  2  3  4  5
   Comments:

Seminar Content:
   The presentation was concise and well organized.
   1  2  3  4  5
   The handouts highlighted the main points and are valuable materials to reference in the future.
   1  2  3  4  5
   The Power Point presentation displayed the points effectively
   1  2  3  4  5
   The information was useful
   1  2  3  4  5

Additional Comments:
REFERENCES


7. Mortenson, Kent. Steffes Corporation. Personal communications: 6/15/06-10/30/06.


85


