Small Business
Ergonomic Case Studies
Hazards, Assessments, Solutions, Costs and Benefits

MFL Occupational Health Centre

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Small Business Ergonomic Case Studies Hazards, Assessments, Solutions, Costs and Benefits

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Preface

What are your thoughts on ergonomics? Do you know what ergonomics is? If you're a small employer, do you think ergonomic fixes are costly? If you have a problem job or you know that workers are developing overuse injuries, do you think anything can be done to help?

Over the years I have met many managers and workers that have some understanding of ergonomics, however, they are unsure of how to deal with problem jobs or if making a change will actually work. There are those that also have difficulties in showing value for their ideas or that solutions are cost effective. The idea for the case study book came from these experiences. Our goal was to show the community what ergonomic hazards are, how to assess the risk, provide examples of real world solutions and their costs and any associated benefits.

These ergonomic case studies all had positive outcomes for:

- workers, they now have safer jobs with less strain and a reduced risk of developing an injury.
- employers, they did not lose skilled workers to injuries. The solutions were also reasonable and practical.
- all workers and employers in Manitoba, they now have a resource that answers what ergonomics is, how to assess jobs, what are some solutions and are they economically feasible?

Finally, for myself since small employers are a difficult group to target health and safety resources to, it was satisfying to have a project that benefits small employers directly and in the end, each workplace, employer and worker is now considered a friend.

I hope this resource helps you with your ergonomics initiative. Please feel free to drop by the Occupational Health Centre and check out our health and safety resources or to just talk ergonomics.

Andrew Dolhy CPE, P. Kin
Ergonomist

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Acknowledgements

First and foremost we would like to thank all the employers, health and safety representatives, workers and managers who directly participated in the project by taking part in the case studies. Under the confidentiality agreement governing this project, employers and participating individuals cannot be identified by name. So, to all who took part – thanks!

This project was made possible by a grant from the Community Initiatives and Research Program of the Workers Compensation Board of Manitoba (WCB). Thank you Janice Meszaros, Manager, Community Initiatives and Research Program, for providing advice and assistance throughout the project. The staff at the MFL Occupational Health Centre (OHC) also deserve much gratitude for their support and help in developing this project.

The advisory committee provided feedback, comments and direction for the case studies. The committee consisted of Shaun Haas formerly of the Manitoba Restaurant Association, Shannon Martin from the Canadian Federation of Independent Business, Peter Wiebe of the Workers Compensation Board of Manitoba and Justin Phillips former owner Digitech Marketing. We also want to thank past members, Shelly Wiseman and Janine Halbessma of the Canadian Federation of Independent Business.

Back Row: Shaun Hass, Peter Wiebe, Carol Loveridge (OHC Director), Shannon Martin.
Front Row: Andrew Dolhy, Justin Phillips.

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Project Overview

Who Conducted the Project

This project was conducted by the MFL Occupational Health Centre (OHC) in Winnipeg MB, Canada (www.mflohc.mb.ca). The OHC is a community health centre funded by the Winnipeg Regional Health Authority and donations. The Centre helps workers, employers, and joint health and safety committees to improve workplace health and safety conditions and eliminate hazards. Our services are available free of charge.

Mission Statement

The MFL Occupational Health Centre is dedicated to attaining the highest level of occupational health and safety for Manitoba workers by delivering services that improve workplace conditions and by empowering individuals and groups to take action on workplace health and safety issues (1991).

Underserviced Groups Small Businesses

The Occupational Heath Centre strives to reach underserviced groups. One of these groups is small businesses, specifically those that employ less than 50 workers. In Manitoba small businesses with less than 50 workers compromise 92% of all businesses and 36% of all employees work for those small businesses (Canadian Federation of Independent Business, 2001).

WCB Community Initiatives and Research Program

The Workers Compensation Board of Manitoba has established a community research grant program (www.wcb.mb.ca). This program funds projects on injury and disease prevention, safety in the workplace, treatment of workplace injuries, support for injured workers and their families and scientific, medical or issues related to workers compensation. Up to $1 million in funding is provided annually by the Board of Directors of the WCB.

The OHC completed an ergonomic resource project in 2004. One outcome of the service was that once the community was made aware of this resource, they contacted us. Therefore there was no need to look for ergonomic projects. One group that did not contact us was small businesses. In 2004, the OHC was awarded a grant by the WCB Community Initiatives Research program to provide ergonomic services to small businesses. Specifically, ergonomic case studies were to be conducted in a variety of sectors in which the before and after ergonomic hazards were to be evaluated, the costs of implementing the solutions recorded and any potential benefits quantified.

Small Business and Ergonomics

In terms of occupational health and safety, small workplaces are of significant concern because they have higher rates of injuries compared to larger workplaces. (Eakin 1992, Eakin et al, 2000 and Walters, 2001). This may be due to smaller workplaces having higher levels of risk factors and hazardous conditions, lower levels of participation in preventive management, fewer internal resources for preventing occupational harm and less access to external assistance (Eakin et al, 2000).

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In Manitoba 50-60% of the lost time injury claims are from musculoskeletal injuries. A survey conducted by the National Centre for Health Statistics in the United States found that many high risk occupations for musculoskeletal injuries are small business related (National Research Council, 2001).

Ergonomics is a health and safety issue that is perceived to be costly, intimidating, and with unproven results by small business (Vavra, 2003, Hofmann, 1999 and Alexander, 2001). These perceptions may be due to the lack of awareness among small business employers concerning the fundamental concepts of ergonomics, the lack of published quantitative ergonomic evaluations reflecting small business issues and the problems of communicating these findings to small businesses(Sundstrom, 2000 and Westgaard and Winkel, 2000).

What to Do

In order to reach small businesses a combination of awareness and education, information sharing, access to technical expertise and other resources and possibly motivation through incentives are required. The Small Business Intervention and Evaluation Project endeavours to meet his criteria through

- marketing and communication of this project and the development of a case study book.
- Small businesses will have access to a qualified ergonomist and other health and safety resources.
- The 'Intervention Grant' was a monetary fund that provided small businesses with some money to pay for the physical improvements that the health and safety committee and ergonomist thought were reasonable and practical. The "Intervention Grant" program should motivate small businesses to improve problem jobs and allow access to their workplaces.

Objectives

The three project objectives are to:

1) develop 25 case studies of ergonomic interventions, (32 were actually developed).
2) determine the average cost of ergonomic interventions for small businesses and to quantify the amount of risk reduction and other positive benefits.
3) increase the awareness and knowledge of health and safety issues in the small businesses that participated in this project.

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Ergonomics and The Case Studies

Ergonomics is a broad field of study that incorporates everything and anything that people interact with. In the workplace, ergonomic knowledge is used to improve workplace conditions, job demands and the working environment to make jobs better, safer, easier and performed with less error.

In health and safety, ergonomic hazards can lead to musculoskeletal injuries such as sprain and strain or overuse injuries of muscles, tendons, ligaments, nerves and other soft tissues of the body. Some ergonomic hazards are related to acute injuries such as a back strain when lifting something heavy and awkward or can be cumulative such as repeated mechanical strain on the shoulder leading to rotator cuff tendonitis. Furthermore, poorly designed work can range from fatigued and tired muscles to chronic and disabling injuries. These injuries can also be found outside the workplace. Therefore the key to determining if you have a problem job is to first assess your own workplace. For more information on the link between ergonomic hazards and musculoskeletal injuries, what can be done about them and other useful information, please consult Manitoba Labour, Workplace Safety and Health's Ergonomics: A Guide to Program Development and Implementation (www.gov.mb.ca/labour/safety/publication) or the MFL Occupational Health Centre.

If worker's hands, backs and arms are sore and tired, would they be a quality driven and efficient worker? If ergonomics is about making jobs better, safer, easier and performed with less error, can ergonomic principles be used to improve quality and efficiency? Is it easier to measure process improvements directly as opposed to measuring the possibility of reduced injuries over time? Note to health and safety committee members, look for **all potential benefits** when trying to justify your project idea. Hopefully, after reading through these case studies you might just change your perception of ergonomics from 'lets spend money on ergonomics" to "lets make and save money with ergonomics".

List of Case Studies

Case Study	Health and Safety Identified Problem	Risk Reduction Solution
Automotive Repair: Tool Use	Vibration and direct pressure	Mechanics gloves and anti-vibration gloves
Automotive Repair: Stooping	Stooping into hoods	Work/Rest schedules
Bakery: Lifting	Awkward and heavy lifting	Lifting eliminated
Bakery: Work Table Height	Working height is too low	Risers for work table
Construction: Muscle Tension	Static postures	Scientific based stretches
Construction: Tool vibration	Vibration from a tool	Grip tape
Construction: Whole body vibration	Vibration from operating heavy equipment	Anti-vibration seat pad
Construction: Awkward Posture	Grip force and arm position	Increase diameter of tool
Construction: Stooping	Stooping to the ground	New tool
Day Care: Part 1- Lifting	Clothing children, stooping	Adult chairs
Day Care: Part 2 - Stooping	Cleaning tables and lifting	Tools to clean tables

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List of Case Studies

Case Study	Health and Safety Identified Problem	Risk Reduction Solution
Food Production: lifting	Heavy lifting of trays	New lighter and stackable trays
Food Production: Whole Body Posture	Scrubbing to clean fixtures	Cleaning tub to soak fixtures
Food Production: Tool Use	Wrong tool for the job	Provided proper tool
Food Production: Material Handling	Cardboard box handling	Material handling gloves
Hair Salon	Use of rolling brush	Work organization
Hair Salon	Clearance and posture	Change of work positions
Manufacturing: Lifting	Manual lifting from carts	Lifting device
Manufacturing: Tool Use	Poorly designed tool	Properly designed tool
Manufacturing: Arm Posture	Awkward postures	Education and training
Manufacturing: Material Handling	Heavy and awkward material handling	Tool to help with lift
Manufacturing: Lifting	Lifting from the floor level	Tool to aid lifting
Metal Fabrication: Lifting	Material handling from a pallet	Low level cart
Metal Fabrication: Material Handling	Awkward and heavy material handling	Work table on wheels
Metal Fabrication: Material Handling II	Handling dies	Lifting device
Office: Sitting and Standing	Inadequate foot support	Footrests and education
Office: Mouse Position and Lighting	Poor shoulder position and too much light	Improved mouse position and better lighting
Office: Mouse, Monitor and Chair	Poor placement of equipment	Improved placement of equipment
Office: Mouse Wrist Rest	Too much use of the wrist	Removed wrist rest and provided education
Office: Keyboard Tray	Poor shoulder position	Improved keyboard placement
Office: Reaching	Poor layout of equipment	Improved layout
Office: Chair Position	Lack of adjustability	New adjustable chair
Total - 32	Health and Safety Identified Problem	Risk Reduction Solution

Help with Reading the Case Studies

The case studies were developed with the WCB's Safe Work campaign in mind. The Safe Work campaign goal is to increase awareness and knowledge of all Manitobans when it comes to health and safety in the workplace. It is funded by the government of Manitoba and the Workers Compensation Board of Manitoba. The campaign centres around, Spot the Hazard, Assess the Risk, Find a Safer Way and Everyday. We chose to use this format for our case studies to help reinforce the Safe Work message and to show how it can be applied to ergonomics.

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Section 1: Spot the Ergonomic Hazard

There are many resources available from the Occupational Health Centre and Manitoba Labour Workplace Safety and Health Division that can be used to identify ergonomic hazards. These case studies do not represent all the ergonomic hazards but they do include hazards such as:

- local mechanical pressure
- excessive hand/arm or whole body vibration
- continuous leaning and stooping
- far reaching
- heavy and awkward lifting and material handling
- awkward body postures
- forceful efforts and non-optimal gripping
- sitting with inadequate back or foot support
- constrained or static postures for long durations

Section 2: Assess the Risk

The key to assessing ergonomic hazards to see if it's associated with an increased risk of injury is to look at it from several different perspectives. These case studies used a checklist, technical expertise, worker consultation and standards and guidelines to assess the ergonomic hazards. If they all say it is a problem, then the ergonomic hazard does increase the risk of injury. If only one tool says it is a problem then the job may not increase the risk of developing a musculoskeletal injury! Most health and safety committee members can identify hazards and use a checklist, guidelines and worker consultation to determine if they have a problem job. If there is a dispute or the job requires a higher level of assessment then an ergonomist with specific training in higher level assessment tools can be consulted.

This project used the checklist from Manitoba Labour Workplace Safety and Health Division's Ergonomics: A guide to program development and implementation (www.gov.mb.ca/labour/safety/publication). The checklists and how to use them are located in the appendix of this case study guide. The checklist scores the ergonomic hazards found in the job based on their duration. A total score of 7 or greater indicates that this may be a problem job.

The technical assessments included the use of biomechanical models, vibration testing equipment, electromyographical (EMG) equipment, valid and reliable assessment tools for lifting and hand intensive tasks and tools used to collect information about postures and forces which were then compared to epidemiological studies and other research documents.

Workers who perform the jobs have the best knowledge and perspectives when it comes to assessing a job for ergonomic hazards. No investigation would be complete without consulting workers about what the root cause of the problem might be and how best to fix the problem. There are also a number of ergonomic ratings scales that can be used for one or more workers to get an idea about their perceptions of the job. These perceptions can be in the form of perceived discomfort in the job, the level of effort required to do the job and in comparing before and after changes to the job. The Occupational Health Centre has a resource centre that includes resources on how to use these rating scales correctly and how to interpret their findings.

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Ergonomic principles can be found in textbooks, guidelines, standards and journal articles. They can be specific to tasks or equipment or they can be general principles geared towards global job design criteria. The standards and guidelines used in these case studies involve many different sources.

Section 3: Find a Safer Way

For every problem there are many different solutions but how do you find the most reasonable and practical solution? These case studies were conducted jointly with the workplace health and safety committee or safety representative, management and effected workers. This ensured that the most reasonable and practical solution was implemented. Furthermore, when all potential costs and benefits were reviewed, then all parties agreed on the chosen solution. That is why these case studies include the costs involved in purchasing the solution, the amount of risk reduction that occurred because of the chosen solution and any quality and efficiency outcomes that occurred because of the improvement to the job.

The median cost (half the costs were more, half the costs were less) incurred by these workplaces to fix the problem jobs was $50 and only 10% of all the case studies required more than $1000 to fix the problem.

The median time (half of the projects were quicker, half took longer) required for quality and efficiency benefits to pay for the initial cost was less than 1 week and only 10% of the case studies required between 5-19 months.

These case studies are not completely random since management agreed to have the ergonomist come into their workplaces but the problem jobs were not picked to make the case study book look good. Each case study was identified because it was causing workers problems.

Section 4: Everyday

Today, every workplace that participated in this project is a better and safer place to work. If 1 or 2 case studies apply to your workplace and they help to make real changes happen then this project was worth it.

Tomorrow, we can all systematically look at our problem jobs and learn how to assess them properly so that the root cause of the problem can be fixed in a reasonable and practical manner. Tomorrow we can change the perception that ergonomics is costly with unproven results to a perception that we can actually make and save money with ergonomics while living up to our moral and legal duty to provide a safe workplace.

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"Hazard Assessments **are not complete without** documenting worker experiences"

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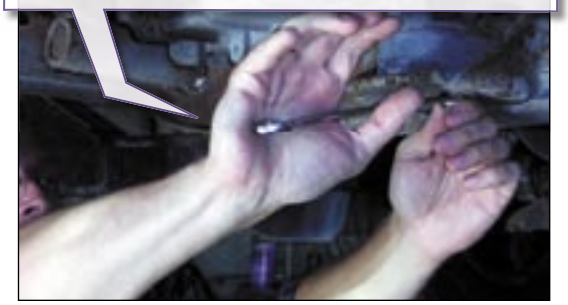
CASE STUDY 1
AUTOMOTIVE REPAIR Tool Use

SPOT the Ergonomic Hazard

Pain in the hands was one of the main issues described by mechanics. They associated this pain with tasks that involve mechanical pressure (contact stress) in the palm of the hands and with vibrating tools. Specifically, repair tasks that occur frequently and result in workers having to take frequent breaks are related to the use of the combination wrench and impact gun. These tools are used on parts that are located in small, cramped places and to loosen parts that are rusted tight.

Ergonomic Hazards

Hazard! Local Mechanical Pressure or 'contact stress' on a vulnerable area of the hand. The pressure to push on the wrench is directed partially onto the palm of the hand.



Hazard! Excessive vibration. High Impact tools produce vibration that can damage nerves and blood vessels.

ASSESS the Risk

Health and Safety Committee Assessment - The Manitoba Labour's Ergonomics Guideline contains a checklist that can be used to score tasks for ergonomic risks. The combination of tools that place contact stress onto the palm of the hand and vibration from tools scored 5. A score over 7 indicates a hazardous task. Note, 7 risk factors were present in the job but they all scored '0' because of a low duration of exposure.

Technical Assessment - Hand arm vibration from the impact tool use was measured. The findings found an acceleration (vibration measure) of 0.743 m/s^2 over 3 trials. This does not indicate a hazardous task according to vibration standards.

Worker Consultation - Direct observations of workers found periods of 5-10 minutes of working with these tools had to be interrupted by small breaks because they were experiencing hand numbness and tingling.

Standards and Guidelines - Scientific literature found many studies linking local mechanical pressure (contact stress) and nerve and blood vessel injuries. Their recommendations were to minimize the contact stress.

Hazards are present in this task but are of a low concern according to scientific guidelines. However, workers are experiencing problems and guidelines generally have footnotes that indicate 'workers with existing or pre-existing conditions may not be covered by this guideline'. Therefore it was decided to reduce the hazards as much as possible.

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The mechanical pressure was minimized by the use of mechanics gloves. These gloves are designed for automotive repair and include a padding in the palm and along the fingers.

Anti-vibration gloves were purchased and tested with the vibration equipment to see how much of a difference they would make.

Results

Direct Cost of Improvements - $32 for one pair of mechanics gloves and $17 for one pair of anti-vibration gloves.

Worker Health Benefits - The Manitoba Labour's ergonomic checklist score was reduced from 5 to 4 due to a reduction in mechanical pressure. The local mechanical pressure was minimized to the point where workers do not feel the pressure in their hands and the acceleration (vibration) was reduced from 0.743 m/s^2 to 0.012 m/s^2 or by 84%

Quality and Efficiency Outcomes - Observations of workers found that tasks can be completed without having to take a small break to reduce the numbness and tingling in the hands. Tools can now be used properly since they don't have to change their grip in order to reduce the pressure in their hands. Automotive repair costs are based on labour standards. If a job takes longer because worker's hands are in pain then money is lost. The total cost of mechanics gloves and anti-vibration gloves can be recovered within 1-2 days of staying within the labour standards.

Other options

- Brand new tools that have low vibration or vibration dampening built in.
- Medical management program for workers that are experiencing musculoskeletal (sprain and strain) problems.

EVERYDAY

Today - Workers were informed of the study results and were asked to provide their feedback. All workers were instructed on the proper use of the gloves and tools and their proper maintenance. Following this process, workers were more forthcoming about other health and safety issues such as noise and air quality. This has led the company to seek more health and safety information.

Tomorrow - The workplace is considering having a two person health and safety committee even though they are under 20 workers. Workers are experiencing less stress in their lives since they are not worrying about missing work due to hand pain.

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"Can't change the job- then change the exposure."

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CASE STUDY 2
AUTOMOTIVE REPAIR Stooping

SPOT the Ergonomic Hazard

Low back pain was one of the main issues described by mechanics. They associated this pain with tasks that involve repetitive and continuous stooping. Specifically, repair tasks that occur under the hoods of cars and trucks. Every situation is different, however, the time spent leaning, stooping and reaching was identified as an issue, especially with mechanics that had previous low back pain.

Ergonomic Hazards

Hazard! Continuous leaning and stooping. Different engines and bumpers result in these awkward postures.

Hazard! Far reaching without upper body support. Some tasks require using both hands and reaching beyond 24" (61cm)

ASSESS the Risk

Health and Safety Committee Assessment - The Manitoba Labour 's Ergonomic Guideline contains a checklist that can be used to score tasks for ergonomic risks, refer to Appendix A for details. The characteristics of this stooping task scored 7. A score over 7 indicates a hazardous task. The main risk factors are posture and duration of the task.

Technical Assessment - Electromyography (EMG) is the study of muscular activity. A tool can be used to measure the muscular activity of muscles and therefore, determine how much effort is being produced and for how long. The readings are compared to the individual 's maximum effort. During this task it was found that an average of 28% of a worker's maximum low back effort was used when stooping and reaching with upper body support. Up to 50% was used when there was no upper body support. When these muscular activities occurred for more than 15 minutes then worker discomfort increased significantly.

Worker Consultation - A rating scale of worker 's perceived discomfort on the lower back increased from 2 to 6 as the task duration lasted longer than 15 minutes. This correlated with the EMG findings of twisting and lack of upper body support.

Standards and Guidelines - Scientific literature found many studies linking continuous stooping and high muscular activity with increased reporting of low back injuries.

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The EMG results for the low back muscles found that after 5 minutes of working in an unsupported upper body position, the ratings of discomfort increased. When there was intermittent supporting of the upper body then discomfort did not increase until after 15 minutes of work. Therefore, it was recommended that work tasks should be changed after 15 minutes of stooping in order to reduce low back fatigue. This can be accomplished in an automotive repair shop since there is flexibility in work tasks.

Results

Direct Cost of Improvements - $0

Worker Health Benefits - The Manitoba Labour's ergonomics checklist score was reduced from 7 to 6 due to a reduction in exposure to risk factors from the increased task variability. The worker's ratings of perceived discomfort was improved from an initial range of 2-6 throughout the day to a range of 2-5. Mechanics with low back problems indicate that they generally feel better in their lower back and are able to perform their duties without slowing down. This was confirmed by the follow up EMG readings that indicated a reduction in exposure to high muscular activity over a 15 minute period.

Quality and Efficiency Outcomes - Mechanics are highly skilled workers. One lost day due to a painful low back condition can result in substantial lost productivity. It was estimated that $200 can be lost when a mechanics low back is giving them problems.

Economic Summary – The estimated pay back for this intervention is immediate with a saving of at least 1 lost days production would cover the time required to change the work organization and train all staff on the new procedures.

Other options

- Low back strengthening exercises.
- Partnering with other mechanics on long, difficult jobs.

EVERYDAY

Today - The mechanics are looking forward to seeing if the short term benefits found with the new work/rest schedule will turn into long term low back pain relief.

Tomorrow - The workplace is considering having a two person health and safety committee even though it is under 20 workers. Workers are experiencing less stress in their lives since they are not worrying about missing work due to low back pain.

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CASE STUDY 3
BAKERY Lifting

SPOT the Ergonomic Hazard

Low back pain was identified as one of the main issues described by bakery workers. They associated this pain with tasks that involve heavy lifting. Specifically, lifting and dispensing pails of canola oil and other products. Workers with low back pain ask coworkers to perform these tasks.

Ergonomic Hazards

Hazard! Lifting objects from below knee height. Objects are lifted off the floor.

Hazard! Side bending and twisting while holding a load. Pouring of product results in workers having to adopt awkward postures.

ASSESS the Risk

Health and Safety Committee Assessment - The Manitoba Labour 's Ergonomic Guideline contains a checklist that can be used to score tasks for ergonomic risks, refer to Appendix A for details. The characteristics of this lifting task scored an 8. A score over 7 indicates a hazardous task. The main risk factors include low back posture and lifting variables.

Technical Assessment - A biomechanical analysis of this task found the low back spine to experience up to 2591 Newtons of compression force and 216 Newtons of shear force in this task. These numbers are acceptable but it is a measure of only one lift. A lifting tool that takes into account cumulative loading found that there is a 43% chance that a worker performing this job would report a low back pain injury. This is a high number.

Worker Consultation - Direct observation and consultation with workers found poor body postures due to the low height of the pail. A consensus found that even though this is an occasional task they do feel back strain.

Standards and Guidelines - Material handling guidelines indicate that heavy loads should be placed between knee and shoulder height.

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The health and safety committee identified several options for improving this task. While investigating an idea of smaller containers, the product supplier suggested a lid remover. Smaller containers can be used to scoop out the product eliminating the heavy lifting and awkward postures.

Results

Direct Cost of Improvements - $11 for lid remover.

Worker Health Benefits - The Manitoba Labour's ergonomics checklist score was reduced from 8 to 2 due to the elimination of the lifting elements. The lifting of the pail has been eliminated. All workers are able to perform this task.

Quality and Efficiency Outcomes - The initial lifting and pouring of the product resulted in some spilling. Currently there is no opportunity to spill the product because the lid is removed. Therefore, the cost of $11 could be recovered by eliminating a few spills. Furthermore, all workers are able to perform this task, thereby saving time in finding another worker to help lift and pour the pail. The low back compression was reduced from 2591 Newtons for the initial lift to 856 Newtons while pulling up on the lid.

Economic Summary - The estimated pay back for this intervention is immediate due to reduced time and spillage.

Other options

- Building a roll out stand for the pail so that lifting is above knee height.
- Installing a pump to squirt out product.

EVERYDAY

Today - All workers are able to perform this task without having to ask for help. This has led to comments about less low back fatigue and improved morale.

Tomorrow - Other tasks are being considered for ergonomic improvements. These include tasks that are not deemed to be hazardous but are difficult to perform by workers with current musculoskeletal issues.

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CASE STUDY 4
BAKERY Work Table Height

SPOT the Ergonomic Hazard

A survey of workers found low back, upper back, shoulders and hand discomfort. Workers indicated that making dough was hard on the hands with prolonged stooping and standing.

Ergonomic Hazards

Hazard! Avoid forceful efforts with awkward postures. The wrists are bent backwards when kneading dough.

Hazard! Avoid stooping for prolonged periods of time. Dough making is continuous throughout the day.

Hazard! Avoid extending the arms continuously. There is far reaching in this task.

ASSESS the Risk

Health and Safety Committee Assessment - The Manitoba Labour 's Ergonomic Guideline contains a checklist that can be used to score tasks for ergonomic risks, refer to Appendix A for details. The characteristics of this food preparation task scored 9. A score over 7 indicates a hazardous task. The main risk factors include wrist bending and mild forward bending of the back.

Technical Assessment - A biomechanical calculation of strain on the wrist joint while kneading dough was found to be 2.7 Nm (Newton-meters). Some researchers have found wrist joint strain 2.0 Nm (Newton-meters) to be a concern.

Worker Consultation - A rating scale of worker's perceived discomfort on the lower back increased from 2 to 6 over the course of the day.

Standards and Guidelines - Tables and charts indicating the proper heights and reaches for optimal work found the current height to be 4-10 inches too low and reaching across to be 3-5 inches too far for continuous work.

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The table height was too low for most workers. The height requirement for this task is 37-43 inches. The current height is 33 inches. Metal risers were constructed to raise the work table. They can be removed for taller workers. A total of 55 square feet of anti-fatigue matting was also purchased since workers stand on a hard surface all day.

Results

Direct Cost of Improvements - $100 for stands and $400 for anti-fatigue mats.

Worker Health Benefits - The Manitoba Labour's ergonomics checklist score was reduced from 9 to 7. Hand strain was reduced from 2.7 to 0.2 Nm (Newton-meters) because of improved wrist position. Worker's perceived discomfort for the low back was reduced from an original range of 2 to 6 throughout the day to a range of 2 to 4.

Quality and Efficiency Outcomes - Large orders are now completed earlier since workers do not have sore hands and backs at the end of the day. Workers now perform other value added duties and/or overtime is reduced. Labour savings to the workplace was approximately $20/week.

Economic Summary - The estimated pay back for this intervention was seven months due to efficiency improvements.

Other options

- Height adjustable cylinders can be attached to the table.
- Build two stands for a range of working heights.

EVERYDAY

Today - The workers were informed of the ergonomic hazards, instructed and trained on how to use the work table height to their advantage and are following good working behaviours. Today workers do not feel aches and pains at the end of their shift.

Tomorrow - The workplace is investigating other tasks for ergonomic issues, incorporating ergonomics into new employee orientations and sending health and safety committee representatives to health and safety training.

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CASE STUDY 5
CONSTRUCTION Muscle Tension

SPOT the Ergonomic Hazard

Sitting for prolonged periods of time with whole body vibration increases the risk of developing low back injuries. One method of reducing the strain on the low back is to perform stretches. Research studies have shown that some common stretches can increase the compression and shear forces on the low back and, therefore, aggravate any low back problems, especially when those same body positions are found in the task.

Ergonomic Hazards

Hazard! Adding to an existing problem. Some stretches increase strain on the low back. Bending the spine to its end range of motion may release muscle tension but increases the compression and shear forces on the discs, ligaments and vertebrae.

ASSESS the Risk

Health and Safety Committee Assessment - The Manitoba Labour 's Ergonomic Guideline contains a checklist that can be used to score tasks for ergonomic risks, refer to Appendix A for details. The characteristics of this equipment operation task and stretching program scored 9. A score over 7 indicates a hazardous task. The main risk factors include posture, whole body vibration and duration of the task.

Technical Assessment - The technical assessment included posture sampling and whole body vibration measurements. The stretching program was assessed for duration and exposure. Touching your toes with a fully rounded low back results in a low back compression force of nearly 2000 Newtons and a shear force of over 900 Newtons. Risk of injury increases when low back shear force is above 500 Newtons.

Worker Consultation - Workers have not felt any improvement in low back discomfort when these stretching exercises were introduced.

Standards and Guidelines - Researchers that are looking at more than just muscle activation but include spine biomechanics have found these 'stretches' to increase the stress on the low back spine. There are no good quality studies that have found these stretches to reduce low back injuries or discomfort.

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Stretches that are 'safer' for the low back spine were introduced and education about how the low back works was given to all workers. Keeping the spine in a 'neutral' position is the key to muscle tension releasing exercises and low back health.

Results

Direct Cost of Improvements - $0.

Worker Health Benefits - Manitoba Labour's ergonomics checklist score was reduced from 9 to 8 due to a reduction in exposure to risk factors from the scientifically validated stretching program. Workers also noted a slight reduction in low back stiffness at the end of the shift as measured on a rating scale.

Quality and Efficiency Outcomes - No quality or efficiency benefits were noted, however, keeping skilled workers healthy instead of working in pain has many documented benefits.

Economic Summary - The pay back for this change in procedure was immediate. The employer found a reduction in absenteeism of 15% due to their health and safety initiatives which included the new stretching program.

Other options

- Continue with the current stretches but not to the extreme end range of motion.
- Perform stretches on a mat so that the low back can be maintained in a neutral position.

EVERYDAY

Today - Workers were very interested in learning how the back works from a practical perspective. Workers are more committed to performing these stretches due to their new understanding of how the back works.

Tomorrow - The workplace is developing a new employee training guide that includes these methods of stretching and why.

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CASE STUDY 6
CONSTRUCTION Tool Vibration

SPOT the Ergonomic Hazard

The level and duration of vibration exposure can be a health hazard when using grinders. This can cause vibration induced white finger disease in the hands, is associated with carpal tunnel syndrome and can lead to a loss of tactility (sense of touch) thereby increasing the grip on the tool.

Ergonomic Hazards

ASSESS the Risk

Health and Safety Committee Assessment - The Manitoba Labour 's Ergonomic Guideline contains a checklist that can be used to score tasks for ergonomic risks, refer to Appendix A for details. The characteristics of this grinding task scored 4. A score over 7 indicates a hazardous task. The main risk factors include the hand posture and tool vibration. Note that five risk factors were present in this task but they all scored '0' because of low duration of exposure.

Technical Assessment - The vibration was measured for an 8 inch disk grinder and the readings were 0.7m/s^2. This is less than the 4m/s^2 standard for an eight hour per day exposure.

Worker Consultation - Workers found that using the grinder for a period of time resulted in squeezing the tool harder and the quality of work was diminished.

Standards and Guidelines - The technical standard was developed for the health risk of developing vibration induced white finger disease. There are no standards for vibration induced sensory loss, which would lead to an increased grip on tools.

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Since workers commented on a reduced sense of touch and quality of work, a method of reducing vibration was sought. A gel backed grip tape was found. It was applied to the tool handle and tested for durability and ease of use.

Results

Direct Cost of Improvements - $23 for anti-vibration gel backed grip tape.

Worker Health Benefits - Manitoba Labour's ergonomics checklist score was reduced from 4 to 3 due to a reduction in vibration exposure.The vibration was reduced from 0.7m/s^2 to 0.2m/s^2 or over 70%.

Quality and Efficiency Outcomes - Workers noted that they are able to work longer on a task without losing their sense of touch. This was estimated to be an efficiency improvement of 1-2 minutes for every grinding task lasting longer than 10 minutes. Therefore, the benefits can range from $10-$100 per day in time savings.

Economic Summary - The pay back period of this solution is one to two days. Better quality of work can also be calculated.

Other options

- New grinders that have lower hand/arm vibration.
- Purchasing anti-vibration gloves for all workers or a pair or two for the toolbox.

EVERYDAY

Today - the workplace has purchased more gel backed grip tape for all their tools, even the ones that produce low vibration.

Tomorrow - the workplace is instituting a health survey of its workers since vibration induced white finger is a gradual disorder that can be caught early.

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CASE STUDY 7
CONSTRUCTION Whole Body Vibration

SPOT the Ergonomic Hazard

Sitting for prolonged periods of time with whole body vibration increases the risk of developing low back injuries. Heavy construction is an industry that exposes workers to these risks.

Ergonomic Hazards

Hazard! Whole body vibration and prolonged sitting. New road construction is a 'bumpy' ride.

ASSESS the Risk

Health and Safety Committee Assessment - The Manitoba Labour 's Ergonomic Guideline contains a checklist that can be used to score tasks for ergonomic risks, refer to Appendix A for details. The characteristics of this equipment operation task scored 8. A score over 7 indicates a hazardous task. The main risk factors includes posture, whole body vibration and duration of the task.

Technical Assessment - Whole body vibration was measured on a Crawler Tractor. The readings were 0.11m/s^2 in the z (up/down) direction. This is less than the 0.315m/s^2 standard for an eight hour per day exposure.

Worker Consultation - Workers considered vibration from the equipment and road building to be a part of the job. Low back discomfort was inevitable.

Standards and Guidelines - Standards and guidelines indicate that the vibration in this task is not a hazard, however, individual susceptibility should to be taken into consideration.

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In order to accommodate workers with existing or previous low back issues, a gel anti-vibration seat pad was purchased.

Results

Direct Cost of Improvements - $298 for a gel anti-vibration seat pad.

Worker Health Benefits - Manitoba Labour's ergonomics checklist score was reduced from 8 to 7 due to a reduction in exposure to whole body vibration. The whole body vibration was reduced from 0.11m/s^2 to 0.02m/s^2 or a reduction of over 80%.

Quality and Efficiency Outcomes - Two workers noted that their sore lower back was better at the end of the day which resulted in a reduction of at least two lost days. When skilled workers are absent then productivity suffers. The benefits of this solution could easily equal its cost if one lost day was reduced.

Economic Summary - The pay back period for this solution was one day.

Other options

- Refurbishing the old seat with a brand new anti-vibration seat.
- Purchasing a cheaper sponge/foam cushion with unknown anti-vibration properties.

EVERYDAY

Today - Workers now believe that ergonomic changes can be made to their jobs. The workplace is also investigating other tasks that can be improved for workers that have existing musculoskeletal issues.

Tomorrow - The workplace is developing a new employee guide that discusses ergonomic issues in the construction industry.

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CASE STUDY 8
CONSTRUCTION Awkward Posture

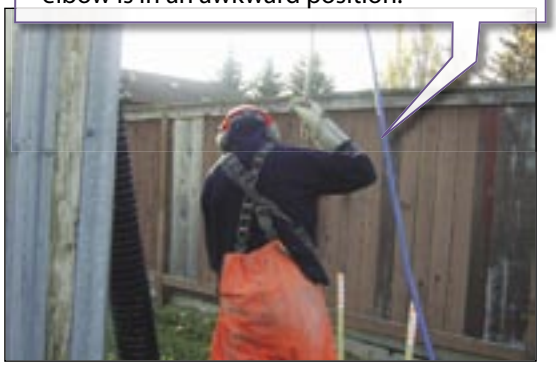
SPOT the Ergonomic Hazard

This task involves holding a tool that exerts high-pressure water. There is vibration from the tool and a moderate grip force is required to push down. This task was identified as an issue by the health and safety committee due to shoulder and forearm complaints.

Ergonomic Hazards

Hazard! Non-optimal gripping and vibration. The diameter of the wand is too small.

Hazard! Awkward body positions. The elbow is in an awkward position.



ASSESS the Risk

Health and Safety Committee Assessment - The Manitoba Labour 's Ergonomic Guideline contains a checklist that can be used to score tasks for ergonomic risks, refer to Appendix A for details. The characteristics of this continuous gripping task scored 11. A score over 7 indicates a hazardous task. The main risk factors include exposure to vibration, awkward postures and over gripping.

Technical Assessment - The vibration was measured for the water pressure wand. The reading was 0.38m/s^2. This is less than the 4m/s^2 standard for an eight hour per day exposure. Electromyography was used to estimate muscular activity in the forearms when gripping the wand. Workers used between 15-35% of their maximum effort when gripping the wand for 50% of the time. This is above recommendations for continuous gripping tasks. Sampling the posture of workers as they perform this task found awkward shoulder positions occurring more than 20% of the time. The general rule for awkward postures is less than 20% of a task duration.

Worker Consultation - The type of ground that they are cutting into plays a major role in how much downward pressure they exert. Therefore perceived exertion can increase 5-8 points from the beginning of the day.

Standards and Guidelines - Ergonomic guidelines for working postures, continuous gripping and exposure to vibration from tools indicates that this is a moderate to high risk task.

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The health and safety committee wanted to reduce the vibration and add warmth to the hands. Therefore an anti-vibration glove was purchased. The awkward postures and continuous gripping are inherent in the task and would require further thought. However, while testing the anti-vibration glove it was found workers felt they were gripping the wand with less force. The added thickness of the glove resulted in a better grip on the wand.

Results

Direct Cost of Improvements - $23 for anti-vibration gloves.

Worker Health Benefits - Manitoba Labour's ergonomics checklist score was reduced from 11 to 8 due to a reduction in exposure to vibration and improved grip. The posture sampling study revealed an awkward shoulder posture occurred less than 20% of the time. The vibration was reduced from 0.38m/s^2 to 0.03m/s^2 or a reduction of 92%. The Electromyographic readings found a reduction in grip muscular activity from 15-35% for 50% of the time to 12-28% for 50% of the time. Therefore two of the three issues have significantly improved.

Quality and Efficiency Outcomes - Workers noted that the quality of their work affects the other crew members ability to perform their work. It was commented that a poor job on their part can add an extra half hour to an hour of work. During the follow up of this project workers noted that all of their work has been of high quality. This is due to the ergonomic improvements. There is a potential cost savings of a few hundred dollars per shift.

Economic Summary - The pay back period for these anti-vibration gloves is realistically one day.

Other options

- Designing a new tool for better posture and force application.
- Job rotation with other crew members.

EVERYDAY

Today - The workplace is looking for other opportunities to incorporate ergonomics into their tasks.

Tomorrow - The health and safety committee is surveying the workers to determine if the changes are having a positive long term effect.

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CASE STUDY 9
CONSTRUCTION Stooping

SPOT the Ergonomic Hazard

Locating and marking is a task that involves stooping. The health and safety committee felt that low back discomfort was just a part of the job.

Ergonomic Hazards

ASSESS the Risk

Health and Safety Committee Assessment - The Manitoba Labour 's Ergonomic Guideline contains a checklist that can be used to score tasks for ergonomic risks, refer to Appendix A for details. The characteristics of this stooping task scored 8. A score over 7 indicates a hazardous task. The main risk factors include posture and duration of the task.

Technical Assessment - Posture sampling is a method of determining the percentage of time a specific posture occurs in a task. In this case stooping more than 20 degrees occurred for more than 30% of the time. Generally poor body positions should occur less than 20% of the time.

Worker Consultation - The handling of the equipment and the pace of the marking was indicated as significant issues by the workers. A rating scale of discomfort in the lower back increased from 2-7 over the course of the shift.

Standards and Guidelines - Scientific studies of low back posture and duration of tasks found a threshold of stooping greater than 20% of the time to be a key indicator of developing low back injuries.

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Changing the locating equipment is a long term project. However, a paint extender was purchased to reduce stooping. Techniques were also discussed at safety talks about methods of reducing stooping such as foot position and upper body posture.

Results

Direct Cost of Improvements - $46 for paint extender.

Worker Health Benefits - The Manitoba Labour's ergonomics checklist score was reduced from 8 to 5 due to a reduction in stooping. The percentage of time the worker was in a stooped posture of more than 20 degrees was reduced from 30% to 20%. Worker's ratings of low back discomfort was also reduced by three points.

Quality and Efficiency Outcomes - Reducing the amount of stooping also reduces motion in terms of time to stoop and getting back up. For larger jobs, there was a reduction of between three to five minutes. This can translate into a cost saving of over $100 per shift.

Economic Summary - The pay back period for the paint extender and work methods training was one day.

Other options

- Job rotation with other tasks.
- Purchasing a new locator that has a longer stem.

EVERYDAY

Today - The workplace is purchasing paint extenders for all its crews.

Tomorrow - Management is more open to other opportunities for improvements because of the positive health and efficiency benefits of this project.

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CASE STUDY 10
Daycare Service Part 1 - Lifting

SPOT the Ergonomic Hazard

Day care workers are involved in a significant amount of stooping and lifting activities. A task analysis revealed 32 different activities. These included lifting children and equipment, sitting, squatting, climbing and cleaning. The ergonomic project was two parts, Case Study Part 1- Lifting and Case Study Part 2 – Stooping.

Ergonomic Hazards

Hazard! Lifting below the knees. Children and equipment are often on the floor.

Hazard! Awkward body positions when lifting. There is extreme stooping and twisting while lifting.

ASSESS the Risk

Health and Safety Committee Assessment - The Manitoba Labour 's Ergonomic Guideline contains a checklist that can be used to score tasks for ergonomic risks, refer to Appendix A for details. The characteristics of these lifting tasks scored 7. A score over 7 indicates a hazardous task. The main risk factor is the posture adopted for the lifts.

Technical Assessment - Posture sampling is a method of determining the percentage of time a specific posture occurs in a task. In this case, mild to severe stooping with a weight in the hands occurred nearly 12% of the time.

Worker Consultation - Workers commented mostly on sore knees and backs. They attribute this to the entire workload of the day and not just a single activity. A rating of worker's perceived exertion found an increase from four to seven throughout the day due to stooping and lifting activities.

Standards and Guidelines - Scientific studies of low back posture with weight in the hands and frequency has found a threshold of greater than 10% of the time to be a key indicator for the development of low back injuries.

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The health and safety committee investigated options for reducing the stooping while lifting. For infants, using a bassinet accomplished this goal. Furthermore teaching proper techniques for lifting children and equipment was taught and practiced. Changes were made to the equipment shed and other storage locations. Procedures were developed for the use of change tables with stairs for children to climb up to help reduce the lifting of children.

Results

Direct Cost of Improvements - $0 since the bassinet was already available.

Worker Health Benefits - Manitoba Labour's ergonomics checklist score was reduced from 7 to 4 due to improved posture. Workers commented on actually feeling the difference on a daily basis and the ratings of perceived exertion while stooping/lifting was reduced one point. This may indicate a reduction in fatigue at the end of the day. The posture sampling study found less than 10% of the daily activities involved lifting with a mild or severe stooping posture.

Quality and Efficiency Outcomes - Quality of care improves when workers are less fatigued. Case Study Part 2 discusses the reduction in worker absenteeism.

Economic Summary - The pay back period for these changes was immediate due to the use of existing equipment.

Other options

- Full cribs were discussed for the infants.
- A new and larger storage shed was an option.

EVERYDAY

Today - All staff received information, instruction, training and supervision on proper lifting techniques and safe work procedures.

Tomorrow - A full wellness program will be established and information on the whole health and safety initiative will be shared with the daycare industry.

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CASE STUDY 11
Daycare Service Part 2 - Stooping

SPOT the Ergonomic Hazard

Day care workers are involved in a significant amount of stooping and lifting activities. A task analysis revealed 32 different activities. These included lifting children and equipment, sitting, squatting, climbing and cleaning. The ergonomic project was two parts, Case Study Part 1- Lifting and Case Study Part 2 – Stooping.

Ergonomic Hazards

Hazard! Continuous stopping to perform tasks. Bending, reaching and squatting occurs frequently

Hazard! Sitting with inadequate back, hip and leg support. Activities are performed while in the children's chairs.

ASSESS the Risk

Health and Safety Committee Assessment - The Manitoba Labour 's Ergonomic Guideline contains a checklist that can be used to score tasks for ergonomic risks, refer to Appendix A for details. The characteristics of these tasks scored 5. A score over 7 indicates a hazardous task. The main risk factors include posture and duration of these tasks.

Technical Assessment - Posture sampling is a method of determining the percentage of time a specific posture occurs in a task. In this case, mild to severe stooping occurred nearly 20% of the time.

Worker Consultation - Workers commented mostly on sore knees and backs. They attribute this to the entire workload of the day and not just a single activity. A rating of worker's perceived exertion found an increase from four to seven throughout the day due to stooping and lifting activities.

Standards and Guidelines - Scientific studies of low back posture and duration of tasks found a threshold of greater than 20% of the time to be a key indicator for developing low back injuries.

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Adult sized height adjustable chairs were purchased for clothing children and performing other activities. The health and safety committee investigated options for reducing the amount of stooping. Tools were purchased to reduce stooping while cleaning. Furthermore teaching proper lifting and stooping techniques was taught and practiced.





Results

Direct Cost of Improvements – Six adult chairs at $134 each. Two handi-reachers at $22 each and three magic cleaners at $16 each. The total cost was $864.

Worker Health Benefits - Manitoba Labour's ergonomics checklist score was reduced from 5 to 1 due to an improvement in posture. Workers commented on actually feeling the difference on a daily basis and the ratings of perceived exertion while stooping and lifting was reduced by one point. This may indicate a reduction in fatigue at the end of the day. The posture sampling study found less than 12% of the daily activities involved stooping with a mild or severe stooping posture.

Quality and Efficiency Outcomes - Absenteeism was reviewed before and after the interventions. The average days lost was reduced from 6.1 days per worker to 3.8 days per worker. This included wellness education and other health and safety issues. Temporary workers are required when a day care worker is absent. Therefore, the savings of 2.3 days per worker translates into a total savings of approximately $3010 per year.

Economic Summary - The pay back period is approximately three and a half months.

Other options

- Stretching exercises for the back and whole body.
- Ergonomic office chairs for complete adjustability.

EVERYDAY

Today - All staff received information, instruction, training and supervision on the use of all equipment and safe work procedures.

Tomorrow - A full wellness program will be established and information on the whole health and safety initiative will be shared with the day care industry.

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CASE STUDY 12
Food Production Lifting

SPOT the Ergonomic Hazard

Pulling, lifting and cleaning trays and carts has been identified as potential hazards for developing low back injuries. Warped trays can become caught in the cart and result in more strain to the low back. Heavy carts must be tipped over and lifted again in order for proper cleaning.

Ergonomic Hazards

Hazard! Awkward posture and potential for jerky motions. Trays can become jammed.

Hazard! Heavy lifting and lowering. The cart is heavy and must be tipped for cleaning.

ASSESS the Risk

Health and Safety Committee Assessment - The Manitoba Labour 's Ergonomic Guideline contains a checklist that can be used to score tasks for ergonomic risks, refer to Appendix A for details. The characteristics of this manual handling task scored 9. A score over 7 indicates a hazardous task. The main risk factors include poor posture and potential for forceful exertions.

Technical Assessment - A biomechanical model was used to calculate the forces on the low back. The findings include a compression force of 2300 Newtons and a shear force of over 900 Newtons. The jamming of trays would result in higher numbers. The National Institute for Occupational Safety and Health (NIOSH) has a tool that measures lifting hazards. The tool calculated a lifting index of 1.2. Risk of injury increases when the lifting index is over 1.

Worker Consultation - Workers noted that the most difficult tasks occurred when the cart had to be tipped over and when the trays would jam in the cart.

Standards and Guidelines - The shear forces on the spine for a single lift should be less than 500 Newtons. The NIOSH lifting index should be less than 1.

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While considering changes to the process, the opportunity arose for a light weight plastic tray system that can be stacked. This would eliminate the cart and the potential jarring motion due to jammed trays.

Results

Direct Cost of Improvements - $5000 for new trays.

Worker Health Benefits - Manitoba Labour's ergonomics checklist score was reduced from 9 to 6 due to a reduction in forceful exertions and improved posture. The NIOSH lifting equation was recalculated based on the new light weight plastic trays and the lifting index was now 0.9. The lifting posture will be improved and the shear forces on the back can be reduced to less than 500 Newtons.

Quality and Efficiency Outcomes - Trays that jam in the cart can cause product damage. If the new system reduces scrap by 50% then there can be a savings of $3000 per year.

Economic Summary - The pay back period is approximately 19 months.

Other options

- A motorized lift that repositions the cart instead of heavy manual lifting.
- Replacing or repairing the metal trays as they become damaged.

EVERYDAY

Today - The workplace is moving forward with the complete system change. They found that ergonomic tools can be used to evaluate whether the new trays would be easier on their workers.

Tomorrow - The workplace is seeking more ergonomic training so that any process changes will have an ergonomic component to it.

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CASE STUDY 13
Food Production Whole Body Posture

SPOT the Ergonomic Hazard

Cleaning equipment in the food industry is very important. In this case workers scrub coils for up to one and a half hours. The health and safety committee is concerned about awkward body positions and repetitive motions.

Ergonomic Hazards

Hazard! Awkward body positions. Reaching and stooping.

Hazard! Continuous gripping and forceful exertions. Scrubbing the coils.

ASSESS the Risk

Health and Safety Committee Assessment - The Manitoba Labour 's Ergonomic Guideline contains a checklist that can be used to score tasks for ergonomic risks, refer to Appendix A for details. The characteristics of this cleaning task scored 9. A score over 7 indicates a hazardous task. The main risk factors include arm and back postures and duration of the task.

Technical Assessment - There is variability in this task, however, awkward body positions were observed frequently, more than 30% of the time. There is also more strain on the body joints when they are at their extreme range of motion as occurs in this task.

Worker Consultation - Workers noted that they would not want to perform this task for more than one and a half hours.

Standards and Guidelines - Ergonomic standards and guidelines recommend designing tasks so that awkward postures occur less than 20% of the time.

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A tub was designed to soak the equipment and eliminate scrubbing. Currently the equipment sits in a bath of warm water and cleaning solution for 10 minutes and then receives a quick scrub down.

Results

Direct Cost of Improvements - $1200 for tub and castors.

Worker Health Benefits - Manitoba Labour's ergonomics checklist score was reduced from 9 to 3 due to the improvement in posture and reduction in duration. The awkward postures to lift, lower and scrub the equipment is now less than 5% of the task.

Quality and Efficiency Outcomes - The time to perform this task has been reduced from one and a half hours for two workers to half an hour for two workers. The extra hour is now spent performing other value added tasks. The efficiency savings add up to $90 per week.

Economic Summary - The pay back period for the tub is three months.

Other options

- Educating workers on improved postures while scrubbing.
- Building a jig that can hold the coils.

EVERYDAY

Today - Workers are extremely happy with the new system and have shown an interest in learning more about ergonomics.

Tomorrow - The workplace is looking for more quality and efficiency improvements through their health and safety committee.

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CASE STUDY 14
Food Production Tool Use

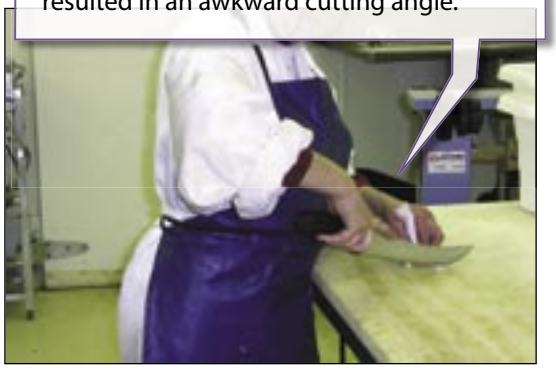
SPOT the Ergonomic Hazard

A butcher shop has the advantage of performing a variety of work throughout the day. However, it is important to have the right tools for the job. In this case a large knife is used for specific cuts. Workers were developing hand problems in the wrist, on top of the knuckle and in the palm of the hand.

Ergonomic Hazards

Hazard! Forceful and continuous gripping. A large knife is used to make cuts.

Hazard! Awkward wrist postures. The tool resulted in an awkward cutting angle.



ASSESS the Risk

Health and Safety Committee Assessment - The Manitoba Labour 's Ergonomic Guideline contains a checklist that can be used to score tasks for ergonomic risks, refer to Appendix A for details. The characteristics of this food processing task scored 11. A score over 7 indicates a hazardous task. The main risk factors include the intensity of the task, posture and direct pressure in the hand.

Technical Assessment - An ergonomic tool called the Strain Index was used to assess the risk of developing hand problems. This task scored 10. The recommendation for a hazardous task is a score over 7. There is also poor shoulder position due to the size of the tool and position of the cut.

Worker Consultation - Workers indicated that the top of the knuckle, the wrist joint and a sore spot in the palm of the hand were issues.

Standards and Guidelines - General recommendations for continuous tool use includes avoiding bending the wrist while squeezing the tool, avoid repetitive pinch gripping and direct pressure in the palm of the hand.

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FIND a Safer Way

The right tool for the job was found. Poultry shears are now used for the specific cuts. There is less strain in the hands and the time to complete the task is one third less.

Results

Direct Cost of Improvements - $48 for poultry shears.

Worker Health Benefits - Manitoba Labour's ergonomics checklist score was reduced from 11 to 4 due to an improvement in hand posture, force and a reduction in direct hand pressure. The Strain Index score was reduced from 10 to 4. Workers do not feel any fatigue in the hands when the work is completed.

Quality and Efficiency Outcomes - The time to complete this task has been reduced by one third. This translates into more time for producing other products. The increase in production has been estimated to be $50-100 per day.

Economic Summary - The pay back period for the poultry shears is one day.

Other options

- Using a smaller knife.
- Talking small breaks every 15-20 minutes.

EVERYDAY

Today - The workplace used to think that spending money on specific tools would be of little value. However, today they are looking at all their tasks to see if health and safety, efficiency and quality improvements can be made.

Tomorrow - The workplace is sending a staff member to receive additional health and safety training so that all issues can be dealt with as they arise.

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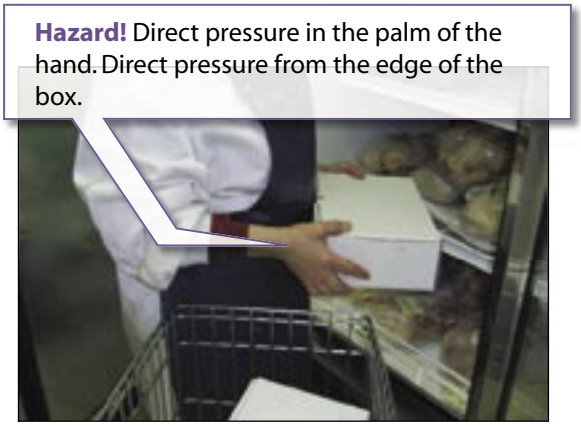
CASE STUDY 15
Food Production Material Handling

SPOT the Ergonomic Hazard

Large orders of product are packaged, stored and shipped. This task involves repetitive handling of cardboard boxes in a cool environment. After this task is performed, workers comment on how fatigued their hands feel.

Ergonomic Hazards



ASSESS the Risk

Health and Safety Committee Assessment - The Manitoba Labour 's Ergonomic Guideline contains a checklist that can be used to score tasks for ergonomic risks, refer to Appendix A for details. The characteristics of this material handling task scored 9. A score over 7 indicates a hazardous task. The main risk factors include grip force and direct pressure in the hands.

Technical Assessment - There is no technical assessment for direct pressure except observation. There is direct pressure in the palm of the hands during this task. Electromyography was used to measure the amount of muscular activity in the forearm muscles. The findings indicate that workers are using 10-15% of their maximum effort for 50% of the time when handling boxes.

Worker Consultation - Workers perceive that their effort to grip the box increases from 4 to 7 after performing this task for more than one hour.

Standards and Guidelines - Ergonomic guidelines indicate that direct pressure should be eliminated, the hands kept warm and that continuous grip effort should be less than 15% of a worker's maximum effort.

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FIND a Safer Way

Material handling gloves were purchased. They have a sticky side that helps with gripping, reduces direct pressure, helps to keep hands warm and may help with hand fatigue. The gloves may reduce grip efforts since there is a better 'feel' for the box.

Results

Direct Cost of Improvements - $30 for three sets of material handling gloves.

Worker Health Benefits - Manitoba Labour's ergonomics checklist score was reduced from 9 to 5 due to a reduction in grip force and direct pressure in the hands. Workers comment on having a reduced perceived effort to grip the boxes. The Electromyographic readings of muscular activity were reduced from 10-15% to 9-12% of maximum grip effort.

Quality and Efficiency Outcomes - The quality and efficiency improvements were found in the tasks that occur immediately after handling boxes. Due to hand fatigue and cold, the quality and pace of work in the other tasks suffered. The employer estimated a benefit of $30/week due to quality of work and efficiency improvements.

Economic Summary - The pay back period for three sets of material handling gloves is five days.

Other options

- Wearing cotton gloves for the cold.
- Having two workers perform this task so that it is faster.

EVERYDAY

Today - All workers like the gloves and are using them for other material handling tasks.

Tomorrow - The workplace has started health and safety talks to improve worker communication about all health and safety issues.

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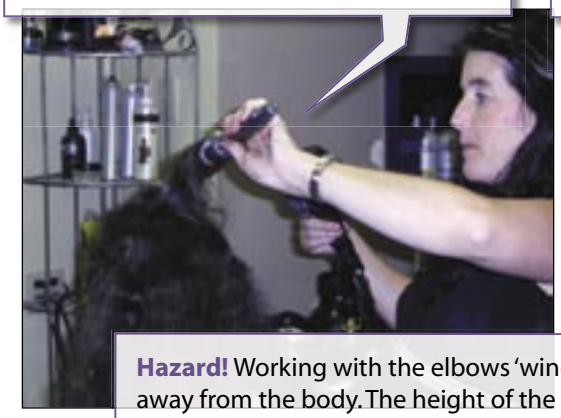
CASE STUDY 16
HAIR SALON Tool Use

SPOT the Ergonomic Hazard

A study of former hair stylists found over 40% left the business because of health and safety issues. Chemical sensitivities and musculoskeletal (sprain and strain) injuries were the main issues. Hair stylists at this salon identified using the rolling brush while drying hair as hard on the hands, forearms and neck area. This task can take 15 to 20 minutes to perform on a client with long hair.

Ergonomic Hazards

Hazard! Bending the wrist backwards while gripping a tool. The brush is often rotated to add or reduce the curl in the hair while drying.



Hazard! Gripping onto tools continuously and holding arms up for long periods of time. This task can occur for 15-20 minutes continuously. It is also difficult for hair stylists to take a break in the middle of a client's session.

Hazard! Working with the elbows 'winged out' away from the body. The height of the worker, the chair's adjustability and the performance of the task do not allow for the elbows to be 'in close' to the body.

ASSESS the Risk

Health and Safety Committee Assessment - The Manitoba Labour's Ergonomics Guideline contains a checklist that can be used to score tasks for ergonomic risks, refer to Appendix A for details. The score for this task was found to be 7 due to the type of work, the effort required and the poor postures. A score over 7 indicates a hazardous task.

Technical Assessment - Electromyography is the study of muscular activity. A tool can be used to measure the muscular activity of muscles and, therefore, determine how much effort is being produced and for how long. The readings are compared to the individual's maximum effort. During this task it was found that an average of 28% of a worker's maximum effort (peak effort was 40%) was being used for the forearm extensors (muscles on the back of the forearm). This mainly occurred when the brush was being rotated and the wrist bent backwards. A guide for determining limits for hand injuries called the Hand Activity Level suggests that this task is above the level that is considered a 'safe' job.

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Worker Consultation - Consultations with workers found muscular pain on the top part of the shoulder, in the back of the forearm and at the back of the wrist joint. This is consistent with the type of work that is occurring and the anatomy of these areas.

Standards and Guidelines - Direct observations of worker's posture found near maximum wrist extension (bending backwards) occurring 30% of the time and shoulder abduction (elbow winging out) greater than 45 degrees to occur 25% of the time. Some posture guidelines recommend that poor postures be under 20% of the total task time.

FIND a Safer Way

There is no tool on the market that can improve the wrist and shoulder posture. If the chair is lowered and/or the worker is raised so that the work is performed at chest level then an improvement in shoulder posture can be made. However, this change actually increased the amount of bending in the wrist because of the tool shape and the inherent nature of the hair rolling procedure.

Work organization and improved work practices were implemented. The schedule of clients was reviewed. Instead of one to three clients with long hair scheduled in a row, they were intermixed with other types of hair styling that did not require much hair rolling.

Workers were also educated on the findings of the study and provided training on keeping the wrist as straight as possible when rolling hair.

Results

Direct Cost of Improvements - $0 of physical purchases.

Worker Health Benefits - The Workplace Safety and Health Ergonomics checklist score was reduced from 7 to 4 due to a reduction in exposure to risk factors from the increased task variability. The percentage of time with wrist bending backwards was reduced from 30% to 20% and shoulder abduction (elbows winging out) from 25% to 15%. The Hand Activity Level was also improved to a score that is below the required limit and therefore is now considered a 'safer' job. This was mainly accomplished from an increase in task variability by rescheduling clients.

Quality and Efficiency Outcomes - The short term effects of this intervention were noticed at the end of the day when workers commented that they did not feel 'beat up and tired'. It is hoped that this will translate into better customer service since a cheerful and pleasant hair stylist is important to clients.

Other options

- Training workers to switch hands throughout the day.
- Purchasing different sized brushes for possible improved wrist postures.
- Muscle strengthening and conditioning exercises.

EVERYDAY

Today - Hair stylists are reviewing their booking procedures and determining the best fit between client needs and their work schedule.

Tomorrow - The workplace will be conducting periodic surveys of their hair stylists to determine the long term benefits of this change. They are committed to working together to overcome any obstacles to the new work organization schedule.

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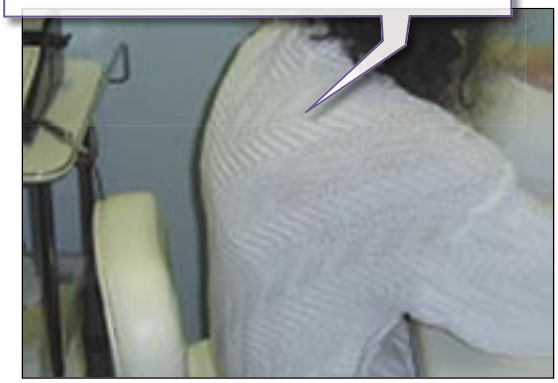
CASE STUDY 17
HAIR SALON Awkward Posture

SPOT the Ergonomic Hazard

Esthetician work involves long hours hunched over clients. These tasks include fine dexterity, visual acuity and high concentration and attention demands. The musculoskeletal problems that these workers experience includes sore necks, backs and hands. The equipment involved is usually designed for the client's comfort and not the workers.

Ergonomic Hazards

Hazard! Rounded back. Slouching and improper working height results in a rounded back.



Hazard! Knees below hip height. Poor sitting position caused by poor leg clearance.

ASSESS the Risk

Health and Safety Committee Assessment - The Manitoba Labour 's Ergonomic Guideline contains a checklist that can be used to score tasks for ergonomic risks, refer to Appendix A for details. The characteristics of this static posture task scored 9. A score over 7 indicates a hazardous task. The main risk factors include trunk posture, sitting position and lack of foot support.

Technical Assessment - Initial observations found this task to be very static with lack of posture changes. A posture sampling study found that postures changed only a few degrees for 90% of the time. A good job has posture changes for 50% of the time or less.

Worker Consultation - The worker's rating of perceived discomfort increased significantly after one hour client. It is also hard to adjust the bed and chair so the worker's body posture can be improved. Workers believe that the discomfort is an inherent part of their job.

Standards and Guidelines - Research has shown that 'rounding the lower back' when lifting or sitting for prolonged periods of time can stretch the ligaments and quickly fatigue the muscles. This can lead to an increased risk of sprain or strain injuries. Rounding of the lower back should be avoided. Furthermore, sitting with the knees lower than the hip can also add to rounding of the lower back. These postures should be avoided.

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There are no reasonable equipment purchases that can be made to the bed or chair that can improve the adjustability of this workstation. Therefore education and awareness about body postures was implemented. The reduction in 'rounding' of the lower back was accomplished through training and adjusting the magnifying glass/light. Some sitting tasks can be changed to standing tasks where one foot can be placed in front of the other in order to reduce bending at the waist.

Results

Direct Cost of Improvements - $0 of physical purchases.

Worker Health Benefits - Manitoba Labour's ergonomics checklist score was reduced from 9 to 4 due to an improvement in posture and foot support. Workers have indicated they feel 50% better after performing work on a 1 hour client. Static postures now occur for more than 50% of the time, down from 90%.

Quality and Efficiency Outcomes - This is a visual inspection and concentration task. There is a mental load on the worker when their muscles are tired and sore. Therefore errors or frustration can easily set in when workers are bothered by long duration clients. The workers report a 50% improvement in their discomfort which should translate into improved customer satisfaction and, therefore, a decrease in client complaints or lost clients due to poor work.

Economic Summary - The pay back period for this improvement would be one day since the cost is non-existent.

Other options

- Height adjustable bed so that knees can fit under the bed when sitting.
- A sit/stand stool, but this would require a height adjustable bed.
- Specific muscle stretching exercises.

EVERYDAY

Today - The workplace is more aware of their working postures and beginning to try different posture changes when working for long periods of time.

Tomorrow - The workplace will be looking at other work scheduling changes that can space out the long duration clients.

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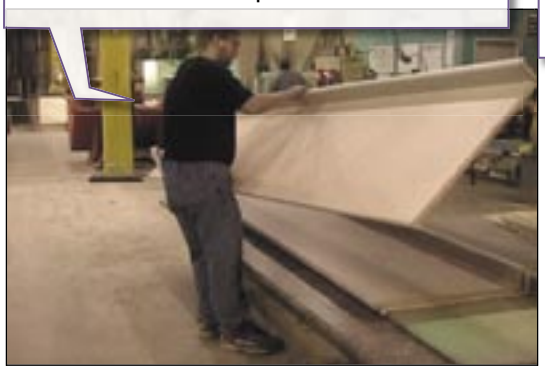
CASE STUDY 18
Manufacturing Lifting

SPOT the Ergonomic Hazard

The lifting of materials from a pallet was identified as an ergonomic hazard. The size, shape and weight of the material led to low back strain.

Ergonomic Hazards

Hazard! Lifting from below knee height. Material is lifted off a pallet.



Hazard! Awkward body posture when lifting. The material's size and shape forces workers to adopt poor lifting postures.

ASSESS the Risk

Health and Safety Committee Assessment - The Manitoba Labour 's Ergonomic Guideline contains a checklist that can be used to score tasks for ergonomic risks, refer to Appendix A for details. The characteristics of this manual handling task scored 13. A score over 7 indicates a hazardous task. The main risk factors include posture and weight of the load.

Technical Assessment - A biomechanical model was used to calculate the forces on the low back. The findings include a compression force of 3200 Newtons and a shear force of over 500 Newtons. A cumulative loading low back pain reporting index indicated that there is a 65% chance the worker performing this job would be classified as a low back pain case due to a combination of variables including frequency and duration.

Worker Consultation - Workers noted that they are used to performing this task. However, workers noted that the task demands were one reason they switched jobs and that workers with low back pain could not perform this task.

Standards and Guidelines - The compression forces on the spine should be below 3400 Newtons for a single lift and shear forces should be less than 500 Newtons. A lifting task should not increase the risk of reporting low back pain for more than 20% of the population.

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A lifting device was purchased to reduce stooping and twisting. The material is now handled at waist level and slides onto a conveyor.

Results

Direct Cost of Improvements - $4020 for the lifting device and new cart wheels.

Worker Health Benefits - Manitoba Labour's ergonomics checklist score was reduced from 13 to 3 due to a reduction in manual handling risk factors. The low back compression and shear forces were reduced to 1200 Newtons and 150 Newtons. The lifting index was reduced to 9%. Workers now find this task easier to perform.

Quality and Efficiency Outcomes - The main efficiency benefit involves the return to work program. Previously workers with job restrictions could not perform this task, but now they can. The cost savings have come from injured workers performing at 50% of their capacity to now 100%. This translates into a labour savings of approximately $10,000 and an improved job rotation schedule.

Economic Summary - The pay back period for this project was five months.

Other options

- A mechanical lifting device that would lift each piece.
- A built-in lifting device in each cart.

EVERYDAY

Today - The workplace has improved their job rotation schedule, and are able to return injured workers back to this job. Workers now find this task less fatiguing on the back.

Tomorrow - The workplace has identified three other tasks that need improvement.

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CASE STUDY 19
Manufacturing Tool Use

SPOT the Ergonomic Hazard

The health and safety committee identified tapping ends as a concern. Tapping ends involves gluing and securing material by tapping with a block. There are concerns for the opposite hand due to the force required to hold the product in place wile tapping.

Ergonomic Hazards

Hazard! Potential for direct pressure in the palm of the hand. Gripping the block and the impact from tapping the material.

Hazard! Static holding effort with force. The opposite hand exerts a downward force.

ASSESS the Risk

Health and Safety Committee Assessment - The Manitoba Labour 's Ergonomic Guideline contains a checklist that can be used to score tasks for ergonomic risks, refer to Appendix A for details. The characteristics of this assembly task scored 7. A score over 7 indicates a hazardous task. The main risk factors include the forces applied by both hands.

Technical Assessment - Electromyography is the study of muscular activity. A tool can be used to measure the activity of muscles and, therefore, determine how much effort is being produced and for how long. The readings are compared to the individual's maximum effort. During this task it was found that up to 75% of the individual's maximum forearm effort was involved. This reading actually shows the impact force from the block onto the material. For the opposite hand there was a static effort of 25% of the individual's maximum triceps effort.

Worker Consultation - Workers found the opposite shoulder to increase in discomfort throughout the shift.

Standards and Guidelines - Scientific literature found many studies linking continuous static holding and shock or impact forces with increased reporting of injuries.

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A roller tool was found that performed the task with the same quality and efficiency standards but was easier on the hands. There was no more impact pressure and, therefore, the material moved less. There was reduced effort from the opposite hand to hold the material in place.

Results

Direct Cost of Improvements - $30 for roller tool.

Worker Health Benefits - Manitoba Labour's ergonomics checklist score was reduced from 7 to 4 due to a reduction in force application in both hands. The electromyographical readings were reduced by 12% for the forearm muscles and 8% for the opposite arm. Workers noted less fatigue in the opposite arm over the shift and a better fit of the roller tool in the hand than the block.

Quality and Efficiency Outcomes - Workers were less fatigued at the end of the shift. This has translated into more production. When high production demands are observed then workers make less mistakes and are more efficient because their hands are not sore. It was estimated that the roller tool paid for itself in the first day.

Economic Summary - The pay back period for this project was one day.

Other options

- Grip wrap around the block was considered.
- A tacky material was considered for the table to increase the friction.

EVERYDAY

Today - Management was unaware of issues with the opposite hand. Today the health and safety committee is conducting a survey of their workers to identify problem jobs and perform a job hazard assessment.

Tomorrow - The health and safety committee is developing an action plan to systematically observe and correct any problem jobs.

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CASE STUDY 20
Manufacturing Arm Posture

SPOT the Ergonomic Hazard

While the health and safety committee was working on identifying, assessing and correcting problem jobs, they noticed several tasks that involved posture issues. These tasks did not have injuries or complaints but were assessed based on a preventative approach.

Ergonomic Hazards

Hazard! Awkward postures of the shoulder. Winging the elbow out.

Hazard! Awkward postures of the hand. Bending the wrist backwards while performing tasks.

ASSESS the Risk

Health and Safety Committee Assessment - The Manitoba Labour 's Ergonomic Guideline contains a checklist that can be used to score tasks for ergonomic risks, refer to Appendix A for details. The characteristics of these tasks scored 4. A score over 7 indicates a hazardous task. Note that five risk factors were present in these tasks but they all scored a '0' because of low duration of exposure. The main issues were due to posture.

Technical Assessment - Ergonomic assessment tools such as the Strain Index and research studies of postural loads indicated that these tasks did not present hazardous work. This was due to the low force and duration of the tasks. The posture was at or near its end range of motion. Therefore some workers may find these body positions awkward.

Worker Consultation - Workers that perform these tasks did not report any issues. However, workers in the return to work program did find these tasks aggravating for their specific issues.

Standards and Guidelines - Extreme range of motion postures should be minimized as much as possible.

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Education and awareness of postures and its effects on the musculoskeletal system was given to all workers. Tasks where the elbow can be brought in closer to the body and the wrist placed in a more neutral position was identified and safe work practices developed.

Results

Direct Cost of Improvements - $0.

Worker Health Benefits - Manitoba Labour's ergonomics checklist score was reduced from 4 to 2 due to a reduction in exposure to risk factors from improved posture. Healthy workers did not notice much of a difference but workers in the return to work program found the task less fatiguing. The extreme ranges of motion were reduced in eight different tasks.

Quality and Efficiency Outcomes - Quality of work can be improved when workers are less fatigued but this was difficult to show in these tasks. An efficiency improvement was noted when more return to work issues were resolved earlier with less aggravation of old injuries. These tasks were now available for these workers and the tasks did not re-aggravate their injuries. The benefits include less overtime for current workers, less use of temporary workers and easier disability management.

Economic Summary - The pay back period for the training time was estimated at three days.

Other options

- Purchasing new tools that resulted in less awkward postures.
- Increasing the job rotation program so that less time is spent on these tasks.

EVERYDAY

Today - The workplace has more confidence in the health and safety committee because of their practical methods for assessing and correcting tasks and the obvious benefits that have evolved.

Tomorrow - The workplace is keeping track of their return to work successes and improvements in reducing overtime and hiring of temporary staff.

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CASE STUDY 21

Manufacturing Material Handling

SPOT the Ergonomic Hazard

Many industrial tasks involve the handling of barrels. These metal and plastic containers can weigh as much as 800 pounds (363 kg). Loading and unloading trucks and moving barrels were identified as a risk for low back strain and pinched fingers.

Ergonomic Hazards

Hazard! Awkward body positions with heavy load. Handling barrels can involve awkward body positions.

Hazard! High force exertions. Tipping barrels involves high forces.

ASSESS the Risk

Health and Safety Committee Assessment - The Manitoba Labour 's Ergonomic Guideline contains a checklist that can be used to score tasks for ergonomic risks, refer to Appendix A for details. The characteristics of this material handling task scored 6. A score over 7 indicates a hazardous task. The overall score does not represent the potential severity of one incident. The main risk factors include the weight and gripping of the barrels.

Technical Assessment - A biomechanical model was used to calculate the forces on the low back. The findings include a compression force of 3200 Newtons and a shear force of over 500 Newtons when attempting to pivot the barrel. There is also a high moment of force on the shoulders which is 85 Nm (Newton-meters).

Worker Consultation - There is a skill to handling barrels but if there is a slip then the weight of the barrel can place a significant amount of strain on the shoulders and back and can lead to pinched fingers when barrels are close together.

Standards and Guidelines - The guidelines for low back compression and shear forces are 3400 Newtons and 500 Newtons for a single lift. A tool used to measure the percentage of workers capable of performing this task found only 75% had the required shoulder strength.

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FIND a Safer Way

A four wheeled barrel handling device that can place barrels onto pallets was purchased. This was used in the trucks and in the facility.

Results

Direct Cost of Improvements - $350 for the four wheeled barrel handling device.

Worker Health Benefits - Manitoba Labour's ergonomics checklist score was reduced from 6 to 2 due to a reduction in material handling risk factors such as force and gripping. Workers find the barrel handling task easier and safer. A two wheeled dolly was difficult to balance when used for long aisles and could not be placed on pallets.

Quality and Efficiency Outcomes - There is an efficiency component due to the improved balance of the device. It is quicker to maneuver in the field where you have no control over the customer's environment. The lifting of barrels onto pallets is also an efficiency improvement. This workplace found a 10% reduction in time when there are loads that require many trips. This can translate into less overtime or the loading of trucks can occur the night before.

Economic Summary - The pay back period for this mechanical device is three months.

Other options

- A mechanical lifting device that would lift every barrel.
- Stretching program for workers.

EVERYDAY

Today - The workplace is purchasing three more devices.

Tomorrow - The workplace is investigating other ergonomic problems for health and safety, efficiency and making jobs easier for workers with existing musculoskeletal issues.

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CASE STUDY 22
Manufacturing Lifting

SPOT the Ergonomic Hazard

Lifting barrels off the floor was identified as an ergonomic hazard. The manual handling of barrels requires tipping and rolling. This is a skill, however, when loads are unbalanced, there is a poor grip, or the floor conditions are poor (icy, uneven, etc.) then barrels can be dropped. Besides strain on the back, the health and safety committee also noticed the potential for pinched fingers when workers try to catch a falling drum.

Ergonomic Hazards

ASSESS the Risk

Health and Safety Committee Assessment - The Manitoba Labour 's Ergonomic Guideline contains a checklist that can be used to score tasks for ergonomic risks, refer to Appendix A for details. The characteristics of this lifting task scored 8. A score over 7 indicates a hazardous task. The main risk factors include posture and weight of the load.

Technical Assessment - A biomechanical model was used to calculate the forces on the low back. The findings include a compression force of 3600 Newtons and a shear force of over 900 Newtons when attempting to lift the barrel.

Worker Consultation - Workers note that they usually have to find another worker to help lift a barrel but occasionally they do it themselves.

Standards and Guidelines - The guidelines for low back compression and shear forces are 3400 Newtons and 500 Newtons for a single lift.

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FIND a Safer Way

A barrel lifter was purchased to help lift the barrels. Sometimes workers would try to hang onto the barrel instead of letting it drop because it was more difficult to lift up. This would lead to pinched fingers and more strain on the lower back.

Results

Direct Cost of Improvements - $55 for barrel lifter**.**

Worker Health Benefits - Manitoba Labour's ergonomics checklist score was reduced from 8 to 5 due to improved posture and reduced force to lift. The workers find that the barrel lifter is easier to use and there is less strain on the back. The biomechanical strain on the lower back is now reduced to 1500 Newtons of compression and 300 Newtons of shear force.

Quality and Efficiency Outcomes - This task is not performed by workers with low back problems. This has led to difficulties in arranging work and wasted time in finding someone else to lift the barrels. After the device was used, a few workers with existing back problems said they could now perform this task. The benefits involve less wasted time to lift a barrel, improved return to work tasks and improved work organization.

Economic Summary - The pay back for this device is one to three days.

Other options

- Purchasing a mechanical lifting device.
- Purchasing two-way radios for faster communication with coworkers.

EVERYDAY

Today - Workers are making sure the device is always available should they require it.

Tomorrow - The workplace is investigating other ergonomic problems for health and safety, efficiency and making jobs easier for workers with existing musculoskeletal issues.

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CASE STUDY 23
METAL FABRICATION Lifting

SPOT the Ergonomic Hazard

A small metal fabrication shop has a problem with handling sheets of metal after they have been cut in the Accushear machine. There have been no reports of injuries associated with this task. Workers find the lifting and stacking of metal pieces of varying sizes and weights to be a concern. Product is lifted from the back of the Accushear machine and stacked on a pallet or brought back to the front of the device for another cut. There are two workers who perform this task for three to four hours every day.

Ergonomic Hazards

Hazard! Lifting objects from below knee height. Objects are lifted off the floor or from a 5 inches (13cm) high pallet.

Hazard! Stooping and reaching for objects continuously. The various sizes and weights of products results in workers having to stoop and reach, sometimes awkwardly.

Example of types of cut material.

ASSESS the Risk

Health and Safety Committee Assessment - The Manitoba Labour's Ergonomics Guideline contains a checklist that can be used to score tasks for ergonomic risks, refer to Appendix A for details. The characteristics of this manual handling task scored 8. A score over 7 indicates a hazardous task. The main risk factors are reach, posture and weight of the objects.

Technical Assessment - A biomechanical analysis of this task found the low back spine to experience up to 2591 Newtons of compression force and 218 Newtons of shear force. These numbers are acceptable but it is a measure of only one lift. A cumulative loading low back pain reporting index indicated there is a 43% chance the worker performing this job would be classified as a low back pain case due to a combination of variables including frequency and duration.

Worker Consultation - Direct observation and consultation with workers found poor body postures due to height, reach and the tight space. Both workers indicated this is a high turnover job.

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Standards and Guidelines - One lifting guideline found there to be no known safe limit' for repetitive lifting under these conditions.

FIND a Safer Way

A cart was made in-house that can accommodate all the materials that are cut. A pallet is placed on top to accommodate wrapping and, therefore, reduces double handling. The cart is also used to transport material to be cut again, further reducing the double handling of material.

Results

Direct Cost of Improvements - $100 for materials and $60 for castors. The cart was made in-house. The cost of this cart for retail value is approximately $500.

Worker Health Benefits - A potential lifting hazard reduction of nearly 100%. All lifting has been eliminated and replaced with push and pull forces. These forces are well within guidelines.

Quality and Efficiency Outcomes - This task can now be performed in two thirds of the original time or one worker can be assigned to another task. The cost savings is approximately $80-$100 per day.

Economic Summary – The pay back period for this improvement is a few days.

Other options

- Proper lifting, training and stretching exercises would not be a benefit since there are still high forces and poor low back posture.

EVERYDAY

Today - Workers and management are excited about looking at other tasks to see what ergonomic improvements can be made. Even though you may not have injuries, problem jobs may still exist.

Tomorrow - The workplace will be conducting ergonomic hazard awareness training for their staff. A process improvement/ergonomic budget will also be established.

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CASE STUDY 24
METAL FABRICATION Material Handling

SPOT the Ergonomic Hazard

The manual handling of products is a common task in most workplaces. In this case, the turning and placement of material is performed by two workers. The long and thin sheet metal is turned on a worktable and placed in a cutting machine where the lengths are cut accurately. The health and safety committee identified this task as an ergonomic concern because of the continuous holding and lifting.

Ergonomic Hazards

Hazard! Lifting of awkward material. The sheet metal bends and can weigh up to 100 pounds.

Hazard! Continuous holding. Feeding the sheet metal requires continuous holding.

ASSESS the Risk

Health and Safety Committee Assessment - The Manitoba Labour's Ergonomic Guideline contains a checklist that can be used to score tasks for ergonomic risks, refer to Appendix A for details. The characteristics of this manual handling task scored 7. A score over 7 indicates a hazardous task. The main risk factors include lifting and handling of the material.

Technical Assessment - Holding onto the material requires a pinch or lateral pinch grip with wrists in a non-neutral position. The grip force and wrist posture was measured and inputted into a biomechanical model. Only 60% of the working population had a grip capacity capable of performing this task.

Worker Consultation - Workers identified this task as always having the potential for strain. The various sizes of material results in awkward postures as the material is turned. Workers rated this task 6 on a 10 point scale of potential hazards.

Standards and Guidelines - Continuous pinching increases the pressure in the wrists and hands. Therefore ergonomic guidelines suggests designing tasks with a neutral grip position and acceptable to 90% of the working population when performing pinch grip tasks.

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One worker had a suggestion to pivot the table instead of the material. This led to a worktable with wheels. A car jack raises and lowers the table enough to allow the wheels to rotate the table. There was also a suggestion to place gauges on the rails to allow for quicker measuring. Both task improvements were made in house.

Results

Direct Cost of Improvements - $120 for materials, made in house.

Worker Health Benefits - Manitoba Labour's ergonomics checklist score was reduced from 7 to 3 due to a reduction in lifting and handling. Workers have rated this task 1 on a 10 point scale of hazards and 99% of the working population is now capable of performing this task.

Quality and Efficiency Outcomes - This job improvement has reduced the need for two workers. The spin table and gauges allows for one worker to handle and measure the material. There is a labour savings since the other worker can now perform other duties. Using the gauges is also a time saving measure. A total of two labour hours per day was found after the improvements were implemented.

Economic Summary - The pay back period for this task improvement was three days.

Other options

- Purchasing a cart that has a spinning table top.
- Training workers to grasp the material with neutral wrist positions.

EVERYDAY

Today - The workplace has identified and made changes to two other tasks. They are using the ergonomic checklist to evaluate the tasks before and after changes are made.

Tomorrow - The workplace is sending their health and safety committee for more training so that all potential hazards can be investigated and resolved.

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CASE STUDY 25
METAL FABRICATION Material Handling II

SPOT the Ergonomic Hazard

It was not difficult for the health and safety committee to identify the most hazardous task. The transfer of dies from a rack to the cutting machine involves heavy and awkward material handling, multiple workers and good manipulation skills to properly lay the die onto the cutting machine.

Ergonomic Hazards

Hazard! Forcefull exertions. The dies are heavy and are pulled out from the rack.

Hazard! Awkward and heavy lifting. Lifting and positioning the die requires 2 or 3 workers.

ASSESS the Risk

Health and Safety Committee Assessment - The Manitoba Labour 's Ergonomic Guideline contains a checklist that can be used to score tasks for ergonomic risks, refer to Appendix A for details. The characteristics of this material handling task scored 12. A score over 7 indicates a hazardous task. The main risk factors include posture and weight of the material.

Technical Assessment - A biomechanical model was used to calculate the compression and shear forces acting on the low back. They are 3600 Newtons of compression force and 396 Newtons of shear force. These calculations involve only single lifts with two workers. There are several lifts performed per shift and worker coordination must, therefore, be precise every time.

Worker Consultation - All workers identified this task as the most hazardous in the workplace due to awkward and heavy lifting.

Standards and Guidelines - There is no maximum weight limit in Manitoba's provincial safety regulations, however, the capabilities of the workers and the known hazards in the task must be taken into consideration. Therefore, according to standards and guidelines, single lifts should have a low back compression force limit of 3400 Newtons and a shear force limit of 500 Newtons. Furthermore, worker consultation would have an effect on the overall hazard assessment.

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A manual crank fork lift was purchased to assist in the manual handling of dies. The dies are pulled out of the rack a few feet, the forks are placed under and lifted slightly. The die is pulled out and balanced on the forks. The forks are then raised or lowered to the machine bed height. The die is then pulled onto the machine bed. Only one worker is required for this task. The time to accomplish this task is shorter since it takes less time to gather two or three workers to perform this coordinated lift.

Results

Direct Cost of Improvements - $995 is the purchase price of the lifting device.

Worker Health Benefits - Manitoba Labour's ergonomics checklist score was reduced from 12 to 2 due to a reduction in material handling and lifting. Workers now rate this task 3 on a 10 point scale of hazardous tasks. The low back compression and shear forces are now 889 Newtons and 233 Newtons for the initial pull out and placement of dies.

Quality and Efficiency Outcomes - The labour requirements have been reduced from two to three workers to one. This has resulted in a time savings of one hour per shift. There are also other uses for this device in the workplace that have been identified for health and safety reasons. They include other material handling tasks in racks, moving worktables around and improving the process of material flow between worktables.

Economic Summary - The pay back period for this device was calculated to be 25 weeks due to time savings for this one task.

Other options

- Redesigning the racks to have roller ball channels and a mechanical hoist.
- Purchasing a lifting device with a gantry system to grasp, lift and place the dies.

EVERYDAY

Today - The workplace is identifying other tasks the lifting device can be used for and developing safe work procedures so all workers are trained in its proper use.

Tomorrow - The workplace is seeking more health and safety information so that their committee can make informed decisions about hazards and what can be done to reduce them.

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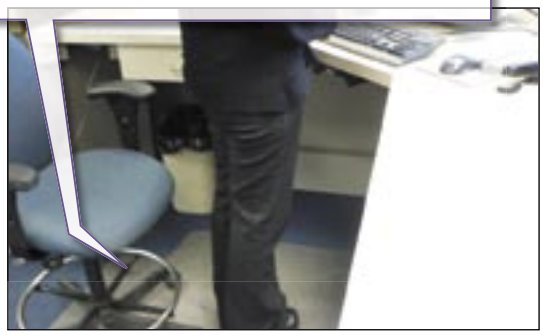
CASE STUDY 26
Office Workstation Sitting and Standing

SPOT the Ergonomic Hazard

Standing all day gave workers sore legs and sitting resulted in a sore lower back. This is a standing workstation, therefore, workers who choose to sit have to raise their chair to a high level and place their feet on the foot ring or if they have longer legs, on the floor.

Ergonomic Hazards

Hazard! Prolonged standing without adequate foot support. There is no place to raise and rest their feet.



Hazard! Sitting without adequate foot support and poor leg posture. The foot ring and hip-knee angle are problems.

ASSESS the Risk

Health and Safety Committee Assessment - The Manitoba Labour 's Ergonomic Guideline contains a checklist that can be used to score tasks for ergonomic risks, refer to Appendix A for details. The characteristics of this standing and sitting office task scored 7. A score over 7 indicates a hazardous task. Main risk factors include poor posture and duration of this task.

Technical Assessment - Standing with minimal movement is a requirement for the whole shift. Sitting with the knee below the hip changes the orientation of the pelvis and the lower back. This reduces the normal curvature of the lumbar section of the lower back. Placing the feet on the foot ring results in the foot being positioned behind the knee. This stretches the quadriceps (thigh) muscles and also changes the orientation of the pelvis and the lower back. These postures place the lower back in a biomechanical poor position and can result in low back fatigue and soreness.

Worker Consultation - Workers rated their discomfort throughout the day from a one increasing to five for standing, one increasing to six for sitting and one increasing to four involving a combination of both.

Standards and Guidelines - There should be adequate foot support when standing for prolonged periods of time. There should also be adequate foot support when sitting for prolonged periods of time. Sitting posture should involve feet positioned in front of the knee and the knee should not be lower than the hip in terms of vertical height.

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A footrest and worker education and awareness was key to solving this problem. A footrest provided adequate foot support when standing and sitting. In some instances a higher footrest was required for shorter workers who prefer to sit. Workers were made aware of how the lower back works and proper sitting and standing positions.

Results

Direct Cost of Improvements - Each footrest cost $30.

Worker Health Benefits - Manitoba Labour's ergonomics checklist score was reduced from 7 to 2 due to an improvement in posture. Worker ratings of perceived discomfort throughout the day started at one and only increased to three for standing and sitting choices. All workers were able to keep a neutral lumbar curve when standing and sitting due to the improved knee and hip positions.

Quality and Efficiency Outcomes - Office workstation tasks can be assessed for productivity and quality improvements several ways. In this case a rating of work measures and worker measures were used. There were improvements in worker satisfaction and comfort which can be related to improvements in work quantity and quality. The effect of the changes scored 10 which relates to a marginal work improvement.

Economic Summary - The cost of the footrest in terms of a marginal improvement in work is justifiable.

Other options

- A height adjustable footrest.
- A chair with a larger foot ring.

EVERYDAY

Today - The workers have no complaints at this workstation and the health and safety committee is assessing all of their other workstations.

Tomorrow - The workplace has made cost effective changes to all of their workstations. All hazards have been identified and corrected. Now they are working on an employee wellness program.

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CASE STUDY 27

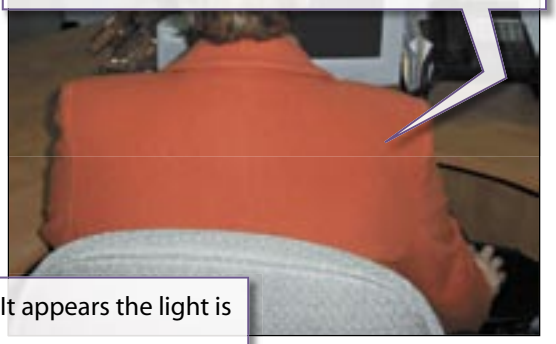
Office Workstation Mouse Position and Lighting

SPOT the Ergonomic Hazard

A health and safety committee member noticed something unusual about a worker's shoulder position while using the computer. The right shoulder appeared to be lower than the left when using the mouse. A survey of all staff revealed right shoulder tenderness and some hand pain in workers who use the mouse continuously for more than one year. There were also comments made about the lighting.

Ergonomic Hazards

Hazard! Static postures with limited movement. The mouse is moved mostly with the wrist and not the arm.



Hazard! Poor posture. The right shoulder is dropped slightly when using the mouse.

Hazard! Poor lighting. It appears the light is too bright.

ASSESS the Risk

Health and Safety Committee Assessment - The Manitoba Labour 's Ergonomic Guideline contains a checklist that can be used to score tasks for ergonomic risks, refer to Appendix A for details. The characteristics of this office workstation task scored 7. A score over 7 indicates a hazardous task. The main risk factors include the workers' posture and lighting issues.

Technical Assessment - The right shoulder is lower than the left when using the mouse. This is due to the mouse tray being half an inch (1.3 cm) lower than the keyboard tray. The mouse is positioned three inches (18 cm) away from the keyboard. This results in an outstretched arm. The shoulder is depressed and the wrist is used to move the mouse. This position can compress a tendon in the shoulder area and can result in a tendinosis injury. This is due to pressure over a long duration. The wrist can be overused when it is the primary mover of the mouse. The pressure within the wrist is increased and has been related to hand/wrist injuries. The brightness of the work area was 490 lumens and the amount of reflectance off the desk 12 lumens.

Worker Consultation - There appears to be higher reports of discomfort in the front part of the shoulder and the wrist when workers used this type of keyboard tray for more than one year. The discomfort increases with the duration of the day and is reduced on weekends. This can be consistent with a tendinosis type of injury.

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Standards and Guidelines - There are no specific guidelines for intramuscular pressure due to dropping of the shoulder. However, there is scientific research that backs up the injury mechanism. More than three workers have noticed the discomfort is associated with this type of keyboard tray. The guidelines for wrist movement include having a relaxed arm position that is not overextended. There should not be wrist bending when continuous repetitive and static work is being performed. The lighting standards for office computer work are in the range of 300 lumens.

FIND a Safer Way

The problem is a mouse tray that is lower than the keyboard tray and an arm position that is extended too far to the right. In order to correct this a piece of cardboard was placed over the mouse tray, some sticky material was used to prevent sliding and a mouse pad was placed on top of the cardboard. This brought the hand in closer to the keyboard tray and raised the shoulder. The lighting was replaced with a natural light tube.

Results

Direct Cost of Improvements - $5 worth of sticky material and $30 for natural light tubes.

Worker Health Benefits - Manitoba Labour's ergonomics checklist score was reduced from 7 to 2 due to an improvement in arm posture and lighting. Workers noticed an improvement immediately in both upper body position and overall discomfort. The average rating decreased by 5 points over the course of the day. The lighting was reduced to 300 lumens and the shoulder and wrist posture was improved to a neutral position.

Quality and Efficiency Outcomes - A rating scale was used to measure the work process and worker environment improvements. A score of 15 was assessed due to improvements in lighting and arm position. This score is justifiable for making the improvements.

Economic Summary - The total cost of the improvement was $35. The economic pay back should be immediate.

Other options

- Purchasing a brand new keyboard tray that has a 29 inch platform for the keyboard and mouse.

EVERYDAY

Today - The workplace is surveying all its workers since this problem is not an obvious ergonomic problem and the keyboard is supposed to be 'ergonomic'.

Tomorrow - The health and safety committee is learning about what to look for in jobs and equipment from an injury mechanism perspective and not rely on just catalogues for equipment purchases.

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CASE STUDY 28

Office Workstation Mouse, Monitor and Chair

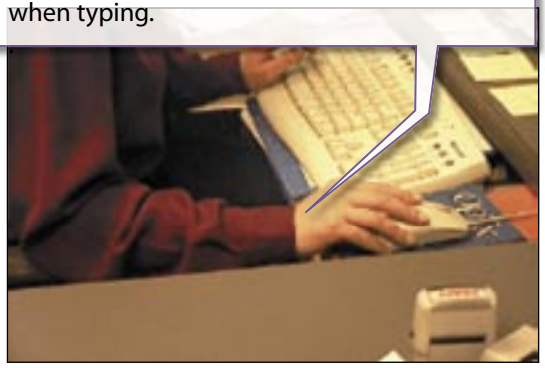
SPOT the Ergonomic Hazard

Previous hand discomfort prompted the workplace to raise the height of the mouse. This did not provide adequate relief since there are a number of other issues in this workstation and raising the mouse hand created other problems.

Ergonomic Hazards

Hazard! Bending the neck backwards. The monitor is too high for proper viewing.

Hazard! Poor arm/hand position. The hand is positioned higher than the elbow when using the mouse and the wrists are bent backwards when typing.



ASSESS the Risk

Health and Safety Committee Assessment - The Manitoba Labour 's Ergonomic Guideline contains a checklist that can be used to score tasks for ergonomic risks, refer to Appendix A for details. The characteristics of this office workstation task scored 9. A score over 7 indicates a hazardous task. The main risk factors include posture of the neck, hand and duration of work.

Technical Assessment - The monitor height is too high. The top of the screen is 2 inches (5 cm) above the worker's line of sight. The mouse hand is too high. The mouse hand should be at the same level as the keyboard tray. The chair's armrest is not adjustable, therefore the mouse was raised with books. The wrists are bent backwards more than 15 degrees. This increases the pressure in the wrist joint and is associated with hand injuries. The keyboard tray clips are raised, giving the keyboard an angle that promotes wrist bending in users that are not properly trained typists.

Worker Consultation - Discomfort in the right wrist and neck were reported with scores increasing with more time on the computer.

Standards and Guidelines - Office workstation standards and guidelines describe the monitor height to be near the line of sight of the worker when their head and neck are in a neutral position. The mouse hand should be at the same level as the keyboard and the wrists should be in a neutral or straight position when typing.

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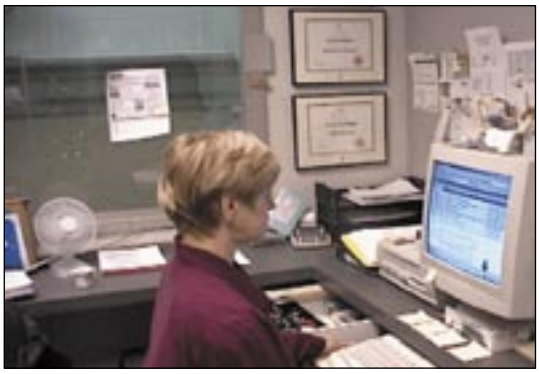
The computer unit was removed and the monitor was raised to its proper height. The keyboard clips were removed and the mouse was positioned at its proper height. Since the armrests of the chair were not adjustable, a new chair was purchased. This allowed for an adjustable armrest and an improvement to the lumbar support for the low back. Other improvements included positioning the phone closer to avoid extended reaches and placing documents between the keyboard and monitor to reduce neck bending.



Results

Direct Cost of Improvements - $250 for an adjustable chair.

Worker Health Benefits - Manitoba Labour's ergonomics checklist score was reduced from 9 to 5 due to an improvement in posture for the neck, shoulder and hands. Worker ratings of perceived discomfort was reduced from 6 to 3. All postures are within recommended positions for continuous computer work.

Quality and Efficiency Outcomes - A rating scale was used to measure the work process and worker environment improvements. A score of 15 was assessed due to an improvement in body positions and layout. This score is justifiable for making the recommended improvements.

Economic Summary - The total cost of the improvement was $250. The economic pay back should be a few weeks due to improved productivity during the course of the day and less absenteeism due to sore hands.

Other options

- Exchanging chairs with other staff.
- Purchasing an adjustable keyboard tray.

EVERYDAY

Today - The workplace is reviewing all of their workstations for ergonomic hazards and surveying their workers.

Tomorrow - Ergonomic education and awareness training will be conducted so that both equipment problems and how the equipment is used can be addressed.

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CASE STUDY 29
Office Workstation Mouse Wrist Rest

SPOT the Ergonomic Hazard

Ergonomic equipment can make the job easier or harder on the body. A few workers at this workplace notified their health and safety committee they were experiencing sore hands from using the mouse. The health and safety committee members thought the repetitiveness of the task was the problem.

Ergonomic Hazards

Hazard! Static small hand movements. The wrist is used to move the mouse.

Hazard! Continuous bending of the wrist. The mouse is moved with just the wrist.

ASSESS the Risk

Health and Safety Committee Assessment - The Manitoba Labour 's Ergonomic Guideline contains a checklist that can be used to score tasks for ergonomic risks, refer to Appendix A for details. The characteristics of this office workstation task scored 7. A score over 7 indicates a hazardous task. The main risk factors include posture and duration of use.

Technical Assessment - The wrist moved the mouse 90% of the time while the arm moved the mouse 10% of the time. This means that the wrist joint and the smaller muscles of the forearm are being used more than the upper arm muscles. This would be fatiguing over the day and lead to more mechanical strain on the wrist joint. Workers would 'plant' their hand on the wrist rest while using the mouse.

Worker Consultation - Workers indicated that wrist pain increased throughout the day and assumed that it was related to the duration of mouse use.

Standards and Guidelines - Proper mouse use includes a light grip, a neutral (straight) wrist position, moved with mostly the upper arm and positioned as close to the keyboard as possible.

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Education and awareness training to workers was provided on proper mouse use. This was not effective since workers still 'planted' their wrist on the mouse wrist rest and still used only their hand to move the mouse. Therefore, the wrist rest was removed to allow for the worker to adjust to using the whole arm.

Results

Direct Cost of Improvements - $0 dollars.

Worker Health Benefits - Manitoba Labour's ergonomics checklist score was reduced from 7 to 6 due to an improvement in wrist posture. Workers found a significant decrease in perceived wrist discomfort within the first two days. The observed use of the wrist to move the mouse decreased from 90% to 12%.

Quality and Efficiency Outcomes - A rating scale was used to measure the work process and worker environment improvements. A score of 15 was assessed due to an improvement in hand position and reduction in mechanical strain. This score is justifiable for making the recommended improvements even if there was a cost included.

Economic Summary - The total cost was $0. The economic pay back should be immediate due to improved productivity during the course of the day and less potential absenteeism due to sore hands.

Other options

- Purchase a different mouse, possibly a roller ball mouse.
- Train workers on proper use of the wrist rest.

EVERYDAY

Today - The workers are discussing their experiences with other staff and interest in participating on the health and safety committee is growing.

Tomorrow - The workplace is reviewing all of their workstations from an ergonomic perspective and will be purchasing equipment based on worker function and needs.

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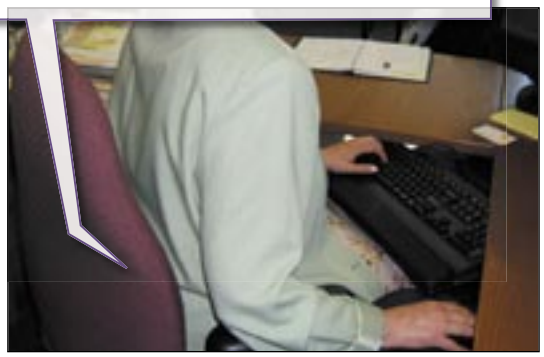
CASE STUDY 30
Office Workstation Keyboard Tray

SPOT the Ergonomic Hazard

The tasks required of this job include inputting information into the computer from documents, charts and from memory. The documents and charts must be flipped through while inputting information. This results in extensive reaching and the worker is experiencing neck and shoulder discomfort. The keyboard tray, chair and document holders have been adjusted, but there is still neck and shoulder discomfort.

Ergonomic Hazards

Hazard! Poor body position. The elbow is behind the body when using the mouse.



Hazard! Far reaching. For documents with the keyboard tray pulled out.

ASSESS the Risk

Health and Safety Committee Assessment - The Manitoba Labour 's Ergonomic Guideline contains a checklist that can be used to score tasks for ergonomic risks, refer to Appendix A for details. The characteristics of this office workstation task scored 6. A score over 7 indicates a hazardous task. The main risk factors include posture and duration of this task.

Technical Assessment - In an office assessment the first question should be 'What is the function of this task?" In this case, flipping through documents and inputting into the computer are tasks performed at the same time. Documents were placed to the right or left of the worker more than 24 inches (61cm).

Worker Consultation - Workers knew that the far reaches for documents were a problem, but they were given ergonomic keyboard trays and thought this was an ergonomic workstation.

Standards and Guidelines - For continuous computer and mouse use, elbows should be in close to the body. Reaching for the mouse while sitting up straight led to the elbow behind the body and reaching for documents led to 'winging' the elbow away from the body. Reaches should be less than 24 inches and documents should be placed in the 2 o'clock or 10 o'clock positions.

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The keyboard tray was removed and the keyboard and mouse were placed on the desk. The chair and monitor were adjusted accordingly. The worker's hands should be just below the elbow height when typing. A corner piece can be purchased that slides in the 'L joint' of the desk so that a flat and secure surface can be used for the keyboard. In this case, the worker was satisfied with the keyboard on the desk. Reaches for documents are now at the same level as the keyboard and with a 24 inch reach.

Results

Direct Cost of Improvements - $0 dollars.

Worker Health Benefits - Manitoba Labour ergonomics checklist score was reduced from 6 to 3 due to a reduction in reaching and improvement in posture. Workers felt an improvement within the first day. Their perceived discomfort score was reduced from 5 to 2. The heights and reaches are within recommended standards and guidelines.

Quality and Efficiency Outcomes - A rating scale was used to measure the work process and worker environment improvement. A score of 20 was assessed due to an improvement in workplace layout and process improvements. Extended reaching can be considered wasted motion and therefore a productivity issue. This score is justifiable for making the recommended improvements even if there was a cost included.

Economic Summary - The total cost of the improvement was $0. The economic pay back should be immediate due to improved productivity during the course of the day and less potential absenteeism due to sore hands.

Other options

- Purchase a corner piece that the keyboard can rest on when it's in the corner.

EVERYDAY

Today - The workplace is assessing the reduction in cycle time for inputting information due to the reduction in reaching and associated wasted motion. They are surveying all their workers for health and safety concerns and reviewing all their tasks based on the function of the job.

Tomorrow - The health and safety committee received hazard mapping training during this project and are now dealing with other health and safety issues in a systematic and assessment driven manner.

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CASE STUDY 31
Office Workstation Reaching

SPOT the Ergonomic Hazard

Reception workstation tasks include computer work, interacting with visitors and answering phone calls. Staff could not find a comfortable position while at this workstation. The piece of equipment to the left is a phone answering and transfer device.

Ergonomic Hazards

Hazard! Extended reaching. Far reaches for the answering device.

Hazard! Poor vision for viewing documents. Fonts are too small and the distance is too far.

Hazard! Bending the wrist backwards. The keyboard tray is too low.

ASSESS the Risk

Health and Safety Committee Assessment - The Manitoba Labour 's Ergonomic Guideline contains a checklist that can be used to score tasks for ergonomic risks, refer to Appendix A for details. The characteristics of this office workstation task scored 6. A score over 7 indicates a hazardous task. The main risk factors include posture and duration of the task.

Technical Assessment - In an office assessment the first question should be 'What is the function of this task?' In this case the use of the answering device and visual searching for information are tasks that occur often but are outside the normal working range. The reaches are beyond 24 inches (61cm). Leaning forward and squinting was necessary to read the documents. This results in the poor shoulder and hand postures. The keyboard tray is too low for shorter workers and the chair does not lower far enough for taller workers.

Worker Consultation - This workstation is used by a number of staff. None of the workers used this workstation long enough to result in injuries. All staff did report discomfort in this workstation and feel more stressed when they are finished their shift.

Standards and Guidelines - Reaches should be less than 24 inches and documents should be placed in the 2 o'clock or 10 o'clock positions. Viewing should be relaxed and documents easily read without squinting.

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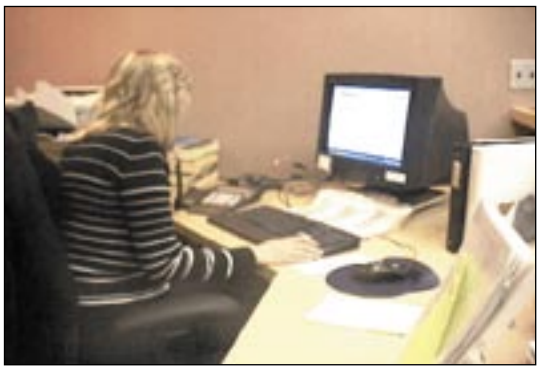
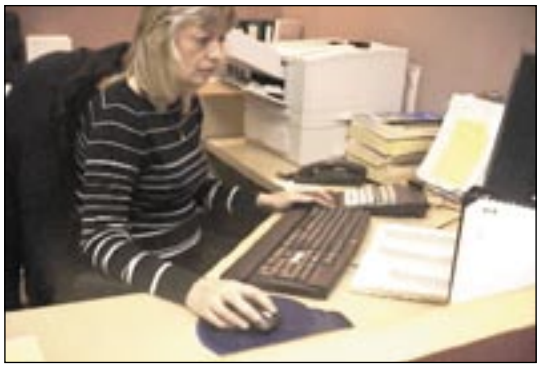
The keyboard tray was removed and the keyboard and mouse were placed on the desk. The chair was raised and a footrest was found in storage. The mouse and answering device can be placed in the 2 or 10 o'clock positions. Documents can be placed between the keyboard and monitor. This workstation can now accommodate a wide range of workers' heights.





Results

Direct Cost of Improvements - $0 dollars

Worker Health Benefits - Manitoba Labour's ergonomics checklist score was reduced from 6 to 3 due to an improvement in posture and reduced reaching. All workers feel comfortable in this task. Their perceived reduction in work load stress was reduced after two weeks of using the new workstation layout. The heights and reaches are within recommended standards and guidelines.

Quality and Efficiency Outcomes - A rating scale was used to measure the work process and worker environment improvement. A score of 20 was assessed due to an improvement in workplace layout and process improvements. Extended reaching can be considered wasted motion and, therefore, a productivity issue. This score is justifiable for making the recommended improvements even if there was a cost.

Economic Summary - The total cost of the improvement was $0. The economic pay back should be immediate due to improved productivity during the course of the day and less potential absenteeism due to sore shoulders.

Other options

- Purchasing a new desk that incorporates a height adjustable keyboard tray into the desk.

EVERYDAY

Today - The workplace is assessing the improvement in cycle time for answering and transferring calls due to the reduction in reaching and associated wasted motion. They are surveying all their workers for health and safety concerns and reviewing all their tasks based on the function of the job.

Tomorrow - The health and safety committee received hazard mapping training during this project and are now dealing with other health and safety issues in a systematic and assessment driven manner.

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"There is no such thing as an 'ergonomic chair'. No chair **will fit** everyone."

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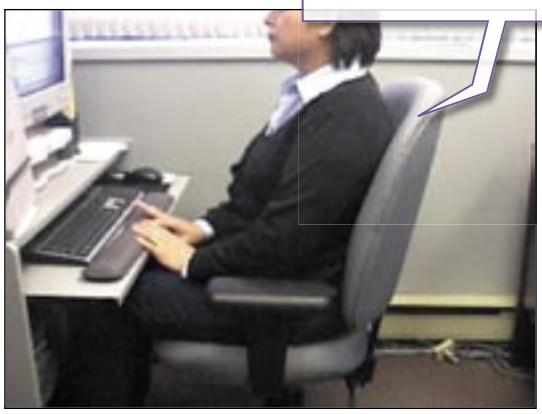
CASE STUDY 32
Office Workstation Chair Position

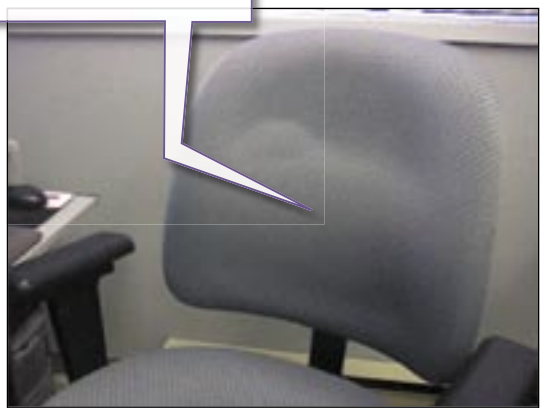
SPOT the Ergonomic Hazard

A review of office workstations did not find obvious hazards. However workers indicated they did not feel comfortable in their chair. Some indicated they felt lower back and pelvic discomfort. Adjustments to the 'new' chairs did not provide any improvement. These chairs were 'ergonomic' chairs with lumbar support and had many different adjustments.

Ergonomic Hazards

Hazard! There are no hazards in this task except that there is a 'fit' issue. The same chair will not fit every worker.





ASSESS the Risk

Health and Safety Committee Assessment - The Manitoba Labour 's Ergonomic Guideline contains a checklist that can be used to score tasks for ergonomic risks, refer to Appendix A for details. The characteristics of this office workstation task scored 4. A score over 7 indicates a hazardous task. The main issues include sitting posture and duration of the task.

Technical Assessment - A review of scientific literature on low back injury mechanisms and anthropometry (the study of the range in sizes of people) found that the lumbar support in the back rest was too big for some of the workers. This lumbar support did not fit the entire range of workers low back curve (the lumbar area has a concave curvature). It was estimated that up to 9% of the working population would not fit in this chair.

Worker Consultation - The average worker rating of discomfort through the working day remained the same at three. However workers having issues reported an increase of four points. These workers also reported not having any previous low back injuries or discomfort.

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Standards and Guidelines - Standards on office chair design indicate a lumbar support is important but specific sizes and shapes have no standard. The automobile industry has specific numbers for driver side lumbar support, but these may not apply to office chairs.

FIND a Safer Way

It was decided to test several different chairs over a day or two to assess for function, adjustability and comfort. A chair was found with the proper requirements. This chair had a higher back support and a different sized lumbar support. One worker also used a separate cushion for added support.

Results

Direct Cost of Improvements - $525 for a new office chair that fit workers better.

Worker Health Benefits - Manitoba Labour's ergonomics checklist score was reduced from 4 to 3 due to an improvement in low back posture. Worker's ratings of discomfort did not increase throughout the day in both the average score and individual scores. According to the anthropometric tables the size and shape of the lumbar support is now able to accommodate the five to nine percent that could not be fitted before.

Quality and Efficiency Outcomes - Office workstation tasks can be assessed for productivity and quality improvements several ways. In this case a rating of work measures and worker measures was used. There were improvements in worker satisfaction and comfort, which can be related to improvements in work quantity and quality. The effect of the new chair scored 10 which relates to a marginal work improvement.

Economic Summary - The cost of the chair in terms of a marginal improvement in work is justifiable if the office tasks are long in duration and measures of absenteeism reduction can be shown to correlate with low back discomfort.

Other options

- Purchasing back supports or pieces of foam that fit over the existing backrest.
- Switching chairs with other staff.

EVERYDAY

Today - The workplace is systematically and formally evaluating all their chairs to see if the chair does fit the worker or if the low back issues are associated with something else.

Tomorrow - The workplace will still use the current chairs since they fit most of the workers. They have identified two styles of chairs that fit both larger and smaller workers or workers who may have different lumbar curves.

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Outcomes

A total of 32 case studies were successfully developed with three that did not proceed past the hazard identification phase. The case studies were selected by contacting small employers directly through referrals and contacts and by communications through various media. The 32 case studies include eight from the manufacturing sector, eight service orientated workplaces, seven office workstations, five from the construction sector and four food production workplaces.

Every task was identified as an issue by the health and safety committee or safety representative. Each case study was determined to be a problem job through the assessment process. Each case study was assessed with a checklist, by worker consultation, the use of technical tools and comparison to standards and guidelines.

Every case study showed a significant reduction in risk along with improvements in worker's well being after the appropriate solution had been implemented.

Figure 1 shows physical costs associated with the 32 case studies. The projects are grouped according to cost. Note, 20% of the recommendations were zero ($0) cost solutions with the overall average cost being $585, the median (half-way) cost was $50, the 90th percentile project cost was under $1000 and the highest cost project was approximately $5000.

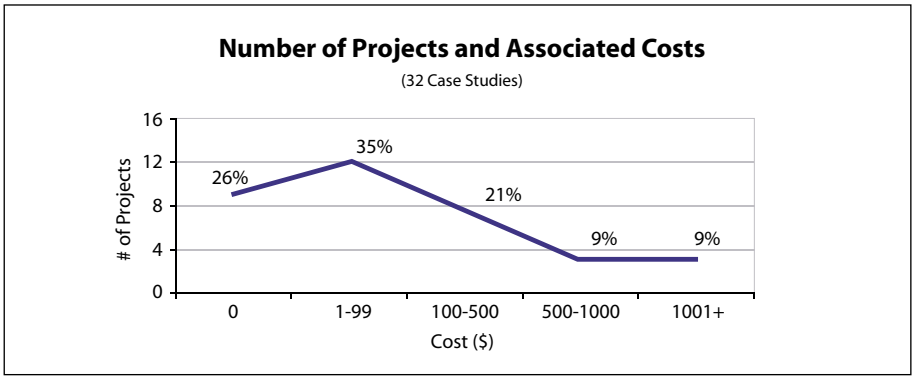

Figure 1: Number of Projects and Associated Costs

Figure 2 shows length of time required to recoup the initial outlay of capital. The direct cost savings and quality/efficiency benefits were found for every task with the average pay back period less than one week and the 90th percentile project had a five month pay back period. The longest pay back period was 19 months. These benefits included only quality and process improvements with no health and safety benefits or savings added.

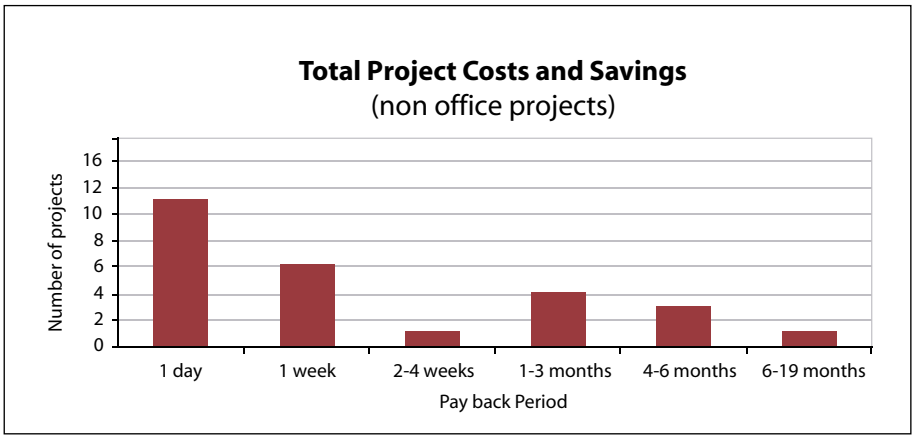

Figure 2: Pay Back Period for the ergonomic projects

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Figure 3 shows reduction in ergonomic hazards according to the health and safety checklist. A score of more than 7 indicates this task has an increased risk of injury. The solid straight line in the graph represents the criteria score of 7. Initially most tasks scored above 7. The average reduction in scores after the ergonomic changes were made was 21% with the median (half-way) score reduced by 34%. There were only two tasks that still scored 8 (Case Study 5 and 8) after the ergonomic changes had been evaluated.

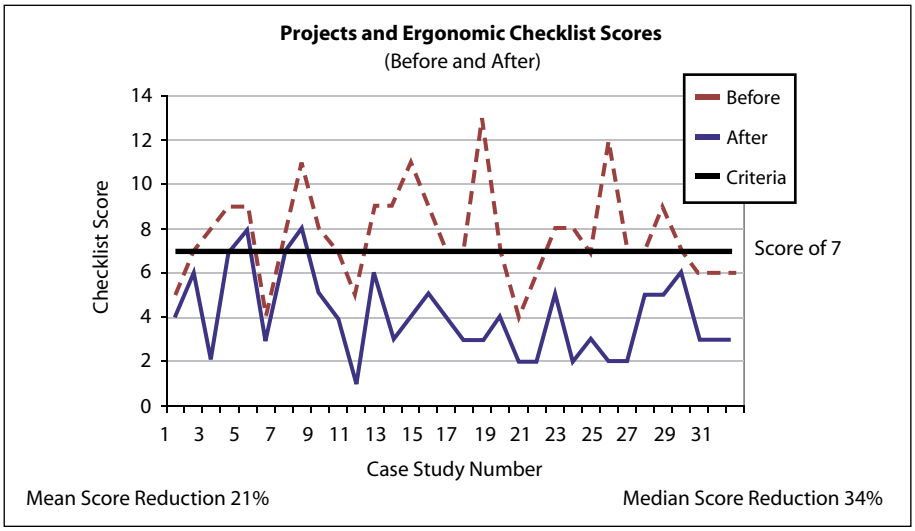

Figure 3: Ergonomic Checklist scores: before and after

Other findings revealed there was a wide variety of ergonomic solutions used. This included engineering, administrative and work organization solutions. They all had an effect in reducing the strain on workers. Moreover, surveys conducted after the projects were completed showed a significant increase in worker and management awareness of health and safety issues and ergonomics.

Lessons Learned

There were two main lessons learned from conducting these case studies. The first lesson involves the perception that ergonomics is costly, intimidating and has unproven results. While conducting these case studies, business owners and managers were told what ergonomics is, what was going to happen, how it is going to work and what should come out of this, then perceptions changed for the better. This changed to a positive perception of ergonomics once the final evaluations were completed and costs were compared to quality and/or efficiency benefits.

The second lesson involves the many issues small businesses face when it comes to health and safety. They include knowing all the legal responsibilities of employers and workers, knowing how to implement a health and safety program in workplaces with less than 50 workers, the lack of resources, knowing how to identify hazards and where to get help from a small business perspective.

Small businesses also require technical assistance in some cases when determining if a problem job is a hazard, how to correctly identify the root cause, and to correct the problem. Suggestions included developing a safety association that focuses on small employers.

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Appendix A

i Resources

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Manitoba Labour and Immigration
Workplace Safety and Health
200-401 York Avenue, Winnipeg, MB, R3C 0P8
Client Service Desk: (204) 945-6848
Toll Free 1-800-282-8069 (Manitoba Only)
Website: www.gov.mb.ca/labour/safety

Workers Compensation Board of Manitoba
333 Broadway, Winnipeg, MB, R3C 4W3
Phone: (204) 954-4922
Toll Free 1-800-362-3340 (in Manitoba Only)
Website: www.wcb.mb.ca

SAFE Manitoba Initiative
Website: www.safemanitoba.com

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ii Glossary of Terms

Anthropometry: The measurement of humans, the different body sizes and proportions of individuals belonging to different populations.

Awkward posture: Deviation from the ideal working posture of elbows at the side of the torso, with the wrists neutral. Awkward postures typically include reaching behind, twisting forward or backward bending, pinching, and squatting.

Biomechanics: The mechanics of biological and especially muscular activity.

Chronic low back pain: General soreness and fatigue of the low back; pain is usually constant, and accompanies most activities.

Electromyography: An instrument that converts the electrical activity associated with functioning skeletal muscle into a visual record.

Engineering controls: A method of controlling worker exposure to risk factors by redesigning equipment, tools, and workstations. Engineering controls are part of hazard prevention and control.

Ergonomics: The scientific study of human work. The term comes from the Greek words "ergos" meaning work, and "nomos," meaning natural laws of. Ergonomics considers the physical and mental capabilities and limits of the worker as he or she interacts with tools, equipment, work methods, tasks, and the working environment.

Ergonomics program: A systematic method (similar to an accident prevention or quality improvement program) used to evaluate, prevent and manage workrelated musculoskeletal disorders. The four elements of a typical ergonomics program are worksite analysis, hazard prevention and control, medical management, and training and education.

Ergonomist: Individuals with specialized training in ergonomics. They contribute to the design and evaluation of tasks, jobs, products, environments and systems in order to make them compatible with the needs, abilities and limitations of people.

Fatigue: A condition that results when the body cannot provide enough energy for the muscles to perform a task.

Forcefulness: The amount of physical effort a person uses to do a task.

Hand-arm vibration: Vibration (generally from a hand tool) that goes through the hand, then travels through the rest of the body.

Hazard: A danger or source of danger, especially one threatening human health or safety.

Hazard prevention and control: Eliminating or minimizing the hazards identified in the worksite analysis. It is changing the jobs, workstations, tools or environment to fit the worker. Hazard prevention and control is an element of the ergonomics program.

Health and Safety Committee: Manitoba Regulation MR106/88R stipulates the requirements, characteristics and processes for forming a joint employer and worker health and safety committee.

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Lumens: is the international system of units for luminous flux. It is the measure of the perceived power of light.

Mechanical Pressure (contact stress): The contact of the body with a hard surface or edge that results in the compression of tissue. Can also result when using a part of the body as a hammer or striking instrument.

Moment of Force: is a quantity that represents the magnitude of force applied to a rotational system at a distance from the axis of rotation.

Musculoskeletal disorders: Illnesses and injuries that affect one or more parts of the musculoskeletal system.

Musculoskeletal system: The soft tissue and bones in the body. The parts of the musculoskeletal system are bones, muscles, tendons, ligaments, cartilage, nerves, and blood vessels.

Neutral posture: Comfortable working posture that reduces the risk of musculoskeletal disorders. The joints are naturally aligned with elbows at the side of the body and wrists straight.

Newton: The unit of force in the meter-kilogram-second system equal to the force required to impart an acceleration of one meter per second squared (m/s^2) to a mass of one kilogram.

Newton-Meter: is the sysmbal for moment in the international system of units. It is abbreviated N m or N•m, and sometimes hyphenated newton-metre. It is a compound unit of torque corresponding to the force of one newton applied over a distance arm of one metre.

Risk factors: An aspect of a job that increases the worker's chance of getting a work related musculoskeletal disorder.

Sprain: Overstretching or overexertion of a ligament that results in a tear or rupture of the ligament.

Static loading: Physical effort or posture that is held and requires muscle contraction for more than a short time. As muscles remain contracted, the blood flow to the muscles is reduced.

Strain: Overstretching or overexertion of a muscle or tendon.

Tendinitis: Inflammation of the tendon inside the sheath of the tendon.

Tendinosis: The suffix "osis" implies a pathology of chronic degeneration without inflammation. Tendinosis is an accumulation over time of microscopic injuries.

Vibration induced white finger: Is a secondary form of Raynaud's Disease, an industrial injury triggered by continuous use of vibrating hand-held machinery.

Work practice controls: Procedures for safe and proper work that are used to reduce the duration, frequency or severity of exposure to a hazard. They include work methods training, job rotation, and gradual introduction to work. Work practice controls are part of hazard prevention and control.

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ERGONOMIC RISK FACTOR CHECKLIST

UPPER EXTREMITY RISK FACTOR CHECKLIST

Date: _____ Analyst: _____ Job: _____ Location:

RISK FACTOR CATEGORY	RISK FACTORS	EXPOSURE Is the risk factor present within the job or task?	TIME				SCORE
			0% to 25% of total job time	25% to 50% of time	50% to 100% of time	If total time for job is >8hrs, add 0.5 per hour	
Upper Limb Movements	**1.** Moderate: Steady motion with regular pauses	☐ YES ☐ NO	0	1	2		
	2. Intensive: Rapid steady motion without regular pauses	☐ YES ☐ NO	1	2	3		
Keyboard Use 	**3.** Intermittent Keying	☐ YES ☐ NO	0	0	1		
	4. Intensive Keying	☐ YES ☐ NO	0	1	3		
Hand Force (Repetitive or Static) 	**5.** Squeezing Hard with the Hand in a Power Grip	☐ YES ☐ NO	0	1	3		
	6. Pinch More than 2 pounds	☐ YES ☐ NO	1	2	3		
Awkward Postures  	**7.** Neck: Twist/Bend (twisting neck >20°, bending neck forward >20° or back < 5°)	☐ YES ☐ NO	0	1	2		
	8. Shoulder: Unsupported arm or elbow above mid-torso height	☐ YES ☐ NO	1	2	3		

RISK FACTOR CATEGORY	RISK FACTORS	EXPOSURE Is the risk factor present within the job or task?	TIME				SCORE
			0% to 25% of job time	25% to 50% of time	50% to 100% of time	If job time is >8hrs, add 0.5 per hour	
	**9.** Rapid Forearm Rotation	☐ YES ☐ NO	0	1	2		
	**10.** Wrist: Bend or Deviate	☐ YES ☐ NO	1	2	3		
Contact Stress 	**11.** Hard/Sharp objects Press into Skin	☐ YES ☐ NO	0	1	2		
	12. Using the Palm of the Hand or Wrist as a Hammer	☐ YES ☐ NO	1	2	3		
Vibration 	**13.** Localized Vibration (without dampening)	☐ YES ☐ NO	0	1	2		
	**14.** Whole-body Vibration (without dampening)	☐ YES ☐ NO	0	1	2		
Environment	**15.** Lighting (poor illumination or glare)	☐ YES ☐ NO	0	0	1		
	16. Adverse Temperatures	☐ YES ☐ NO	0	0	1		
Control Over Work Pace	**17.** One control factor present = 1 Two or more control factors present = 2	☐ YES ☐ NO					
TOTAL UPPER EXTREMITY SCORE							

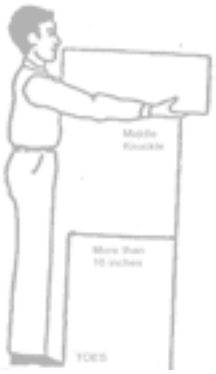
BACK AND LOWER EXTREMITY RISK FACTOR CHECKLIST

Date: _____ Analyst: _____ Job: _____ Location:

RISK FACTOR CATEGORY	RISK FACTORS	EXPOSURE Is the risk factor present within the job or task?	TIME				SCORE
			0% to 25% of job time	25% to 50% of time	50% to 100% of time	If job time is >8hrs, add 0.5 per hour	
Awkward Postures 	**18.** Mild Forward or Side Bending of Torso More than 20° but Less than 45°	☐ YES ☐ NO	0	1	2		
	19. Severe Forward Bending of Torso More than 45°	☐ YES ☐ NO	1	2	3		
	20. Backward Bending of Torso	☐ YES ☐ NO	0	1	2		
	21. Twisting of Torso	☐ YES ☐ NO	1	2	3		
	22. Prolonged Sitting Without Adequate Back Support	☐ YES ☐ NO	0	1	2		
	23. Standing Stationary or Inadequate Foot Support While Seated	☐ YES ☐ NO	0	0	1		
	24. Foot action (pedal), Standing Stationary with Inadequate Foot Support, Balancing	☐ YES ☐ NO	0	1	2		
	25. Kneeling/ Squatting	☐ YES ☐ NO	1	2	3		
	**26.** Hip Abduction (Repetitive/ Prolonged)	☐ YES ☐ NO	0	1	2		
	27. Repetitive Ankle Extension/ Flexion	☐ YES ☐ NO	0	1	2		

RISK FACTOR CATEGORY	RISK FACTORS	EXPOSURE Is the risk factor present within the job or task?	TIME				SCORE
			0% to 25% of job time	25% to 50% of time	50% to 100% of time	If job time is >8hrs, add 0.5 per hour	
Contact Stress	**28.** Hard/Sharp objects Press into Skin	☐ YES ☐ NO	0	1	2		
	29. Using the Knee as a Hammer or Kicker	☐ YES ☐ NO	1	2	3		
Vibration 	**30.** Whole-Body Vibration (without dampening)	☐ YES ☐ NO	0	1	2		
Push/Pull	**31.** Moderate Load	☐ YES ☐ NO	0	1	2		
	32. Heavy Load	☐ YES ☐ NO	1	2	3		
Control Over Work Pace	**33.** One control factor present = 1 Two or more control factors present = 2	☐ YES ☐ NO					
MANUAL HANDLING CHECKLIST SCORE (Add scores 2 & 3 from page 3 and insert total here)							
TOTAL BACK AND LOWER EXTREMITY SCORE							

MANUAL HANDLING CHECKLIST

34(a). STEP I:	**NEAR LIFT**	**MIDDLE LIFT**	**FAR LIFT**
Determine If the Lift is Near, Middle, or Far (Body to Hands) - Use an average horizontal distance if a lift is made every 10 minutes or less. - Use the largest horizontal distance if more than 10 minutes pass between lifts.			

34(b). STEP II:	**NEAR LIFT**		**MIDDLE LIFT**		**FAR LIFT**	
Estimate the Weight Lifted (Pounds) - Use an average weight if a lift is made every 10 minutes or less. - Use the heaviest weight if more than 10 min. pass between lifts. - Enter 0 in the total score if the weight is 10 lb or less.	**DANGER ZONE**	More than 51 lb 5* points	**DANGER ZONE**	More than 35 lb 6 points	**DANGER ZONE**	More than 28 lb 6 points
	CAUTION ZONE	17 to 51 lb 3 points	**CAUTION ZONE**	12 to 35 lb 3 points	**CAUTION ZONE**	10 to 28 lb 3 points
	SAFE ZONE	Less than 17 lb 0 points	**SAFE ZONE**	Less than 12 lb 0 points	**SAFE ZONE**	Less than 10 lb 0 points

*If lifts are performed more than 15 times per shift, use 6 points. **STEP II SCORE:**

STEP III: **Determine the Points for Other Risk Factors** - Use occasional lifts if more than 10 minutes pass between lifts - Use the more than 1 hour points if the risk factor occurs with most lifts and lifting is performed for more than 1 hour	**Factor**	**Occasional lifts (<1 hr/shift)**	**Frequent lifts (>1 hr/shift)**	
	35. Twist torso during lift	1	1	
	36. Lift one-handed	1	2	
	37. Lift unexpected loads	1	2	
	38. Lift 1-5 times/minute	1	1	
	39. Lift > 5 times/minute	2	3	
	40. Lift above the shoulder	1	2	
	41. Lift below the knuckle	1	2	
	42. Carry objects 10 - 30 feet	1	2	
	43. Carry objects > 30 feet	2	3	
	44. Lift while seated or kneeling	1	2	
			STEP III SCORE:	

User's Guide to Filling in the Ergonomic Risk Factor Checklist

The purpose of this booklet is to provide an explanation of the content and use of the Ergonomics Risk Factor (ERF) Checklist. A checklist is only one part of an ergonomics analysis, and works best as a preliminary tool for observing a job and characterizing the levels of risk factors present within a job. A checklist does not provide answers, but instead provides a means of remembering what to analyse and an indication of what factors could be a problem within a job.

The ERF checklist was created to address the situations found within an industrial manufacturing environment. The design of the ERF checklist emphasizes the identification of the combination of risk factors that occur most frequently in industry, and those associated with the highest magnitude of risk. The checklist is divided into three parts: risk factors for the upper extremity, risk factors for the back and lower extremity, and risk factors associated with manual materials handling. Within each of the parts, risk factors are assigned scores that increase with duration of exposure to each risk factor. To utilize the checklist, the analyst (you) must evaluate a work task or job to determine which, if any, risk factors are present and for how long each day the worker is exposed to each risk factor. The assigned scores for each combination of risk factor exposure/duration identified are added separately for the upper limb and the low back. Scoring risk factors for the upper limb and the low back are kept separate because simultaneous exposure to an upper extremity risk factor and a low back risk factor does not generally affect the same joint or anatomic region.

General Instructions

The following is a quick guide on how to perform an analysis using the ERF checklist. All components of the checklist should be filled out for each job or task to ensure that a full analysis has been performed.

STEP 1 - Familiarize Yourself with the Job

The first step in the analysis process is to familiarize yourself with the job. The two key ways to do this is through observation and interview. Stand back and watch the person perform the job for a few minutes; you are trying to get a feel for the range of activities that the person must perform in a day. To ensure that you are seeing everything that the person does, talk with the worker and ask them some questions about their job. Once you have observed the job and interviewed the worker, you should now write down your information.

You should try and describe the job on two levels: general and specific. The general description should detail the goals and duties that are involved with this job; this will provided a base for understanding why the person is performing various duties. The specific description should break down a job into the actions that are required to perform it. For instance: pick up part A from bin B and place on table C. These statements describe the general movements of the person and the sequencing of these movements.

The comments you make about a job should provide additional, useful pieces of information that do not fit within the structure of the checklist, and may be relevant for further

analyses. Within this section, you can make general remarks about the workstation, environment, job, or worker. You may want to include any measurements that you were able to perform (e.g. mass, dimensions, temperature, etc.). You could also include information pertaining to the anthropometrics (body, size and type) of the person, and how well this matches with the workstation. Upon completion of the risk factor analyses, you could also comment on which parts of the task tended to contain which risk factors (i.e. was there any specific task that was causing trouble?)

The goal of an ergonomic analysis is to ensure that the job fits the worker. Therefore, the input on the person performing the job is a key part of the analysis. To fill out a 'Worker Interview' portion of the assessment, you must talk with the person and gain their insight into the daily workings of the job. Some questions that could provide some useful information are:

Could you explain what you do for me?
Is this what you do all day, or do your duties change at any time?
If you could improve this job in any way, what would you change?
Do you feel any aches, pains, etc., that you feel are related to your job?
If YES, what parts of your job are a problem to you?

STEP 2 – Determine What Risk Factors are Present

The next step within the checklist analysis is to determine what risk factors the person is being exposed to over the course of a day. If you look at these pages, you will note that the checklist is divided into columns; you will be filling out the column with the title ***Exposure***. The exposure column contains simple yes/no questions, requiring you to answer whether or not the person is being exposed to the various risk factors described in each row. REMEMBER, you should have read and understood the risk factor definitions before you attempt to perform this step in the analysis, or any further ones.

You should look at each risk factor, and observe the job to determine if the person is exposed to this factor at any time. If exposure exists, enter a YES; if the risk factor does not occur within this job, then check off NO. Once you have addressed all of the risk factors, then you can move on to Step 3.

STEP 3 – Determine the Duration of Exposure to the Risk Factors

In Step 2, you determined WHAT the person is being exposed to. Now, you must determine HOW LONG (***Time*** column) the person is exposed to each risk factor. For every risk factor that you recorded a YES for in Step 2, you will now evaluate the length of time that the person is exposed to this factor. The risk factors that were found not present for this job, and were checked NO in Step 2, can be ignored in Step 3.

The duration of exposure you are measuring here is not how long a person does a job, but instead how long the person does what is described as a risk factor. As an example:

Joe performs a job on a production line that has a cycle time (or job cycle) of 60 seconds; he does this job for 8 hours per day. For 45 seconds of every cycle, Joe works with his wrist deviated. For 20 seconds of every cycle, Joe's elbow is above mid-torso level. For 5 seconds of every cycle, Joe is bent forward greater than 45^{o}. The easiest way to look at this job is to consider the job cycle to be representative of the entire day (i.e. whatever Joe does for 60 seconds, he does for 8 hours). Therefore, if Joe's wrist is deviated for 30 seconds every cycle, then through simple math (45/60 = 0.75), Joe spends ¾ of his day or 6 hours with his wrist deviated. You would then give Joe a score of 3 for wrist deviation. Using the same format, you can calculate that Joe spends approximately 3 hours per day with his elbow above mid-torso level, and less than 1 hour per day with his torso bent forward greater than $45^{o.}$ These durations of exposure would result in a score of 2 for shoulder posture and a score of 1 for trunk posture.

Regardless of the length of work cycle, the principal is the same for determining duration of exposure. All that you have to remember is that you are measuring how long the person is exposed to the individual risk factor, and this does not always correspond to the actual duration of the job.

Once you have determined the duration of exposure for a risk factor, and have determined the score that corresponds to this exposure, you should then circle this score in the appropriate column and write down this score in the far right column. When you have completed both the Upper Limb and the Back & Lower Extremity Checklists, look over each checklist to ensure that every risk factor that has a YES in the ***Exposure*** column has a score in ***Time*** column. Additionally, every risk factor that was checked NO in the ***Exposure*** column should have no score in the **Time** column. Once you have completed this task, you can now go on to Step 4.

STEP 4 – Evaluation of Manual Materials Handling

The Manual Materials Handling (MMH) checklist is designed to evaluate the risk factors associated with lifting and carrying materials. The MMH checklist focuses on such variables as the location of the item being the lift, the mass of the item, how often the items is lifted, and the posture of the person while handling the item. To perform this analysis, the MMH checklist guides you through 3 distinct steps.

The first step in the analysis is to determine the ***Horizontal Distance*** of the load from the body. The distance is divided into 3 categories: near (0 to 4 inches), middle (4 to 10 inches), and far (more than 10 inches). These ranges refer to the distance from the toes of the person to the middle knuckle.

The second step in the analysis is to estimate the ***Weight*** of the item being lifted. If an item is lifted every 10 minutes or less, then use the average weight of all the items being lifted. If more than 10 minutes pass between lifts, then use the heaviest weight that the person lifts. Once you have established the ***Weight*** of the item, you then combine this information with your estimate of ***Horizontal Distance*** to determine your score for Step II. For example: a job where a person lifts a 20 lb load at a middle distance from the body (4 to 10 inches) would receive a

score of 3 points. If the person does not lift any item that are greater than 10 lbs, then a score of 0 would be given to this job.

The third steps in the MMH analysis is to evaluate the ***Other Risk Factors*** that are related to handling loads. This third step is completely separate from step II; therefore, even if the items being lifted are not above 10 lbs, you should still fill out this section. The procedure for filling out this section is similar to that of the Risk Factor checklists for the Upper Extremity and Back & Lower Extremity. Your first decision is with respect to duration of exposure: how often and how long do the MMH activities occur? If lifting is only occasional, and more than 10 minutes pass between lifts, then you will be choosing values from the first column titled ***Occasional Lifts***. If the risk factor occurs with most lifts, and lifting occurs for more than 1 hour, then you will be using the values from the second column titled ***Frequent Lifts***. Once you have determined which column you will be using, your next task is to review each risk factor and determine whether or not the person is exposed to this factor. If the person is exposed to the factor, then circle the score in the appropriate column and transfer this value to the far right column. Once you have evaluated all of the risk factors, add up the scores in the right hand column and place the total in the box marked STEP III SCORE.

The MMH checklist is really a component of the Back & Lower Extremity checklist. As such, the scores you obtain from the MMH checklist are recorded within the Back & Lower Extremity checklist, and contribute to the total score in this checklist. Once you have completed the MMH checklist, add up your scores from Steps II & III and record this value in the second last row of the Back & Lower Extremity checklist. You are now ready to move on to STEP 5 of the analysis.

STEP 5- Add up the Checklist Scores

The next step in the analysis is to determine the ***Total Scores*** for the Upper Limb and Back & Lower Extremity Checklists. All that is required here is to add up the scores in the far right column for each of the checklists, and record the total at the bottom of each checklist.

STEP 6 – Opportunities for Improvement

The final stage of the analysis is to record any actions that you feel could be performed to improve the job. After observing the job, talking with the worker, and performing the checklist analysis, are there any recommendations that you can make? You could recommend that certain aspect of the job be looked at in more detail before any decisions are made. The size and importance of your ideas are irrelevant; the key here is to record some ideas while you are there and the information is fresh in your head. Do some quick brainstorming, and try not to leave before you have written down at least 2 or 3 ideas. You can record your thoughts in the ***Comments*** section of the EAW.

Risk Factor Definitions

Upper limb movements:

Repetitiveness is performing the same motions repeatedly. The severity of risk depends on the frequency of repetition, speed of the movement or action, the number of muscle groups involved, and the required force. Repetitiveness is influenced by machine or line pacing incentive programs, piece-work and unrealistic deadlines. This risk factor, upper limb movements, is a measure of the amount of time a person spends with their upper limbs moving, as well as the speed of the movements. You should think of this as a 10-point scale of movement where *moderate* falls around the 5-7 mark and *intensive* falls around the 8-10 mark. If you think of the fastest pace you could work, where if you took a break you would fall behind immediately, then that would be intensive movement. The key here is that you are looking at the amount of movement over the entire work cycle. You cannot have intensive movement for 10 seconds, and then take a break. This scale takes breaks into consideration. If you feel the movements are moderate over the entire work cycle then the person is exposed to this risk factor. Therefore, the only two answers you can have are no exposure or exposure for the entire work cycle.

0	2	4	6	8	10
Hands idle most of the time; no regular exertions	Consistent, conspicuous pauses	Slow steady motion; frequent pauses	Steady motion; infrequent pauses	Rapid steady motion; no regular pauses	Rapid steady motion; difficulty keeping up

Hand Force:

A power grip is gripping an object with your hand in the shape of a fist. You are able to use your fingers, thumb and palm to generate the force. A pinch grip involves gripping onto an object using your thumb and any of your fingers. A power grip becomes forceful when either the object being held weighs more than 10 lbs, or (through visual analysis) you note excessive muscular activity in the forearm while gripping the object (i.e. high force movement ... heavy push/pull, etc.). The pinch grip becomes a risk factor when you grip something weighing more than 2 pounds. Poorly fitted gloves reduce dexterity and feeling, resulting in a need to use stronger muscle force; if the worker is wearing gloves, you will add 1 point to the risk factor score.

Figure 1: Pinch Grip

Figure 2: Power Grip

Awkward Postures:
An awkward posture refers to a deviation from the ideal working posture, which is one of arms at the side of the torso, elbows bent, with the wrists straight. Awkward postures typically include reaching behind, twisting, working overhead, kneeling, forward or backward bending, and squatting. These are postures that cause the body to produce excessive and unnecessary force to perform a movement. The principal here is that when the muscles and joints are not in an optimal position for force development, then they must increase their level of effort to perform the activity.

You are looking for the following:

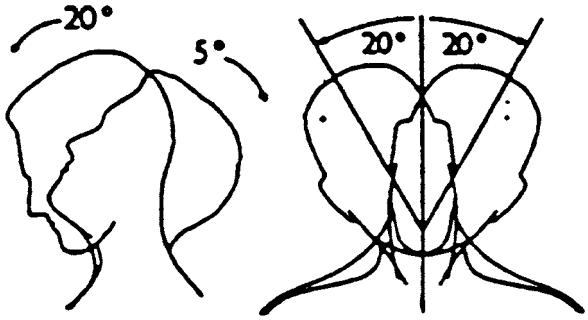


Figure 3: Neck bending/twisting > 20°

Figure 4: Shoulder being flexed such that the elbow is working above mid-torso height

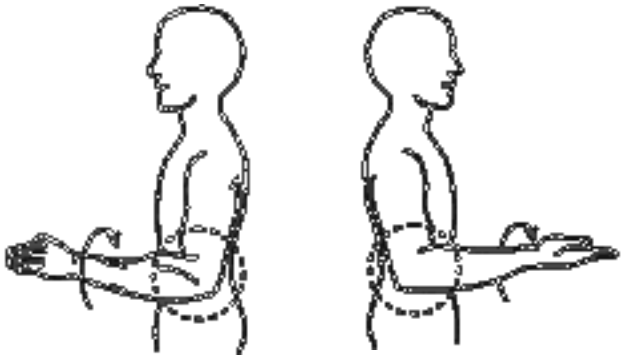


Figure 5: Rapid rotation of the forearm (screwdriving action)

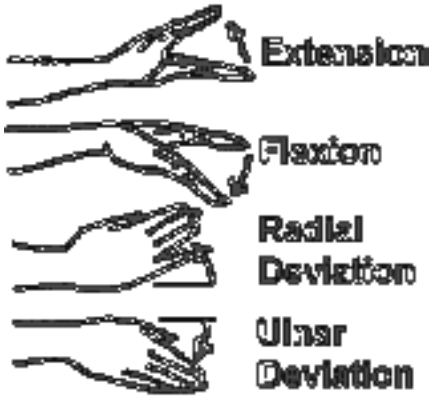


Figure 6: Flexion/extension of the wrist >20° or ulnar/ radial deviation of the wrist

Figure 7: Mild forward bending (20-45^{o})

Figure 8: Severe bending of the torso (>45^{o});

Figure 9: Bending to the side

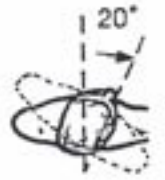


Figure 10: Twisting of the torso > 20^{o} (you are looking for the angle between the shoulders and the hips)

Figure 10: Prolonged sitting without back support

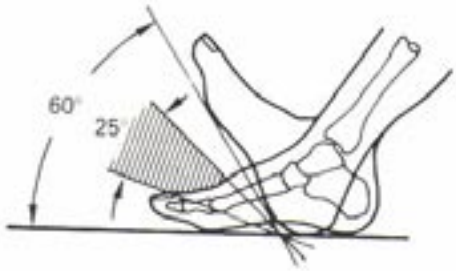


Figure 11: Repetitive ankle extension/flexion

Contact Stress:
Mechanical contact stress refers to contact of the body with a hard surface or edge that results in the pinching or crushing of tissue. Contact stress can also result when using a part of the body as a hammer or striking instrument. You are looking for objects/materials that would press into the skin and in some way deter blood flow or place undue pressure on a nerve, tendon or muscle (i.e. inhibit motion in any way). Using the hand as a striking tool is also a contact stress risk factor.

Vibration:
Hand-arm vibration refers to vibration (generally from equipment or a hand tool) that goes through the hand and arm, then travels through the rest of the body. Vibration can also affect the lower back, especially when driving a vehicle. Vibration reduces blood flow and sensory response. You are looking for either the transfer of vibration into a distinct body area, usually through the hand, or into the entire body by standing or sitting on a vibrating surface. Many tools vibrate during use, and this can transfer into the arm to produce localized vibration.

Environment:
Low temperatures reduce sensory feedback, dexterity, blood flow, muscle strength, and balance. High temperatures increase the rate at which the body fatigues. Lighting levels affect the person's ability to perform the task (e.g. bending forward in order to see product).

Control Over Work Pace:
Control over work pace is a risk factor because it affects the ability of the worker to regulate their speed of work. If a worker starts to feel pain or discomfort, the best method of alleviating this is to stretch and take a break. If the pace of the work is externally controlled, then the worker cannot take a break when needed. Things such as a production line, a conveyer belt, working for piece rate (e.g. tree planting), electronic monitoring, etc., are all examples of control factors. If the person is exposed to one factor, they get a score of 1. If they are exposed to 2 or more factors, they get a score of 2.

Push/Pull:
If you have a device that can measure a push/pull force, then a Moderate push/pull is when the initial force is between 90 and 225 N; a Heavy push/pull is when the initial force required is >225 N. If you cannot measure the force, then you can estimate the force by watching the person work. A Moderate push/pull can be produced with one hand or two, requires little effort from the legs and looks smooth and steady once the object is moving. A Heavy push/pull will require two hands, steady and possibly significant effort from the legs, and the movement will seem very strenuous over the entire course of the push/pull.

Keyboard use:
Any type of keyboard use, including typewriter, computer keyboard, or machine control keys. 'Intermittent' use refers to 50-75% of the day spent on a keyboard. 'Intensive' keyboard use refers to 75-100% of the day spent on a keyboard.