



Evaluation of Workforce Perceptions as a Means to Identify and Mitigate the Causes of Musculoskeletal Disorders

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Todd William Loushine, Principal Investigator
Department of Mechanical and Industrial Engineering
University of Minnesota Duluth

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16. Abstract (Limit: 250 words) An analysis of workers' compensation data showed that five job classifications accounted for over 93% of all cases. This analysis also showed that 48% of the cases resulted in sprains and strains, and 70% of those cases were caused by over-exertion and/or awkward work postures. Based on these findings, a research proposal was created to investigate worker perceptions of potential musculoskeletal injury factors and possible corrective actions. Fifty randomly-selected Mn/DOT transportation generalists and mechanics from District 1 were interviewed via telephone. Interviews were voice recorded, transcribed, and analyzed by shortening and separating responses. Each of the six questions produced between fifteen to twenty-one response categories and total response counts between 63-to-123. The most frequently cited safety concern was exposure to public traffic on road projects; followed by heavy or awkward lifting, "rushing" to get a job done and exposure to typical construction site hazards. Overall, workers felt management and co-workers were committed to safety on the job. Possible safety improvements revolved around: general awareness, watching out for each other, planning ahead, taking time to do the job right, and proper use of personal protective equipment. Most of the workers interviewed indicated interest in participating and promoting a workplace wellness program to improve their health and fitness. Efforts to reduce musculoskeletal injuries need to incorporate the concerns and ideas of workers, building off of what was learned in this study.			
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Prepared by:

Todd William Loushine
Department of Mechanical and Industrial Engineering
University of Minnesota Duluth

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EXECUTIVE SUMMARY

The objective of this study was to ascertain the risk perceptions of workers in order to determine the best method for reducing musculoskeletal-related injuries for Mn/DOT workers. Fifty interviews were conducted from July – September 2009 with a random sample of field workers within Mn/DOT District 1. Most of the interviews were conducted over the phone, due to the dynamic and sometimes unpredictable schedules of general transportation specialists, heavy equipment mechanics, and transportation specialists. Interviews were voice recorded and transcribed for analysis. Analysis consisted of reviewing the response and attempting to transform longer strings of language into shorter strings. These shortened strings were then compared among all the responses and common language was discovered and adopted. Each interview question had 15 to 21 response categories from this analysis. These responses were counted and sorted by demographic data. Total response frequency counts ranged from 63 to 123 per question.

The primary concern among all groups of workers was exposure to public traffic on job sites. Other concerns reported by the sample were: heavy/awkward lifting, “rushing” to complete a job, and construction-site hazards, such as uneven terrain, moving equipment, and working at heights. Workers tend to believe that the best way to protect themselves is general awareness while working and proper use of personal protective equipment (PPE). Seventy-six percent of the sample indicated that management is committed to safety, with less than 18% indicating something negative such as, “management says one thing but does another”. Whereas sixty-eight percent of the sample indicated that their co-workers were committed to safety, with less than 18% indicating something negative such as, “although most everyone is safe, there are a few who are not”. Almost a quarter of the subjects indicated that if they had more time to complete a job or if better planning for work was implemented that injuries would decrease. Improving equipment availability (or maintenance of equipment) and better communication were also somewhat frequent recommendations from workers.

Although few recommendations were directed toward how heavy and awkward lifting injuries could be decreased, over 65% of the subjects indicated that they would participate in a wellness/fitness program at work and would encourage co-workers to participate. Less than 30% had unfavorable things to say about a worksite wellness program, such as “it was tried before and didn’t work” or “it would be too difficult for all sites to be included”. A few subjects indicated that they were, “too busy in the summer to participate, but might have time in the winter when the scheduled is not so hectic.”

This study provides some interesting insight to what the employees perceive as job-related risks and how they believe those risks could be reduced. The main recommendations to Mn/DOT management is to continue addressing employee concerns about exposure to public traffic on job sites, address the perceived need to “rush” through jobs, and discuss with employees what can be done to reduce heavy/awkward lifting injuries. The creation of a wellness/fitness program is just one option for reducing musculoskeletal-related injuries by improving the strength, flexibility, and overall conditioning of workers. Other possible options include, but are not limited to: job/task evaluation and redesign, use of lifting or mechanized equipment, teamwork, training on proper lifting, and taking breaks from prolonged awkward positions (such as driving a plow).

1. INTRODUCTION

In early 2009, the Minnesota Department of Transportation (Mn/DOT) Safety Director and District 1 Safety Administrator met with the principle investigator to discuss ideas for reducing musculoskeletal-related injuries for field employees throughout Minnesota. A musculoskeletal injury is typically recognized as the outcome of exposure to force (heavy weight), repetition, awkward postures, and vibration; and can range from low back pain, to muscle strain, to carpal tunnel syndrome (to name a few more common musculoskeletal injuries). Initial discussion revolved around whether or not a behavioral-based safety or wellness/fitness program would help Mn/DOT reduce musculoskeletal injuries. Caution was given to simply create and disseminate a behavior-based safety effort, ergonomics program, or wellness initiative without first investigating what workers thought about the issue and what they would be interested in attempting. A primary barrier to these types of workplace injury reduction programs is that the current state of worker perception of safety issues and how they could be integrated into the work system was not evaluated and considered in the design. The principle investigator recommended a study consisting of interviews with a sample of employees from Mn/DOT District 1 to ascertain what workers believed were the common causes of workplace injuries and what they believe should be done to improve workplace safety and reduce injuries.

The first step consisted of a review of five years of workers' compensation data from Mn/DOT District 1. This analysis provided some insight to the injury and illness experience for the sample population. A description of the data analysis methods is in the next section. Results indicated that sprains/strains were the primary injury type and that job classifications with "transportation general" and "mechanic" represented a large majority of cases. This confirms the contentions of the Safety personnel and will be the qualifiers for the interviews and subject for the interview questions.

Second, an interview script was developed to evaluate six areas:

1. What are the primary causes of injury on a typical day, and a not so typical day at work?
2. What is being done to reduce the chance of injury for those causes?
3. What is the perceived level of management commitment to safety?
4. What is the perceived level of co-worker commitment to safety?
5. If you could change anything about your job, what would it be?
6. What do you think about wellness programs, and would you participate?

The advantage of conducting an interview study versus a survey study is that surveys assume that the participants have an opinion on the items questioned, and that the response categories accurately represent the entire field of possible responses to those items. Interviews provide full freedom of response and allow the subject to elaborate as much or as little as they deem appropriate. The disadvantage of interview studies is that they are time and resource intensive and data analysis is complex and must address evaluator bias. The study presented in this report will provide Mn/DOT Safety personnel in District 1 with recommendations based on the prevailing perceptions and opinions of their employees.

1.1 Mn/DOT Workers' Compensation Records Analysis

Workers' Compensation (W.C.) records contain all the information from the first report of injury forms, required as part of the state of Minnesota Workers' Compensation laws. These records are sometimes called "Loss Run" reports, and are reviewed regularly by safety professionals to benchmark injury and illness experience and to identify areas of concern for further evaluation and potential safety improvement. For the study, the loss run report was evaluated to look at the overall injury experience to identify the major sources of injuries (and injury case severity), with special attention to musculoskeletal-related injuries.

Five years of workers' compensation data for Mn/DOT District 1 was cleansed of personal identification and provided in a Microsoft Excel file format. The first step was to evaluate the aggregate counts of the overall data set. In all 249 cases were evaluated, representing calendar years 2004 to 2008. A total of \$1,057,465 was paid in workers' compensation and medical benefits as of April 2009 (\$1,328,627 incurred, or set aside for future case payment). Of the 249 cases, 171 were closed, 53 were re-closed, 23 were open, and 2 were re-opened. Therefore, 25 cases are still being paid and could cause the results of this analysis to be slightly different. The maximum payout for a single case was \$165,550, and the average amount paid per claim was \$4,247. However this average is skewed due to just a handful of expensive cases. In fact, almost 88% of the cases are below the \$4,247 average amount paid, with 32 cases listed as zero dollars paid. Based on status code, 193 medical only (MO) cases accounted for \$155,275 (\$805 average); whereas 41 cases incurred lost time (LT) and paid \$432,085 (\$10,539 average) and 15 cases which were initially filed as MO and switched to LT (XI) were paid \$470,106 (\$31,340 average).

The next step was to sort the full database based on job classification (of injured person), nature of injury, cause of injury, and breakdown by year, to investigate where further analysis is needed. Five job classifications accounted for over 93% of all the cases: Transportation General (n=113, 45.4%), Transportation General Sr. (n=59, 23.7%), Transportation Specialist (n=22, 8.8%), Heavy Equipment Mechanic (n=9, 3.6%), and Heavy Equipment Field Mechanic (n=7, 2.8%).

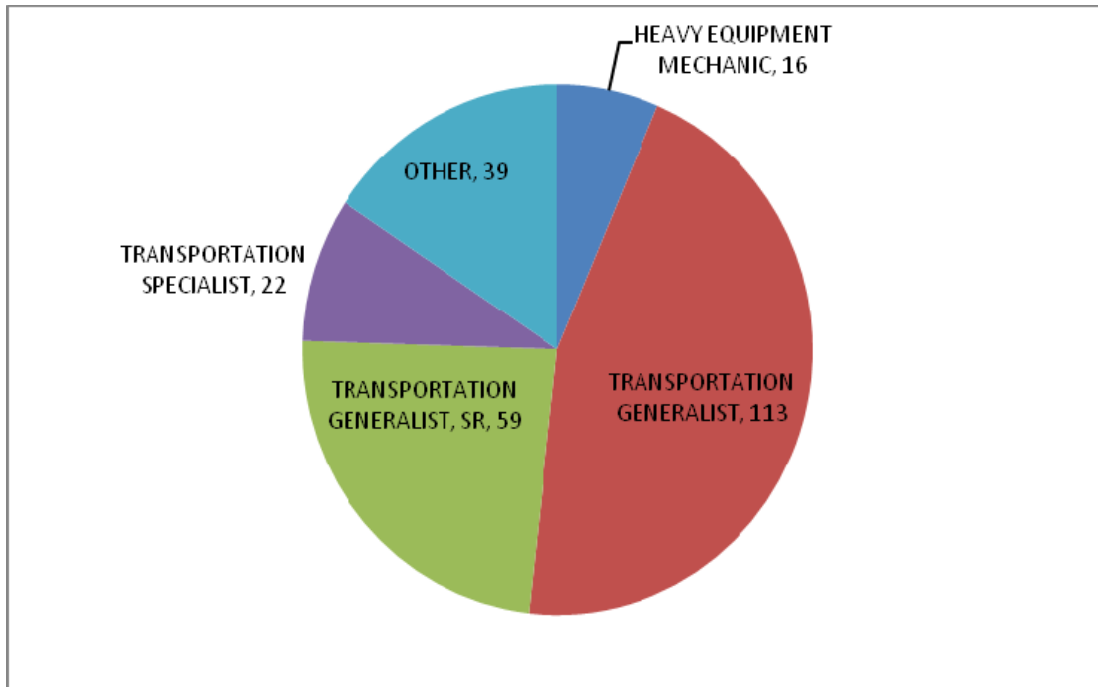


Figure 1. W.C. Data Breakdown by Job Classification and Count

Four “nature of injury classifications” accounted for over 77% of all the cases: Sprains/Strains (n=120, 48.2%), Contusion/Crush/Bruise (n=35, 14.1%), Cut/Laceration/Puncture (n=24, 9.6%), Nervous system/Nerves/Ganglia (n=13, 5.2%), Eye, Optical Nerve, Vision (n=19, 7.6%). The “cause of injury” had 45 classifications that were compressed to 9 representative categories. Overexertion (n=67, 26.9%) and bodily reaction - no contact (n=37, 14.9%) were the two most frequent causes of injury, followed by struck-by (n=33, 13.3%), falls (n=28, 11.2%) and struck-against (n=20, 8.0%). Due to interview responses, this analysis was recalculated to find that 8 cases were caused by collision with vehicles (all types), accounting for 3.2% of the total. The dataset was then sorted by year of injury, and the data showed no definitive trend except that number of cases appears to be decreasing and calendar year 2005 was curiously high in all financial categories. Figure 2 shows the breakdown by nature of case injury. Figure 3 shows the breakdown by cause of injury. Table 1 provides case counts and money paid per year.

Table 1. W.C. Data Breakdown by Year

YEAR	COUNT	PAID	INCURRED	AVERAGE	MAX	NO \$ PAID
2004	54	\$174,489	\$213,852	\$3,231	\$87,901	10
2005	55	\$418,998	\$443,488	\$7,618	\$164,550	9
2006	52	\$154,362	\$160,582	\$2,969	\$75,663	9
2007	43	\$171,051	\$236,561	\$3,978	\$69,173	1
2008	45	\$138,566	\$274,144	\$3,079	\$58,602	3
TOTAL (AVG)	249	\$1,057,466	\$1,328,627	(\$4,175)	(\$91,178)	32

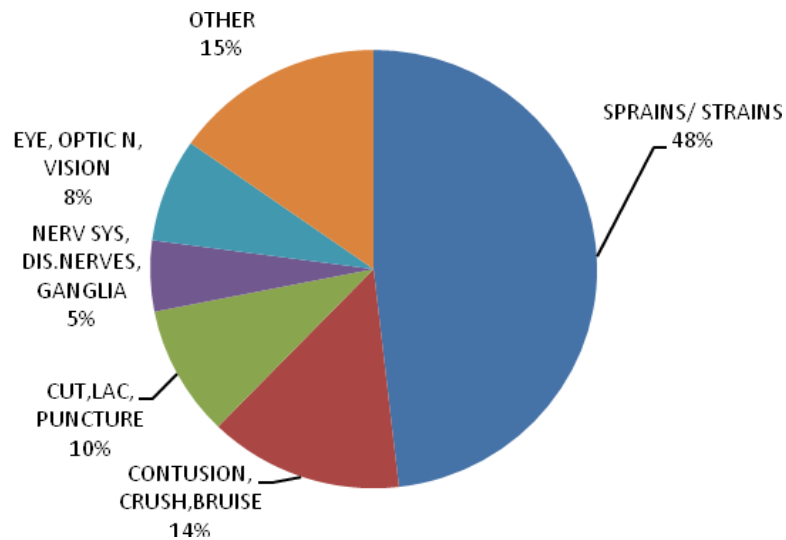


Figure 2. W.C. Data Breakdown by Nature of Injury

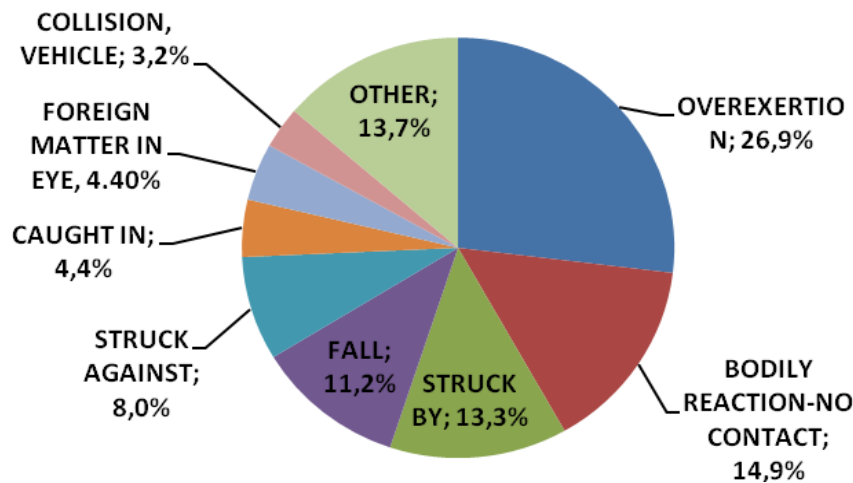


Figure 3. W.C. Data Breakdown by Cause of Injury

Based on the results of the aggregate there are several interesting findings. First, 5 job classifications represented over 93% of the total number of cases. This is the reason the study focused on just these job classifications. Second, 48% of all the cases resulted in sprains/strains. The focus of this study is to evaluate employee perceptions in an effort to better understand the primary concerns of risk at work, primarily musculoskeletal-related injuries. Initially, it was assumed that the sprain/strain classification was a good representation of MSD-related cases. However, further investigation indicates that under 70% of the sprain/strain cases are related to

MSD type injuries or to causes such as over-exertion or awkward positions/lifting. Therefore, two datasets were created to investigate a potential relationship.

The first new dataset was based on cause classifications of “overexertion”, of which 67 cases (26.9% of total) were identified and placed in a new spreadsheet for analysis. Overexertion cases accounted for \$369,034 in total payments (34.9%) at an average of \$5,508 per case (overall case average is \$4,247). There were 11 cases which incurred no money paid (overall there were 32 no payment cases). Over 77% of the overexertion cases were classified as sprain/strain.

The second new dataset was based on review of injury description entries to determine if a case may have been caused by awkward positions or awkward/heavy lifting. A total of 58 cases (23.3% of total) were identified and placed in a new spreadsheet for analysis. Awkward/heavy lifting cases accounted for \$359,394 in total payments (34%) at an average of \$6,196 per case. There were only 6 cases which incurred no money paid. Over 91% of the awkward/heavy lifting cases were classified as sprain/strain.

Nothing within these two new datasets, such as specific job tasks, employee behaviors, or individual characteristics, provided any indication or insight as to what might be contributing to musculoskeletal-related injuries for Mn/DOT District 1. Therefore, the interview data (self-reports and employee perceptions) will attempt to identify potential job, behavioral, or individual characteristics that might be contributing to musculoskeletal-related injuries, and possibly how these injuries might be reduced/prevented. Based on the limited ability to evaluate the workers compensation data set to the point of specifying and classifying actual causes, it is recommended that Mn/DOT safety personnel consider re-designing this database. It would be helpful to quantify specific injury classifications for benchmarking and tracking purposes.

1.2 Literature Review

Management commitment and employee involvement are the foundation elements of a safety program (Cohen et al. 1975, Smith et al. 1978, Cleveland et al. 1979). The role of management is to set the policy and importance of safety in the workplace. The compliance of workers to management's safety policy is based on the practicality of the safety rules and observations of management's commitment to safety. Safety rules that lack practicality require interpretation and extrapolation by supervisors and workers, which can lead to unforeseen issues and accidents. It is therefore of utmost importance the management seek input from workers while developing safety rules and initiatives (Cox et al. 2003).

A concept that encompasses management commitment and employee involvement is safety culture. Safety culture represents the prevailing beliefs and perceptions of an organization towards the importance of safety that can be observed by watching employees at work (Guldenmund 2000). The strength of an organization's safety culture is dependent on two factors: communication between management and labor, and the strength of the message toward safety. It is believed that strong safety cultures incur fewer injuries because workers understand their role from a safety standpoint and continually assess their work to minimize risk. Organizations

with strong safety cultures tend to operate more efficiently, save money (maximizing profit), and have a happier and more committed workforce.

Musculoskeletal disorders (MSDs) are the primary cause of lost time injuries in the United States (BLS 2009). MSDs, especially low back injuries, also represent a majority of cases and greater than average cost per case for workers' compensation expenditures. The conceptualization of ergonomics has changed over the past decade. Once thought to be limited to tool and workstation design, ergonomics now extends to worker fitness, inter-organizational relationships, and hiring practices. Each job demands a unique approach, and therefore should be evaluate individually for a customized ergonomic solution. In many cases, the worker's input during the ergonomic evaluation provides essential information for the development of a practical solution. Therefore companies need to incorporate both ergonomic expertise and employee involvement in the assessment and development of solutions to ergonomic issues.

Although employee surveys are easy to develop and administer, they restrict concepts and responses and actually bias user-responses and ultimately provide limited insight to worker perception. Face-to-face interviews with open-ended questions remove the constrictions of surveys, but require a large commitment and time for data collection and analysis. For case studies and exploratory research, face-to-face interviews are the preferred methodology. Results from case study and exploratory research provide concepts and language for the development of self-administered survey instruments for larger-scale, quantitative research projects targeting similar issues or sample populations.

The development of open-ended interview scripts can be a time-consuming and iterative process. Case or sample background information and previous research provide a basis for concepts and issues in the development of interview questions. For complex issues with limited background, the work system (or "balance") model is recommended as it provides a construct for contributing elements at work and their interactions (Smith & Carayon 1989, Carayon & Smith 2000). The work system model consists of five elements that constantly interact: organization, environment, technology, tasks, and people. As applied to worker safety and health, an element that poses a risk of injury can be controlled through a counter-balance of another element. Likewise, each element has its limitations and therefore to truly affect workplace safety, all elements need to be given attention to mitigate both physical and behavioral causal factors.

2. METHODS

This section will provide details on the techniques used to plan and administer interviews, data collection and handling methods, and data analysis methods.

2.1 Random Selection of Subjects

Mn/DOT District 1 Management provided a list of current workers with job classifications that included Transportation and/or Mechanic in the title, sorted by the twenty sites located throughout the region. This list contained a total of 251 individuals, which were sorted into three lists to represent three regions in District 1: North and East, Central, and South. Table 2 shows the breakdown by region.

Table 2. Random Selection Breakdown by Region

	Sites	Site Count	Cluster Count	% Total	Out of 70	Out of 50
Cluster 1			112	44.6%	31	22
	Duluth	97				
	Pike Lake	5				
	Nopeming	10				
Cluster 2			105	41.8%	29	21
	Int'l Falls	6				
	Littlefork	4				
	Deer Lake	3				
	Hibbing	8				
	Virginia	41				
	Cook	4				
	Ely	4				
	Floodwood	4				
	Grand Rapids	17				
	Grand Marais	5				
	Illgen City	4				
	Two Habor	5				
Cluster 3			34	13.6%	9	7
	Carlton	15				
	McGregor	5				
	Moose Lake	3				
	Pine City	7				
	Sandstone	4				
Total		251	251			

Cluster subject sampling was used to ensure representative selection from the three regions of District 1. A total of 50 interviews were targeted for data collection, and with a 1-to-3 to 1-to-5 rate of refusal to participate, a sample set of 70 random numbers was generated using an online random number generator. The list of workers was arranged (confidential) and first 50 numbers drawn were the initial subjects contacted to participate in the study. If a member of the initial list refused, the next person on the list was contacted. In all, only one subject refused initial contact due to their busy schedule, and therefore the 51st person on the 70 person list was activated and interviewed.

2.2 Interview Script Development

The objective of this study was to collect the risk perceptions of workers in an effort to determine the best method for reducing risks that lead to musculoskeletal-related injuries. To better understand what risks concern workers the most, employees were asked questions related to the following areas: what can be done to reduce the risk, perceived management and co-worker commitment to safety, ideas for improving the job, and would they would participate in a wellness or fitness program at work. To keep the script as simple as possible, a short script was created. The introduction portion of the script, which was not voice recorded, addressed the requirements for human subjects protection, collected some basic demographic information about the subject in categorical form, and provided an opportunity for questions. The first question was meant to get the subject thinking about their work and get comfortable interacting with the interviewer. The first question simply asked what they did on a typical and not-so-typical days at work. The second question addressed the types of risks and hazards they encounter during the typical and not-so-typical day. The reason these first two questions contained two parts (i.e. typical vs. not-so-typical) was to call attention to what may be everyday safety and health issues versus unique to rarely seen safety and health issues. The third question addressed what is currently being done to reduce the likelihood of injury and illness at work. The fourth question addressed what they believed was management's commitment to safety. The fifth question addressed what they believed was their co-workers commitment to safety. The sixth question addressed what they would change in their job to make it safer, if they could. The final question addressed their opinion of worksite wellness and fitness programs, and whether they would encourage co-workers to participate. Each of these questions were open-ended to get the subject to talk and explain an answer. The interviewer was also instructed to provide limited response information because the goal was to get the subject to talk about whatever came to their mind regarding their opinions and perspectives on workplace safety.

2.3 Conducting Interviews and Coding Data

For human subject protection (See Appendix A for Human Subjects Protection Application), each subject interviewed was given a three-digit code for tracking purposes, for which only the PI had the key with names. This key was kept on a password-protected drive on the University of Minnesota (U of MN) system. The recorded interviews were transcribed by the interviewer into a Microsoft Word rich-text format, and once the transcription was verified by the interviewer, it was stored solely on the password-protected U of MN drive. The PI created spreadsheets on Microsoft Excel, each question was given its own tab and all the responses to that question were copied and pasted to the spreadsheet. The demographic information for each subject

accompanied each questions spreadsheet tab. The spreadsheet document contains no identifiable information about the subjects, and therefore is safe to be shared for data analysis.

2.4 Interview Data Analysis

The transcribed responses to each question need to be transformed into smaller, representative phrases, which provide a single to multiple possible answers to the question. Each response contained words that could be removed because either they were illegible or had nothing to do with the question. Once the un-needed words were removed, the transformed short response phrases were typed up. After completing the evaluation of each response for a particular question, the PI and assistant researcher went over all the responses and created response phrases that encompassed the meaning of the transformed response phrases. This was done to reduce the overall response categories. Both the PI and the research assistant had to agree on a reduction and to what degree the reduction process would go.

Once the response reductions were completed, they were counted. The table below shows the number of response categories for each question.

Table 3. Response Category and Total Response Counts for Each Question

Question	Response Categories	Total Response Counts
2. What concerns might you have for getting injured on a typically day versus a not-so-typical day?	21	94
3. What do you use to minimize or avoid getting injured at work?	19	109
4. How would you describe the safety mindset or commitment of management to safety?	20	79
5. How would you describe the safety mindset of your co-workers?	15	67
6. If you could change anything about your job to make it safer what would you recommend?	17	63
7. If a workplace fitness and wellness program were offered what is your willingness and thoughts about participating?	19	123

The aggregate results are provided in the results section. The final analysis consisted for sorting the data by three demographic variables: Region, Job Tenure, and Job Classification. With only 50 subjects, it would be near impossible to conduct statistical analysis by sorting the data by these three variables. Therefore, the percentage of subjects from each sorted variable was compared against the overall percentage to identify interesting trends (i.e. which part of a sorted demographic reported the most on a particular response category).

3. RESULTS

This section provides the results of the interview data analysis. Tables 4-9 provide the raw response category count, percent of total count, percent out of total responses for that question, and percent out of the fifty subjects. The top/most frequent response categories were analyzed further by sorting by region, job tenure, and job classification. Results of the sorting are also provided.

3.1 Question #2 Results

Q2. What concerns might you have for getting injured on a typical day versus a not-so-typical day?

Table 4. Question #2 Responses and Counts

Number	Response Category	Count	% Total	% of 50
1	Getting hit by public vehicles driving through work zone	32	34.04%	64.00%
2	Heavy, awkward, and/or repetitive lifting	7	7.45%	14.00%
3	Need to pay attention	6	6.38%	12.00%
4	No safety concerns	6	6.38%	12.00%
5	Road construction hazards: uneven terrain	6	6.38%	12.00%
6	Not enough time to plan things out, rushing to get things done	5	5.32%	10.00%
7	Road construction: work vehicles	5	5.32%	10.00%
8	Try to be safe	4	4.26%	8.00%
9	Getting in and out of work vehicles	3	3.19%	6.00%
10	Slips/falls due to unsafe walking surfaces	3	3.19%	6.00%
11	In winter, dealing with traffic while snow plowing	2	2.13%	4.00%
12	Responding to an emergency	2	2.13%	4.00%
13	Looking out for each other	2	2.13%	4.00%
14	Pinch-points on equipment	2	2.13%	4.00%
15	Road construction: working from heights	2	2.13%	4.00%
16	Noise exposure	2	2.13%	4.00%
17	Awkward working conditions	1	1.06%	2.00%
18	Road construction: flying debris	1	1.06%	2.00%
19	Lack of proper equipment for the job	1	1.06%	2.00%
20	Every day is different	1	1.06%	2.00%
21	Respirable fumes	1	1.06%	2.00%

Breakdown of most frequent Question 2 responses by region, job tenure, and job class

Question 2 response: “getting hit by public vehicles driving through work zone”

1. Sorted by region: all regions above 60%
2. Sorted by job tenure: 75% of “< 5 years” group
3. Sorted by job class: 73% of “Transportation General” group

Question 2 response: “heavy, awkward and/or repetitive lifting”

1. Sorted by region: all regions similar, 12-15%
2. Sorted by job tenure: 25% of “< 5 years” group
3. Sorted by job class: all job classes similar, 9-15%

Question 2 response: “need to pay attention”

1. Sorted by region: 19% of northern region
2. Sorted by job tenure: 25% of “< 5 years” group
3. Sorted by job class: 17% of “Transportation General, Sr.” group

Question 2 response: “No safety concerns”

1. Sorted by region: 20% of central/Duluth region
2. Sorted by job tenure: all ranges, 8-13%
3. Sorted by job class: 16% of “Transportation Specialist” group

3.2 Question #3 Results

Q3. What do you use to minimize or avoid getting injured at work?

Table 5. Question #3 Responses and Counts

Number	Response Category	Count	% Total	% of 50
1	Proper use of PPE	27	24.77%	54.00%
2	Be aware of your surroundings	13	11.93%	26.00%
3	Proper use of traffic control devices	13	11.93%	26.00%
4	Be aware of what you're doing	12	11.01%	24.00%
5	Think before you do things, plan ahead	8	7.34%	16.00%
6	Remind co-workers about safety, talk to each other	8	7.34%	16.00%
7	Use your head not your back, use proper lifting technique	6	5.50%	12.00%
8	Use equipment for lifting	5	4.59%	10.00%
9	Take your time to do things right	3	2.75%	6.00%
10	Think about what you are doing	2	1.83%	4.00%
11	Ergonomic evaluations of work	2	1.83%	4.00%
12	Use ventilation, dust collection	2	1.83%	4.00%
13	Use 3-pt. contact in and out of vehicle	2	1.83%	4.00%
14	Try to be as safe as you can	1	0.92%	2.00%
15	Use common sense	1	0.92%	2.00%
16	Use seatbelts while driving	1	0.92%	2.00%
17	Nothing	1	0.92%	2.00%
18	Stretching before work	1	0.92%	2.00%
19	Keep walkways free from slip hazards	1	0.92%	2.00%

Breakdown of most frequent Question 3 responses by region, job tenure, and job class

Question 3 response: "proper use of PPE"

1. Sorted by region: 62% of northern region
2. Sorted by job tenure: 73% of "5-15 year" group
3. Sorted by job class: 69% of "Transportation Specialist" and 100% of "Mechanic"

Question 3 response: "be aware of your surroundings"

1. Sorted by region: all regions similar, 24-28%
2. Sorted by job tenure: 30% of "> 15 years" group
3. Sorted by job class: 50% of "Transportation General, Sr."

Question 3 response: “proper use of traffic control devices”

1. Sorted by region: all regions, 20-33%
2. Sorted by job tenure: 40% of “5-15 years” and 33% of “< 5 years”
3. Sorted by job class: 32-33% of “Transportation General” and “Transportation General, Sr.”

Question 3 response: “be aware of what you’re doing”

1. Sorted by region: all regions, 20-29%
2. Sorted by job tenure: all groups, 22-27%
3. Sorted by job class: 25-41% of “Transportation General” and “Transportation General, Sr.”

3.3 Question #4 Results

How would you describe the safety mindset or commitment of management to safety?

Table 6. Question #4 Responses and Counts

Number	Response Category	Count	% Total	% of 50
1	Top management commitment is very good	16	20.25%	32.00%
2	Top management is committed to safety	11	13.92%	22.00%
3	Top management commitment is pretty good	10	12.66%	20.00%
4	Top management tries to do their best	4	5.06%	8.00%
5	New safety manager is doing a great job	4	5.06%	8.00%
6	Top management seems aware of safety	4	5.06%	8.00%
7	Top management provides safety training	4	5.06%	8.00%
8	Responds to safety inquiries, getting things done	4	5.06%	8.00%
9	Sometimes top management "pushes" to rush a job, so it's not safe	3	3.80%	6.00%
10	Top management says one thing but does another	3	3.80%	6.00%
11	Top management provides PPE	3	3.80%	6.00%
12	They enforce safety policy, stress working safely	3	3.80%	6.00%
13	Top management has made big changes	2	2.53%	4.00%
14	Top management does a very good job	2	2.53%	4.00%
15	Top management can't plan for everything	1	1.27%	2.00%
16	Training is not effective	1	1.27%	2.00%
17	Top management attempts to inform the public	1	1.27%	2.00%
18	Sometimes top management is a little over-board	1	1.27%	2.00%
19	Safety is still up to the worker	1	1.27%	2.00%
20	Outlying stations don't get enough attention	1	1.27%	2.00%

Breakdown of most frequent Question 4 responses by region, job tenure, and job class

Question 4 response: "Top management commitment is pretty good" to "very good"

1. Sorted by region: 68-75-100% for central-north-south regions, respectively
2. Sorted by job tenure: 75-66-78% for "< 5 years"-<5-15 years"->15 years", respectively
3. Sorted by job class: 59-99-99-69% for "Trsp Gen"-<Trsp Gen, Sr."-<Mech"-<Trsp Sp"

3.4 Question #5 Results

Q5. How would you describe the safety mindset of your co-workers?

Table 7. Question #5 Responses and Counts

Number	Response Category	Count	% Total	% of 50
1	Co-worker commitment to safety is pretty good	13	19.40%	26.00%
2	Co-worker commitment to safety is very good	11	16.42%	22.00%
3	We watch each other's backs	7	10.45%	14.00%
4	Co-worker commitment to safety is good	7	10.45%	14.00%
5	We try to be safe, be aware of safety	7	10.45%	14.00%
6	For the most part people are committed to safety, a few are not	5	7.46%	10.00%
7	We work together, share the load, communicate with each other	4	5.97%	8.00%
8	Some work is unsafe, just get the job done, rush	3	4.48%	6.00%
9	Older guys look out for the younger/newer guys	3	4.48%	6.00%
10	New guys out of training can help older guys who get laxed	2	2.99%	4.00%
11	We rotate jobs to prevent fatigue and injury	1	1.49%	2.00%
12	Truck driver is responsible for his crew's safety	1	1.49%	2.00%
13	Depends on "morning attitude", if equipment is available	1	1.49%	2.00%
14	Good in construction, poor in maintenance	1	1.49%	2.00%
15	Even better than management	1	1.49%	2.00%

Breakdown of most frequent Question 5 responses by region, job tenure, and job class

Question 5 response: “Co-worker commitment is pretty good” to “very good”

1. Sorted by region: 56-72-50% for central-north-south regions, respectively
2. Sorted by job tenure: 67-60-61% for “< 5 years”-“5-15 years”-“>15 years”, respectively
3. Sorted by job class: 59-75-67-54% for “Trsp Gen”-“Trsp Gen, Sr.”-“Mech”-“Trsp Sp”

3.5 Question #6 Results

Q6. If you could change anything about your job to make it safer what would you recommend?

Table 8. Question #6 Responses and Counts

Number	Response Category	Count	% Total	% of 50
1	More time to do the job, not rush, if an issue arises take care of it	10	15.87%	20.00%
2	Can't think of anything or no recommendations	10	15.87%	20.00%
3	Get public to slow down, pay attention, in work zones	10	15.87%	20.00%
4	More or better availability of equipment, better maintenance	6	9.52%	12.00%
5	We're doing all we can, the job is just dangerous	4	6.35%	8.00%
6	Watch each other's back, be aware at work	4	6.35%	8.00%
7	Better communication, more safety discussions	3	4.76%	6.00%
8	More training or more specific training	3	4.76%	6.00%
9	Plan more, plan better	2	3.17%	4.00%
10	Stronger enforcement for contractors, they make it unsafe for us	2	3.17%	4.00%
11	Annual ergonomic evaluations	2	3.17%	4.00%
12	Noise reduction, better dust collection systems	2	3.17%	4.00%
13	Use proper equipment for the job	1	1.59%	2.00%
14	Better management commitment, don't say one thing and do another	1	1.59%	2.00%
15	Lighter sample bags (under 25 pounds)	1	1.59%	2.00%
16	More workers on the job	1	1.59%	2.00%
17	Better lighting in buildings, less screen glare on monitors	1	1.59%	2.00%

Breakdown of most frequent Question 6 responses by region, job tenure, and job class

Question 6 response: “more time to do the job, not rush, if an issue arises take care of it”

1. Sorted by region: 19% of northern region and 24% of central/Duluth
2. Sorted by job tenure: all groups, 17-22%
3. Sorted by job class: 23-25% of “Transp Gen” and “Transp Gen, Sr.”

Question 6 response: “can’t think of anything or no recommendations”

1. Sorted by region: all regions, 19-25%
2. Sorted by job tenure: 26% of “> 15 years” group
3. Sorted by job class: 39% of “Transportation Specialist”

Question 6 response: “Get public to slow down, pay attention in work zones”

1. Sorted by region: all regions, 16-25%
2. Sorted by job tenure: 42% of “< 5 years” group
3. Sorted by job class: 23-25% of “Transp Gen” and “Transp Gen, Sr.”

Question 6 response: “More or better availability of equipment, better maintenance”

1. Sorted by region: 50% of southern region, 19% of northern region
2. Sorted by job tenure: 20% of “5-15 years” and 17% of “< 5 years”
3. Sorted by job class: 23% of “Transportation General”

3.6 Question #7 Results

Q7. If a workplace fitness and wellness program were offered what is your willingness and thoughts about participating? (If yes, would you encourage others?)

Table 9. Question #7 Responses and Counts

Number	Response Category	Count	% Total	% of 50
1	I would participate	22	17.89%	44.00%
2	I would encourage others to participate	17	13.82%	34.00%
3	I might, probably would participate	11	8.94%	22.00%
4	I would not participate	9	7.32%	18.00%
5	Participation depends on schedule/time, summer too busy, maybe winter	9	7.32%	18.00%
6	Sounds like a good idea, I think people would participate	9	7.32%	18.00%
7	I might encourage others to participate	8	6.50%	16.00%
8	I probably would not participate	6	4.88%	12.00%
9	I try to keep fit, watch what I eat, on my own	5	4.07%	10.00%
10	It was tried before and didn't work	5	4.07%	10.00%
11	I would not encourage others to participate	4	3.25%	8.00%
12	I don't think management would support, would need support	3	2.44%	6.00%
13	I think workers should keep fit and stretch on their own	3	2.44%	6.00%
14	We need better education on eating, I think people are overweight	3	2.44%	6.00%
15	I think it would be very difficult to get everyone on-board, not everyone will participate	3	2.44%	6.00%
16	I don't think group stretching is a good idea, wouldn't work	2	1.63%	4.00%
17	Some people would be left out, cant' service all the shops	2	1.63%	4.00%
18	I'm not sure	1	0.81%	2.00%
19	We already receive training on stretching	1	0.81%	2.00%

Breakdown of most frequent Question 7 responses by region, job tenure, and job class

Question 7 response: “I would participate”, “I might/probably would participate”

1. Sorted by region: 60-76-50% for central-north-south regions, respectively
2. Sorted by job tenure: 75-80-52% for “< 5 years”-“5-15 years”-“>15 years”, respectively
3. Sorted by job class: 64-58-66-76% for “Trsp Gen”-“Trsp Gen, Sr.”-“Mech”-“Trsp Sp”

Question 7 response: “I would encourage others to participate”, “I might encourage others”

1. Sorted by region: 56-47-25% for central-north-south regions, respectively
2. Sorted by job tenure: 50-60-43% for “< 5 years”-“5-15 years”-“>15 years”, respectively
3. Sorted by job class: 32-58-67-69% for “Trsp Gen”-“Trsp Gen, Sr.”-“Mech”-“Trsp Sp”

Question 7 response: “I would not participate” and “I probably would not participate”

1. Sorted by region: 36-19-50% for central-north-south regions, respectively
2. Sorted by job tenure: 25-20-39% for “< 5 years”-“5-15 years”-“>15 years”, respectively
3. Sorted by job class: 32-25-33-31% for “Trsp Gen”-“Trsp Gen, Sr.”-“Mech”-“Trsp Sp”

Question 7 response: “Participate depends on schedule, summer too busy, maybe winter”

1. Sorted by region: 28-10-0% for central-north-south regions, respectively
2. Sorted by job tenure: 8-20-22% for “< 5 years”-“5-15 years”-“>15 years”, respectively
3. Sorted by job class: 5-42-33-15% for “Trsp Gen”-“Trsp Gen, Sr.”-“Mech”-“Trsp Sp”

4. DISCUSSION OF RESULTS

Analysis of the interview responses has shown three primary findings that need to be considered in an effort to reduce musculoskeletal-related injuries for field employees in Mn/DOT District 1. The first issue is the risk of injury by collision/contact with public traffic while on a work site. The second issue is the perceived need to “hurry-up” or rush on a job and thereby placing themselves at great risk of injury due to short-cuts or not paying attention to risks. The third issue is the (overall) favorable perception of a wellness program to improve the health and fitness condition of employees. Originally, it was hoped that employees would have ideas or suggestions for reducing musculoskeletal-related injuries would be found using questions #3 and #6. Employees indicated that the best way to protect themselves from risks are: proper use of personal protective equipment (54%), awareness of your surroundings and work at-hand (50%), proper use of traffic control devices (26%), to think and plan ahead (16%), remind co-workers about safety (16%), and the use of proper lifting techniques and equipment (12-22%). Employees were also asked what they would change about their work if they could, and their responses were: more time to do the job (20%), get public traffic to slow down/pay attention (20%), better availability/maintenance of equipment (12%), and better communication and awareness (8-14%). These are all good ideas and recommendations, but more effort is needed to better understand the work factors that are contributing to musculoskeletal-related injuries.

Based on the results of the workers compensation injury data analysis, it was somewhat surprising to discover that the primary concern of this group was exposure to public traffic while on work sites and driving a snow plow. Sixty-four percent of the subjects interviewed indicated that exposure to public traffic while working on a job site was a concern, yet only 3.2% of all the workers' compensation cases over the past five years were caused by a vehicular collision (and most of those were while in a DOT vehicle). What is not surprising is that the perceived severity of such an incident increases the perception of the threat. This is called “dread risk” (a term coined by Paul Slovic (1987), a well-respected researcher and author in the field of risk perception). An example of dread risk is when people tend to be more afraid of flying in an airplane than they are travelling in a motor vehicle even though the crash/accident statistics clearly show the opposite. The issue of dread risk is somewhat serious in regards to how to deal with musculoskeletal-related injuries. If workers underestimate or under-perceive the risk of overexertion or sprain/strain injuries because they are primarily concerned with contact with a public vehicle, then any risk management efforts directed solely toward reducing the occurrence of musculoskeletal injuries will likely be ignored or not taken seriously. In fact, studies have shown that worksite ergonomic programs (designed to reduce musculoskeletal-related injuries) can fail if management fails to recognize the primary safety and health concerns of workers. A majority of the workers interviewed had a favorable perspective on management commitment to safety, and just a bit lesser were their perspectives on co-worker commitment to safety. Therefore, communication between employees and management should be effective.

While reviewing and classifying the sprain/strain injury cases, it was observed that many of the musculoskeletal-related injuries occurred during everyday activities, such as bending over to retrieve something, shoveling, changing a tire, or while closing a tailgate. A common, but not prominent, concept throughout the interview response was a perception that employees needed to hurry or rush to complete a job and that practice was causing injuries. It is impossible to support or refute this contention based on the workers compensation data because this type of case data is

not collected. It seems logical that if a worker rushes through a job that they could overexert themselves, utilize short-cuts and violate safety rules, or simply not see a risk and accidentally expose them(selves) to a hazard. As with the previous perceived issue, this is a good opportunity to have an open discussion between employees and management to investigate the perceived need by workers to “rush” through a job.

Workers with job tenure of less than 5 years and Transportation Generalists were the groups who primarily indicated that heavy/awkward lifting was an issue; and the mechanics were primarily concerned with the risks associated with entering/exiting vehicles. When questioned about their willingness to participate in a workplace fitness and wellness program, these two groups were also more likely to participate in a wellness/stretching program than the older group of respondents. On the other hand, workers with job tenure greater than 15 years and Transportation Generalist Seniors were more concerned with construction related issues, such as walking on uneven terrain, and tended to believe that a general awareness of the work was the best way to protect ones-self and co-workers. The interviewer did not specify or define the term “workplace fitness and wellness program”, but rather when queried about it the interviewer simply asked the interviewee what they thought it might be. The employees interviewed tended to report that their perception of a workplace fitness and wellness program ranged from group stretching on the job, to discounts to join a fitness club, to education on diet and healthy eating. Some employees reported that a wellness initiative was attempted before at Mn/DOT but wasn’t very successful. If individual fitness level or stiff-muscles are contributing to the musculoskeletal-related injuries for Mn/DOT District 1 employees, then a workplace fitness and wellness program might be beneficial at reducing those injuries (da Costa and Vieira 2008). Workplace wellness programs are typically customized to a workforce, depending on the goals of management and the needs of the workers. A quick google-search (<http://www.google.com>) of “wellness programs” yields literally hundreds of resources and companies who develop and administer programs for employers. The University of Minnesota is currently contracting with Healthways (<http://www.healthways.com/MN/>) and provides newsletters for healthy eating and lifestyle choices, along with smoking cessation programs, a health coach who calls once every 6 weeks to answer questions, and a monthly rebate for going to fitness club a minimum number of times per week/month. As mentioned earlier, these types of programs are only effective if employees realize the importance and benefit; but if they perceive a greater concern or need then they are less likely to commit to the program.

As indicated in the literature review section, the best way to reduce musculoskeletal-related injuries is a comprehensive program that evaluates and attempts to improve the five factors of the work system model: management support and involvement, proper use of technology and tools, consideration for environment (weather, condition of ground, etc.), user-centered task design, and workers who are mentally and physically fit for the job. A possible source for information to start this effort is the NIOSH Ergonomics for Construction workers (Albers and Estill 2007). This ninety-two page document is based on research literature that assesses successful efforts to reduce musculoskeletal-related injuries. A free copy in Adobe (.pdf) can be found and downloaded from: <http://www.cdc.gov/niosh/docs/2007-122/>.

5. CONCLUSIONS AND RECOMMENDATIONS

Analysis of the workers compensation injury data clearly supports that musculoskeletal related injuries, such as sprains and strains due to heavy, awkward and repetitive lifting are a frequent and costly injury for Mn/DOT District 1. Based on the results of the interviews, the following conclusions/recommendations can be made on what needs to be considered when establishing initiatives for reducing musculoskeletal-related injuries;

The commonly-shared perceived risk associated with exposure to the traveling public while working on a work site or within work zones is a major hurdle to get over and should not be overlooked when trying to institute safety programs and policies. The risk of having a musculoskeletal injury will be minimized by employees who have the perceived threat of a much more severe injury, making it difficult for employees to effectively “buy into” safety initiatives not related to the traveling public. Mn/DOT management needs to address this shared concern for exposure to public traffic while on jobsites.

There was a strong perception by workers that there was not enough equipment or well-maintained equipment, which required “borrowing” equipment from other sites and then rushing to get a job finished. This perception of rushing or hurrying to get a job done places the worker at greater risk because they are paying less attention to their own safety and more on speed of work. Management needs to address this issue, if this perception results in employees not following safe work practices appropriate communication needs to take place between management and employees and management and supervisors.

Based on the results of the interviews a workplace wellness/fitness program would be well received by workers, primarily those workers who have job tenure of less than 15 years and job classifications Transportation Generalist and Mechanic. Management needs to show visible support for this effort, and the best way to do this is to go to the individual sites and ask for their input on how to best create and administer the fitness/wellness program. In addition, management should talk to workers about the task, equipment, and environment that employees believe may be contributing to the musculoskeletal-related injuries. It is recommended one or two sites be chosen as pilot sites for a workplace wellness/fitness program. The chosen sites should have helpful and energetic supervisors and employees because they will need to try out new ideas and provide Mn/DOT management with feedback on what works and what doesn't work. Based on the results of the site pilot testing of a wellness/fitness program, perhaps a wellness committee could be formed to help develop and implement a successful model to other District 1 sites.

By addressing the shared concern about exposure to public traffic and evaluating the perceived need to “rush” and “hurry” to get a job done, Mn/DOT will be actively attempting to remove barriers associated with employee perceptions and enhance the opportunity for focused efforts such as the implementation of the wellness/fitness program to be successful and effective at reducing musculoskeletal injuries.

5.1 Study Limitations

The discussion of results and conclusions presented in this paper need to be considered in regards to the limitations with interview research and the lack of researcher observations of job site conditions and worksite practices. The workers' compensation data analysis was limited to five years and to the classification of injury cases contained therein. This database did not contain "near-misses" or other possible less-severe injury incidents. Therefore the analysis focused on cases which were filled with the workers compensation office, and therefore had a first report of injury form completed. The injury data analyzed for this study was basically the information recorded on the first report of injury and subsequent payments made for medical and indemnity case billing. The information contained in that injury spreadsheet was limited in specification of case "cause" classification. Attempts were made to recover a minimum level of injury cause classifications, but attempts were not completely successful. Some liberties were taken to extrapolate the injury experiences in the workers' compensation database to interview responses, and strength of those expressed relationships may come to be questioned. Any findings and relationships reported in this paper regarding the workers' compensation database were made with the best intentions and based on the best deductive analysis as possible.

The responses analyzed for this study came from a randomly-selected sample of 50 employees, and the results were generalized to the entire Mn/DOT District 1. It is possible that there are additional concerns by other employees that were not identified in this study. Therefore the results of this study should be viewed as a starting point for further discussion between management and employees within Mn/DOT District 1. Additionally, it was assumed that the interview responses were accurate; both from the perspective that the employees interviewed were telling the truth and they fully understood the questions. There may have been unintentional confusion by employees, or an inability to recall or accurately verbalize a response. Since it is practically impossible to evaluate the validity of these issues, the original assumption that the interview responses are accurate representations of employee perceptions about their work will be held as true. Some variability and error could have been introduced during the transformation of long-strings of response language into shorter-strings and eventually to common-language response categories. Every attempt was made by the researchers to evaluate the reliability of each transformation, combination, and frequency count. It is possible that a different set of evaluators could find variances in the creation of common-language response categories and therefore frequency counts. Therefore only the response categories with the greatest frequency counts were considered in the discussion and conclusion statements.

5.2 Research Funding

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APPENDIX A

HUMAN SUBJECTS PROTECTION APPLICATION

IRB Proposal

“Evaluation of workforce perceptions as a means to identify and mitigate the causes of musculoskeletal disorders”

Request for Exemptions status for Human Subjects Protection under:

Exempt Category #2

Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures or observation of public behavior, unless:

- Information obtained is recorded in such a manner that human subjects can be identified, directly or through identifiers linked to the subjects; and
- Any disclosure of the human subjects' responses outside the research could reasonably place the subjects at risk of criminal or civil liability or be damaging to the subjects' financial standing, employability, or reputation.

Note: Surveys on sensitive or personal topics which may cause stress to study participants are not exempt from IRB review. The section of this category pertaining to standardized educational tests may be applied to research involving children. This category may also apply to research with children when the investigator observes public behavior but does not participate in that behavior or activity. Note: This section is not applicable to survey or interview research involving children.

The proposed research will involve interviews with State of Minnesota supervisors and workers at several sites throughout Northern Minnesota (MN/DOT District 1). The interviews will be recorded for transcription purposes. Once an interview is transcribed, it will be verified by listening and editing the script. Once the electronic transcription is given to the PI for back-up storage, the recorded interview will be erased to protect the autonomy of the interview participant.

The goal of the interview is to collect perceptions on work factors which may cause physical burden that could lead to strain, or other types of injuries, and ideas/suggestions for minimizing or eliminating those factors. This approach to hazard identification and correction is favored over audits and job hazard analysis because the work is so dynamic and occurs at various sites. In addition, by collecting worker and supervisor perceptions, we will better understand how work expectations might influence unsafe behaviors, or whether some work expectations differ between management and labor.

The interview transcripts will be analyzed using either Microsoft Excel. Once an interview transcript is fully transformed and reduced, it can be reviewed and compared with other interview transcripts. Ultimately, it creates a range and count of responses for each interview question, looking much like a “wordy” survey instrument. The codes can also be sorted and viewed via demographic codes, such as age, job tenure, or position/title. This sorting option allows the researcher to breakdown the interview responses to look for patterns that provide insight as to relationships between particular demographic information and interview responses.

The output of this research will be a report that contains the aggregate results, and any interesting results when sorting by demographic information. This report will express the worker’s perception of what is causing musculoskeletal injuries on the job, and possible corrective action for reducing the occurrence of MSDs.