

SESSION 1: MUSCULOSKELETAL DISORDERS (MSDs) AND SOFT TISSUE INJURIES IN THE TRADES

- 1-1 MSDs and Injuries Among Workers in the Mechanical and Electrical Trades
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- 1-2 MSDs in the Sheet Metal, Mechanical, Air-Conditioning, and Plumbing Trades
Tom Soles, Executive Director
*Market Sectors, SMACNA (Sheet Metal and Air-Conditioning Contractors
National Association)*

- 1-3 MSDs in the Electrical Trades
Robin Johnson, Director
Loss Control Casualty Services, CNA Insurance Company

- 1-4 Non-Traumatic Lost-Time Injuries in Ontario
Peter Vi, Ergonomist
Construction Safety Association of Ontario, Canada

[Please note: The following presentation summaries are transcriptions from the 2-day meeting. These transcriptions have been edited and reworded for clarity of meaning. The presentations, including questions and answers, are included in the proceedings as documentation of the meeting. The content, however, might not reflect current NIOSH policy or endorsement.]

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SESSION 1: PRESENTATION 1-1 MSDS AND INJURIES AMONG WORKERS IN THE MECHANICAL AND ELECTRICAL TRADES

John Rosecrance, Assistant Professor

**Department of Occupational and Environmental Health, University of Iowa,
Iowa City, IA**

Construction is the most dangerous occupation in the country. Six percent of the U.S. workforce works in construction, yet construction workers represent 23% of occupational deaths (Figure 1-1.1).

Approximately three construction workers die every day due to occupational injuries.

Of all industries, the construction industry has the second highest incidence rate of occupational illnesses and injuries. Manufacturing has the highest. The incidence rate in construction has been declining over the last five years, as it has been in all industries. In 1996, there were 10 injuries or illnesses per 100 full-time workers (FTW), and in 2000, there were 8.2 injuries or illnesses per 100 FTW (Figure 1-1.2). This data includes both recordable injuries and illnesses.

Low-back problems are considered injuries, whereas the repetitive strain types of disorders, such as CTS or shoulder strain, are categorized as illnesses.

If we look at rates of lost workdays from strains and sprains, and compare all industries with construction and manufacturing, we see that construction has a much higher rate than the others: 122.6 per 10,000 FTW vs. 86.6 per 10,000 FTW for manufacturing (Figure 1-1.3).

Lost workdays from low-back injuries are also high at 68.8 per 10,000 FTW (Figure 1-1.4).

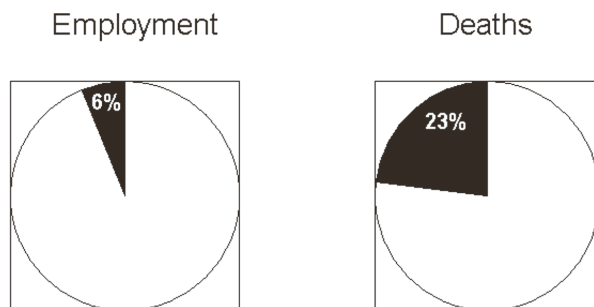


Figure 1-1.1. Construction employment vs. deaths
BLS 2001

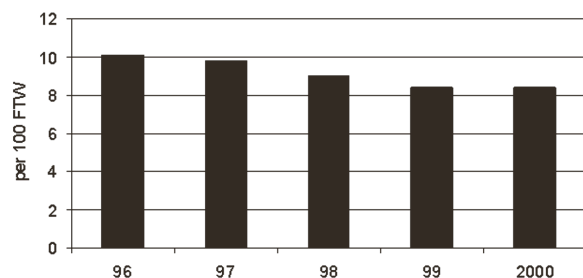


Figure 1-1.2. Non-fatal workplace injuries and illness
BLS 2001

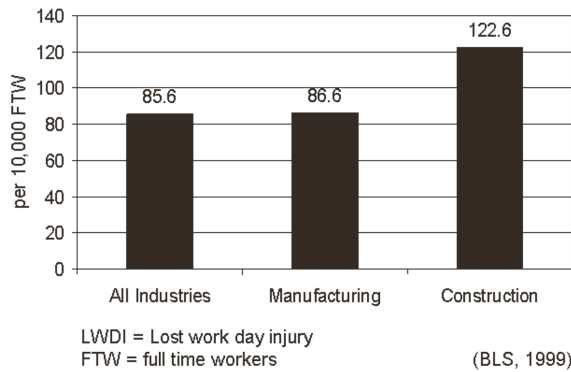


Figure 1-1.3. Lost work days due to sprains and strains in 1998

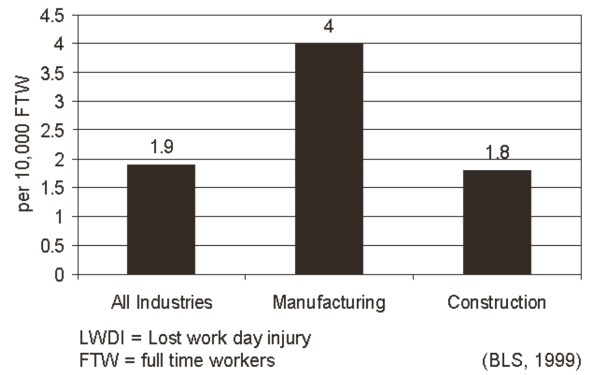


Figure 1-1.5. Lost work days due to carpal tunnel syndrome in 1998

CTS more lost workdays overall than any other type of injury or illness; the median case is out of work for 30 days. The BLS [1999] reports a higher CTS rate in manufacturing, than construction (Figure 1-1.5).

survey data. See also Scott Schneider’s “Musculoskeletal Injuries in Construction: A Review of the Literature” (2001). *Applied Occupational and Environmental Hygiene*.

Some sources for occupational injury and illness data are the OSHA 200 and 300 logs, Ontario Injury Atlas [Construction Safety Association of Ontario (CSAO) 2002] data, and self-reported symptom

The body part injured most often in construction is the low back. Shoulders, knees, and hand-wrist combination are the other body parts injured most often.

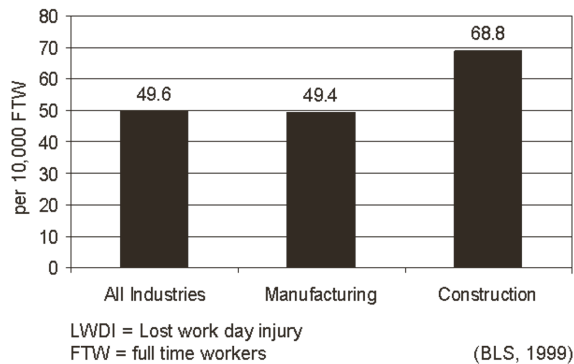


Figure 1-1.4. Lost work days due to low back injuries in 1998

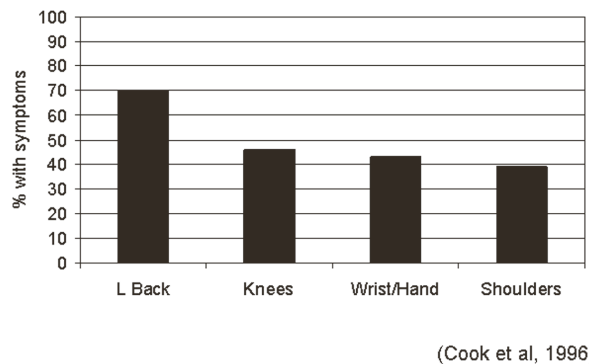


Figure 1-1.6. Prevalence of MSDs by body area for mechanical/electrical trades

The Iowa survey [Cook et al. 1996] asked journey-level construction workers whether they had experienced work-related pain in the last year. These are symptom data, which are self-reported rather than medical diagnoses or disorder data. The following responses were provided by electricians, plumbers and pipefitters, and sheet metal workers: low back, 70%; knees, 45%; wrist/hand, 42%; and, shoulder, 39% (Figure 1-1.6).

The survey also asked whether they had seen a doctor for their symptoms in the last year. Workers reported visiting a doctor for their symptoms the following percent of the time: low back pain, 33%; knees, 7%; shoulders, 12%; and, wrist/hand, 8% (Figure 1-1.7).

A study concluded at the University of Iowa [Rosecrance et al. 2002a] found a

high prevalence of CTS among construction apprentices (8.2%) compared to the findings of other studies. (Fig. 1.1-8).

The percentage of people in different population groups with CTS is 3.5% for the Swedish general population and 1.7% for the Swedish population under 45 years old [Atroshi et al. 1999]; 2.5% for U.S. computer operators [Stevens et al. 2001]; and 2.1% for U.S. construction workers [Tanaka et al. 1994].

The University of Iowa study [Rosecrance et al. 2002a] included nerve conduction studies and hand exams conducted by physical therapists using construction apprentice symptom reports. This study indicates that CTS is a problem in construction—not just among computer operators.

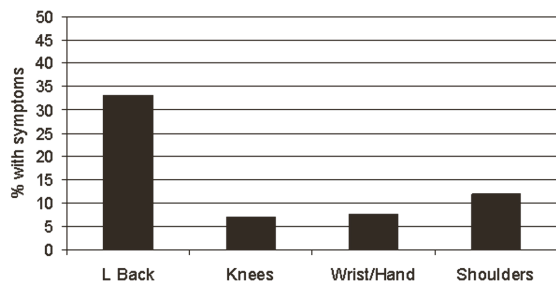


Figure 1-1.7. Percentage of individuals seeking medical attention for MSDs by body area

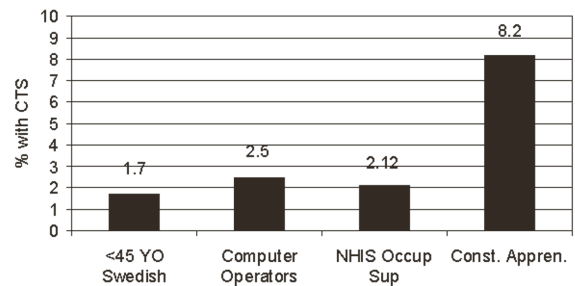


Figure 1-1.8. Prevalence of carpal tunnel syndrome

Work activities that can cause or contribute to MSDs include carrying or lifting heavy materials; awkward or cramped positions (the floor seems to be the workbench for many workers); holding the same position for long periods; bending or twisting back; forceful exertion; repetition (this may be a problem); vibration; and the environment, such as cold temperatures. Other work activities that may cause or contribute to MDSs are illustrated below (Figures 1-1.9–1-1.12). Other contributing factors are obesity, smoking, age, other disease, and general health status.

In summary, a large proportion of construction workers develop MSDs. MSDs are associated with physical aspects of construction, and they are different for different trades. Laborers and ironworkers have much higher rates of low back pain. Operating engineers have lower incidences of all problems. People who work on the floor have more knee problems. Construction workers continue to work when injured; they work in pain. They often do not see a doctor for their symptoms (e.g., numbness or tingling for various economic and psychosocial reasons).



Figure 1-1.9. Carrying or lifting heavy materials



Figure 1-1.11. Working in an awkward position for shoulder/wrist/hand



Figure 1-1.10. Using the floor as a workbench



Figure 1-1.12. Working in an awkward position for wrist

SESSION 1: PRESENTATION 1-2
 MSDS IN THE SHEET METAL, MECHANICAL, AIR-CONDITIONING,
 AND PLUMBING TRADES

Tom Soles, Executive Director

Market Sectors, Sheet Metal and Air-Conditioning Contractors National Association (SMACNA)

Thanks to Robin Johnson, Vice-President of CNA Insurance Company, for supplying the below data. The following data were taken from a review of almost 20,000 WC claims, representing \$113 million in paid and reserved claims, reported to CNA Insurance Company for a 3-year period (1999–2001) [CNA 2002]. The claims involve 3,200 contractors who are part of a program CNA calls SMAP (Sheet Metal, Mechanical, Air Conditioning, and Plumbing Program).

SMACNA Statistics

MSDs in the CNA data include: cumulative trauma disorders, ergonomic injury or ill-

nesses, carpal tunnel, trigger finger, sciatica, tendonitis (inflamed tendons), “carpet layer’s knee”, vibration syndrome, and tension neck syndrome. Over the three years studied, MSDs represented 29% of all WC claims and 36% of the costs (Figures 1–2.1 and 1–2.2).

When my colleagues on the management side of the industry say MSDs do not exist—I think the facts clearly show otherwise. I will relate frequency (number of occurrences) to severity (dollars spent) throughout the presentation.

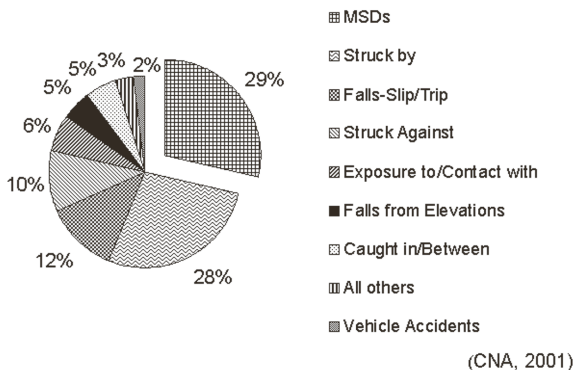


Figure 1-2.1. Mechanical Trades WC Claims (% of WC Claims)

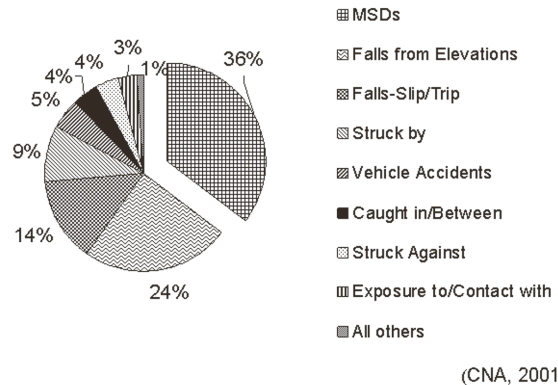
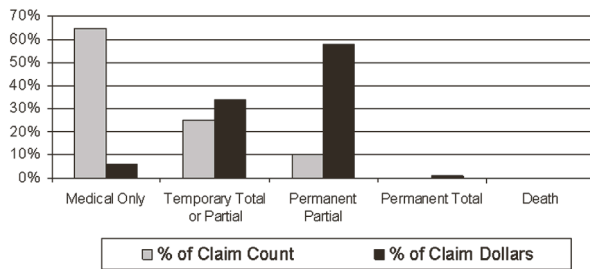
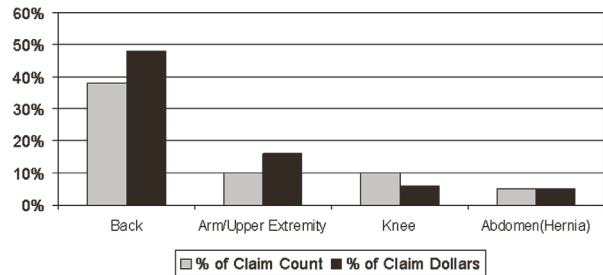


Figure 1-2.2. Impact of MSDs on Mechanical Trades: Percent of WC Claim Dollars



(CNA, 2001)

Figure 1-2.3. Impact of MSDs on Mechanical Trades: Percent Claim Count and Dollars by Disability Type



(CNA, 2001)

Figure 1-2.5. Impact of MSDs on Mechanical Trades: Part of Body Most Affected by MSDs

Percentage of MSDs by Disability Type:

Figure 1-2.3 uses state WC criteria to define different degrees of disability. The largest percentage in terms of claim count is medical only, followed by temporary total or partial, and permanent partial.

Severity of MSDs:

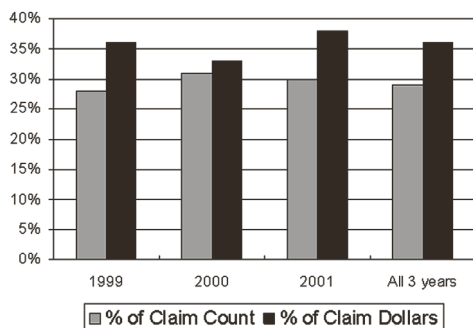
The severity of MSDs increased 5% from 2000 to 2001, although claim frequency remained fairly consistent (Figure 1-2.4). We can expect the figures for 2001 to increase further, as those claims mature. An adage within the insurance industry is that, “The longer a claim is open, the more expensive it gets.”

Body Parts Affected:

The back is the body part most affected by MSDs, in terms of both cost and frequency. Arms, knees, and hernia are also affected by MSDs, though they are affected less frequently and result in less dollars spent in claims (Figure 1-2.5).

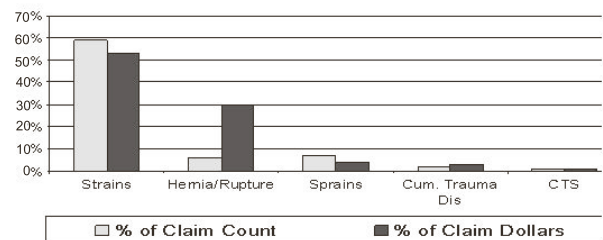
Types of MSDs:

Strains are the type of MSD resulting in the highest cost and frequency of WC claims. Although hernias only account for 6% of WC claims, they are an expensive item. There are few claims and claim dollars spent for carpal tunnel syndrome (Figure 1-2.6).



(CNA, 2001)

Figure 1-2.4. Impact of MSDs on Mechanical Trades: Percent of WC Claims and Cost (1999–2001)



(CNA, 2001)

Figure 1-2.6. Impact of MSDs on Mechanical Trades: Types of MSDs (1999–2001)

Median Days Away from Work (MDAW):

In Figure 1-2.7, sheet metal workers represent the Standard Industrial Classification (SIC) or North American Industrial Classification System (NAICS) [2003] category, which is used for workers who only perform shop work. Heating, air-conditioning, and refrigeration mechanics showed the highest rate of DAW for MSD cases in 1999 [BLS 2001].

Average Cost of MSDs, 1996-2001:

Figure 1-2.8 shows the average cost of MSD claims for 1996 to 2001. As previously discussed, the claims for 2001 have not yet matured, so the cost of claims for 2001 could

be quite high, as in 1998. MSDs are expensive injuries and reflect ultimately what an employer's insurability is, and what his WC premiums are going to be.

Costs of MSD Claims for Different Body Parts:

Rotator cuff injuries are quite expensive, as are hernias and lower back problems. (Figure 1-2.9)

Frequency and Cost of Claims by Type of MSD:

Figure 1-2.10 shows the average cost per claim by type of MSD. Strains account for 59% of MSDs, and 53% of the claim dollars spent.

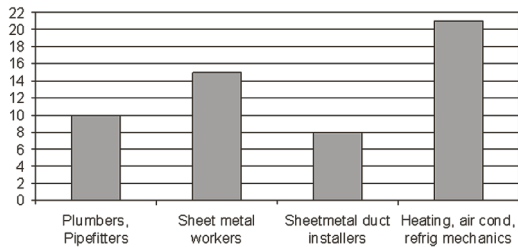


Figure 1-2.7. Impact of MSDs on Mechanical Trades: Median number of days away from work for MSD cases (1999)

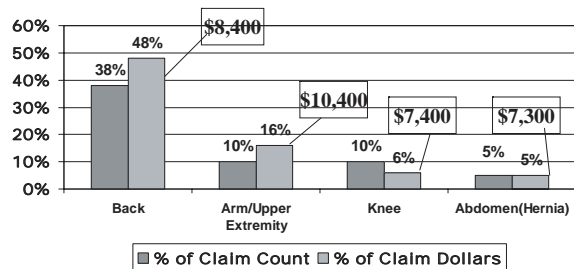


Figure 1-2.9. Impact of MSDs on Mechanical Trades: Average Cost of Claims by Body Part

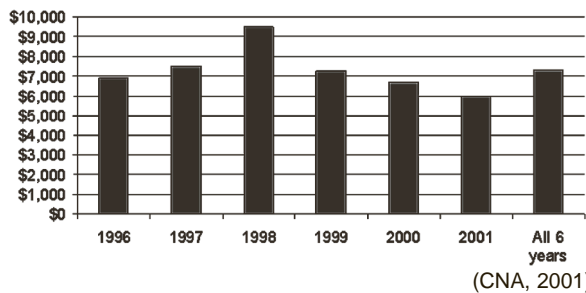


Figure 1-2.8. Impact of MSDs on Mechanical Trades: Average Cost of MSD Claims (1996-2001)

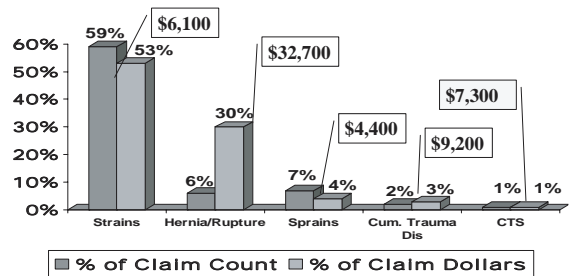


Figure 1-2.10. Impact of MSDs on Mechanical Trades: Average Cost of Claims by Type of MSD

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SESSION 1: PRESENTATION 1-3 MSDS IN THE ELECTRICAL TRADES

Robin Johnson, Director

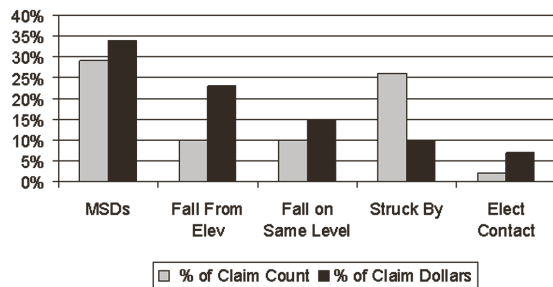
Loss Control Casualty Services, CNA Insurance Company

If any of you receive visits from safety people in your insurance company, I'm the person at the home office who is responsible for directing the services they provide to you, from a WC standpoint and a general liability standpoint.

I will highlight some of the differences between the MSD statistics for electrical trades and the sheet metal trade statistics that Tom Soles presented. The information I will present is taken from a review of about 13,000 WC claims totaling \$76 million, reported in 1999–2001 by about 2,100 electrical contractors who participate in our company's electrical contractor's business insurance program. The program is endorsed by both the Independent Electrical Contractors Association and the National Electrical Contractors Association [CNA 2002].

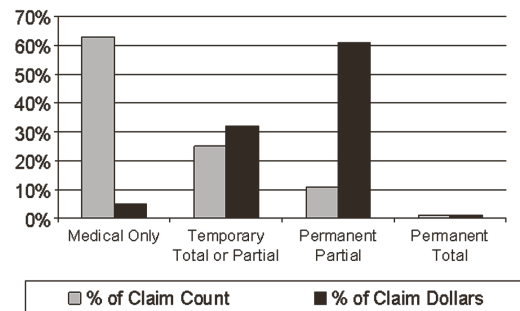
MSDs are the leading type of WC claim reported by electrical contractors, accounting for 29% of all claims in the 3-year period studied (1999–2001), and 34% of all dollars spent (Figure 1-3.1).

The good news is that 63% of WC claims for electrical contractors are medical only. In other words, there is no lost-work time. Twenty-five percent of the claims involve temporary partial or total disability. The permanent partial category, depending on state law, involves situations where workers are off work for more than a year, or have lost partial function of one of their members—a hand, an elbow—or some of the mobility in their back. Those disability types represent only 12% of all MSD losses, but 61% of the cost (Figure 1-3.2).



CNA, (2001)

Figure 1-3.1. Impact of MSDs on Electrical Trade: Frequency and WC Cost of MSDs (1999-2001)



(CNA, 2001)

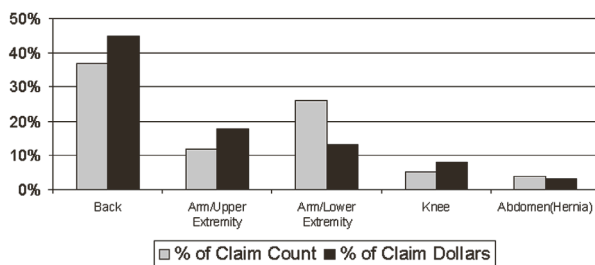
Figure 1-3.2. Impact of MSDs on Electrical Trade: Percent Claim Count and Dollars by Disability Type

The back was the body part most frequently affected by MSDs, representing 37% of all MSD claims and 45% of the associated costs. Lower arm injuries—from the elbow down—were the second most frequent claim (26%) (Figure 1-3.3).

Strains—injuries to the muscles or tendons—accounted for 58% of all MSDs reported from 1999 to 2001. These were followed by hernias, sprains (injuries to ligaments), and CTS, or other cumulative trauma disorders, such as tendonitis (inflamed tendons) and epicondylitis

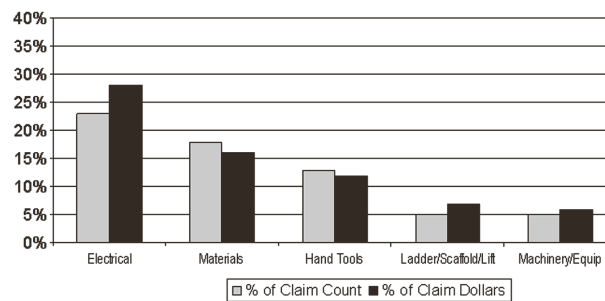
(inflamed muscle and tissue around the elbow). The frequency of CTS was slightly higher than in the sheet metal trade statistics discussed in the previous presentation (Figure 1-3.4).

The most frequently reported source for MSDs was working with electrical components, such as wires and cables, outlets, junction boxes, and transformers. These injuries were followed by non-electrical construction materials and hand tools. Handling ladders or scaffold components accounted for 5% of the claims (Figure 1-3.5).



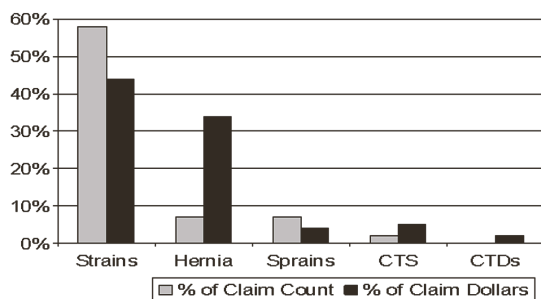
(CNA, 2001)

Figure 1-3.3. Impact of MSDs on Electrical Trades: Part of Body Most Affected by MSDs



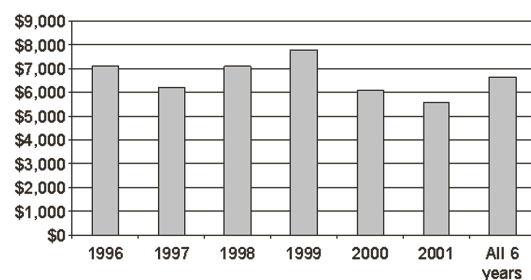
(CNA, 2001)

Figure 1-3.5. Impact of MSDs on Electrical Trade: Percent of Claims and Claim Dollars by Source of MSD



(CNA, 2001)

Figure 1-3.4. Impact of MSDs on Electrical Trades: Types of MSDs (1999-2001)



(CNA, 2001)

Figure 1-3.6. Impact of MSDs on Electrical Trade: Average Cost of MSD Claims (1996-2001)

In 1999, the MDAW for cases involving MSDs were eight days for journey-status electricians, and six days for apprentices.

According to Figure 1-3.6, the average cost of MSD claims peaked in 1999. However, many of the MSD claims reported in 2000 and 2001 may eventually be higher figures. The average cost of one MSD claim for 1996 to 2001 is \$6,650. When you think about the cost of your premiums, you can look at it as a percentage of that figure, to see the impact of one claim.

The good news is that 77% of MSD claims are under \$2,500. Sixteen percent (16%) of claims cost between \$2,500 and \$24,999, and 6% cost between \$25,000 and \$99,999. Only 1% of claims are over \$100,000. This figure has been consistent over the last three years (Figure 1-3.7).

Discussing the difference in cost of MSD claims by type of disability would be useful if you were trying to convince someone to buy a particular type of material handling equipment. For example, a medical only disability MSD claim (i.e., hernia) had an

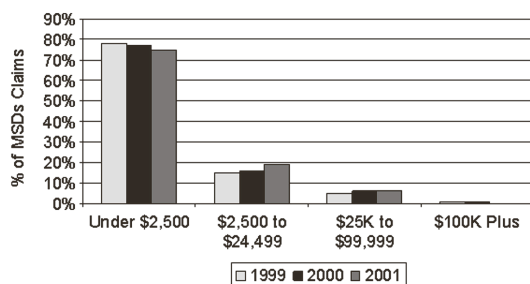
average cost of \$600 (\$100 less than the sheet metal figure). However, the cost of a permanent total disability MSD claim (also a hernia) averaged \$169,000.

Upper and lower extremity injuries accounted for the highest average costs per MSD claim, followed by back injuries. The average claim costs for knee injuries for electrical workers are about half of what we see in the sheet metal trade (Figure 1-3.8).

The MSD type with the highest average cost per claim was cumulative trauma disorder, followed by hernia. The costs for CTS and cumulative trauma disorder claims were much higher for electricians than for sheet metal workers (Figure 1-3.9).

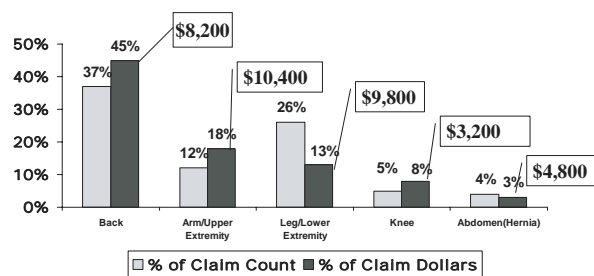
Following, are two examples of large MSD claims in which an ergonomic intervention might have prevented the losses.

An electrician injured his back while trying to move a transformer that was



(CNA, 2001)

Figure 1-3.7. Impact of MSDs on Electrical Trade: Average Cost of MSD Claim by Cost Range

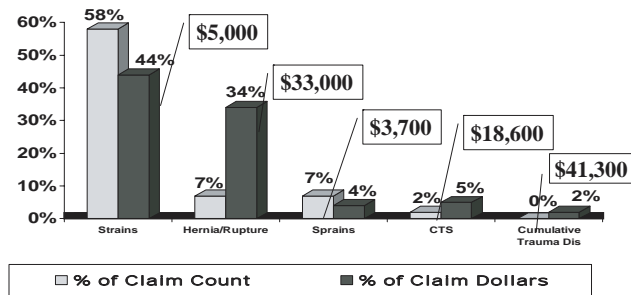


(CNA, 2001)

Figure 1-3.8. Impact of MSDs on Electrical Trades: Average Cost of Claims by Body Part

tight against the wall to access the electrical panel behind it. He lifted the transformer, and his supervisor tried to slide a pry bar beneath it. The pry bar broke. The transformer slipped and jerked the electrician's arms and back. This injury resulted in an MSD claim reserved at \$450,000.

In the second example, a 52-year old electrician had been employed by a contractor for 25 years. The employee was using a 1" EMT bender to bend a piece of 1" pipe for a conduit when he felt a snapping sensation in his right shoulder. The employee injured his rotator cuff, resulting in an MSD claim currently reserved at \$260,000.



(CNA, 2001)

Figure 1-3.9. Impact of MSDs on Electrical Trade: Percent of Claims and Claim Dollars by Type of MSD

SESSION 1: PRESENTATION 1-4 NON-TRAUMATIC LOST-TIME INJURIES IN ONTARIO

Peter Vi, Ergonomist

Construction Safety Association of Ontario (CSAO), Canada

The Construction Safety Association of Ontario (CSAO) is a labor-management organization funded by the Ontario WC system. CSAO provides free job hazard prevention services to all workers and contractors in Ontario [CSAO 2002]. Having worked in both manufacturing and construction, I can say that prevention is much harder in construction, and there are many opportunities for improvement.

A non-traumatic injury is one caused by overexertion, awkward posture, repetition, or a combination of these. (A traumatic injury is defined as a slip and fall, being struck by an object or against an object, or a motor vehicle accident.)

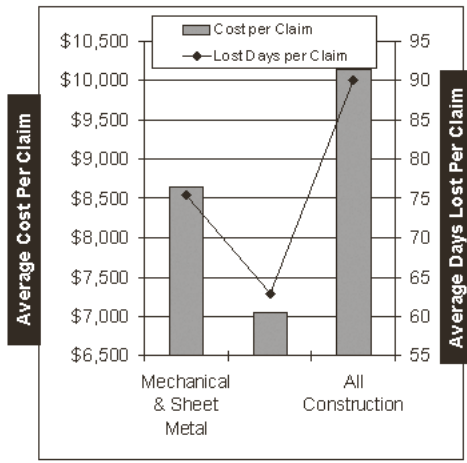
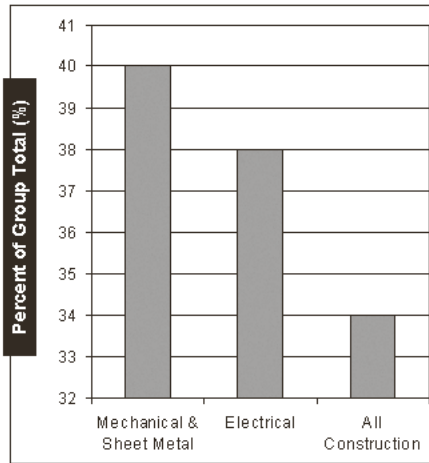
The source of the data for this presentation is the Ontario Workplace Safety and Insurance Board (WSIB) accident information obtained from workers and employers from 1996 to 2001. The costs are in Canadian dollars.

In the mechanical and sheet metal trades, 40% of all lost-time injuries (LTI) were the result of non-traumatic injuries; in electrical, 38%; and in all construction, 34%. The average cost per claim was \$8,700 for mechanical and sheet metal trades; \$7,000 for the electrical trades; and \$9,000 for all construction occupations. The numbers of lost days for the three

trades were 75 (mechanical and sheet metal), 63 (electrical), and 90 (all construction) (Figure 1-4.1).

Figure 1-4.2 shows the categories of causation for MSDS: overexertion, awkward posture, and repetition. The bottom four categories shown are forceful exertion. The next three categories up are repetition. Awkward postures consist of bending, climbing, etc. Bodily reaction is a combination of repetition and awkward posture. Bodily reaction and exertion combine all three factors (repetition, awkward posture, and exertion).

The grey bar represents mechanical trades, and the black solid bar is electrical trades. Mechanical trades seem to have a higher number of injuries related to higher forces than the electrical trades do: for overexertion, it is 13% vs. 10%; for overexertion due to lifting, it is 7% for mechanical trades vs. 5% for electrical. However, there are more injuries for overexertion due to pulling or pushing in the electrical trades, than for the mechanical trades. If you look at repetition injuries, the two trades are about the same. For awkward posture, the percentage of injuries is higher for the electrical trades. Moreover, the number of bodily reaction injuries is almost the same.



*LTI = Lost-Time Injury

CSAO, 2002

Figure 1-4.1. Non-traumatic lost-time injuries by construction sectors in Ontario from 1996–2001.

Overall, mechanical trades have a slightly higher risk of injury than electrical trades, because of the overexertion–lifting and applying more force.

In Figure 1-4.3, we see LTIs by source of injury. For both trades, awkward postures cause more non-traumatic LTI than materials. If awkward postures are reduced, the load on the back will be reduced.

While the injury rate is low for younger workers, the highest rate of injury is in the 30-40 year-old age group for all trades. Non-traumatic LTI for MSDs decrease as workers get older, since older workers tend to get better jobs. This relationship (an inverted U), however, does not hold true for traumatic injuries (Figure 1-4.4).

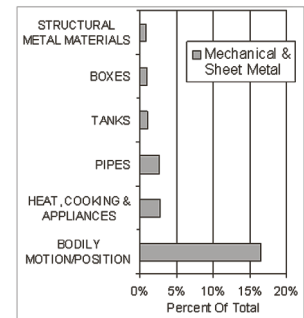
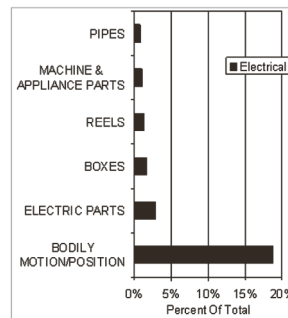
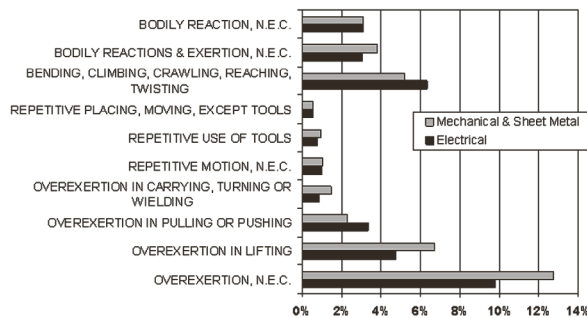


Figure 1-4.2. Detail non-traumatic lost-time injuries

Figure 1-4.3. Non-traumatic lost-time injuries by source of injury

For workers under age 30, the number-one reason for traumatic injuries is struck by object. For older workers, the number of falls increases, the older the workers become.

During the years 1996–2000, there was a consistent decrease in the rate of injuries per million hours worked. Injuries for the mechanical and electrical trades follow the same pattern (Figure 1-4.5). In the previous five years, there was also a gradual decline.

Questions from Presentation 1-4

Question for Peter Vi: About the age distribution—How much of a survivor effect is there? People who are injured may drop out of the trades. The roofers are looking at this, and the laborers want to.

Answer: It's correct that as the age group gets older, the number of LTIs do decrease—the overall number. That could be because many are gone. However, these figures are percentages for each age group, so they are independent of whether there is a dropout rate or not. It is related to the fact that older workers have better jobs, with less exertion.

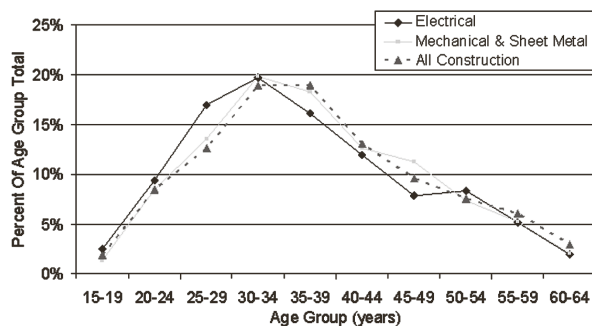


Figure 1-4.4. Non-traumatic lost-time injuries by age groups

Question for Peter Vi: About Figure 1-4.5: Are we perhaps shifting the cost of these injuries back to the employer and not onto the insurance, through our return-to-work programs, which become effective loss-management tools, but may not necessarily reflect the decrease in injuries to workers that the data seem to represent?

Answer: These are about the rate of accepted claims, so the figures are independent of whether workers go back or not. They represent a minimum of one day's loss of work. The submission rate is dependent on workers and doctors, whether both see the injury as work-related. If you graphed claims submission rate by itself, independent of the administration of the workers' compensation system, the submission rate would be decreasing. Is that because of lack of education—that workers don't understand injuries are work-related? I doubt it. There is a lot of education out there. Claims management may be a factor, but not so large a factor. There is also a decrease in injuries that do not result in time-off work, but do require medical aid. So, numerous data indicate that these data are real, not an administrative cause, but a real

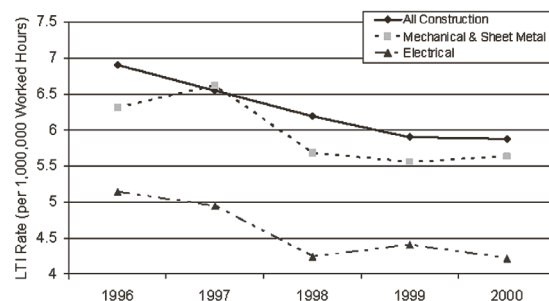


Figure 1-4.5. Non-traumatic lost-time injuries by year

improvement in the industry. This situation has occurred not only in construction, but also in all industries.

Question for Peter Vi: Does anyone know whether many workers get easier jobs as they get older?

Answer: I don't think there are any studies that suggest that.

Comment from Scott Schneider: I think there is a progression in careers. Apprentices are given the hardest jobs to do, a "baptism by fire". And people do learn better ways to do things. Studies of carpet layers using knee kickers show that

experienced workers use a lot less force. Toward the end of their careers, people with 20–30 years in the trade do become upper-level journey people and supervisors, but there are only a small number of those. No one has really documented accommodations as workers age. It's a good question.

Response from Peter Vi: Masonry workers in Ontario have one of the highest rates of non-traumatic LTI. They lift massive blocks. I observed older workers asking others to help them lift, but the younger ones would lift the blocks by themselves. We need more studies.