



Work-Related Musculoskeletal Disorders (WMSDs) in Washington State Construction

A Summary of Research Study Findings

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Contents

OVERVIEW	3
Why do we study sprains and strains and overexertions?	3
TRENDS	4
What are the injury trends in Construction?	4
How does Construction compare to other industry sectors in Washington State?	5
Which industry groups in Construction have high WMSD claims rates?	6
What is the burden of WMSDs in Construction?	7
What kind of WMSD injuries are occurring in Construction?	8
RESEARCH	9
What are the physical risks in Construction?	9
Job Categories Assessed	10
Level of Risk of Back Injury from Prolonged Standing	11
Level of Risk for Back Injury from Static Back Postures	12
Level of Risk for Back Injury from Back Movements	13
Level of Risk of Injury from Awkward Shoulder Postures	14
Level of Risk of Injury from Heavy, Awkward or Frequent Lifting	15
Discussion	16
SOLUTIONS	17
Physical Job Evaluation Checklist for Construction	17
Start With the Basics: General Principles for Preventing Musculoskeletal Injuries and Disorders	18
What other factors could be involved in sprains, strains, and overexertions?	19
Industry Prevention Strategies	21
Additional Resources	23

Why do we study sprains and strains and overexertions?

The Construction sector in Washington State includes a range of industries. Workers in these environments face a multitude of occupational safety hazards, from fractures and contusions to lacerations and dislocations.

However, the most common and most costly types of injuries construction workers incur are soft-tissue sprains and strains, generally referred to collectively as work-related musculoskeletal disorders (WMSDs). These injuries can result from years of accumulated stress on muscles, tendons, ligaments, and nerves. Common risk factors for WMSDs include repetitive motions, awkward body postures, forceful hand exertions, and heavy manual material handling.

In 2010 the Safety and Health Assessment and Research for Prevention (SHARP) Program, began a five-year study exploring the physical and organizational factors that may contribute to WMSDs in several major industries of the construction sector. Through interviews with company managers, employee representatives, and injured workers, our researchers gained insight into the organizational climate, the nature of existing safety programs, and the context within which WMSDs occur. During site visits to construction operations, SHARP researchers assessed physical risk factors for hundreds of jobs using a combination of well-researched evaluation instruments. This report draws on the data collected and summarizes the results of the analyses performed.



What are the injury trends in Construction?

According to Washington State workers' compensation claims data from 2002-2010, Construction ranks first (out of six) when compared to other industry sectors in its compensable claims rate of WMSD injuries (for claims that involved more than 3 days away from work).

Three construction industry groups rank in the top 25 when ranking industry groups within all industry sectors by compensable claims incidence rate.

Foundation, Structure, and Building Exterior Contractors has the highest number of lost work days among all Construction groups.

Within Construction, the top five industry groups by claims rate are:

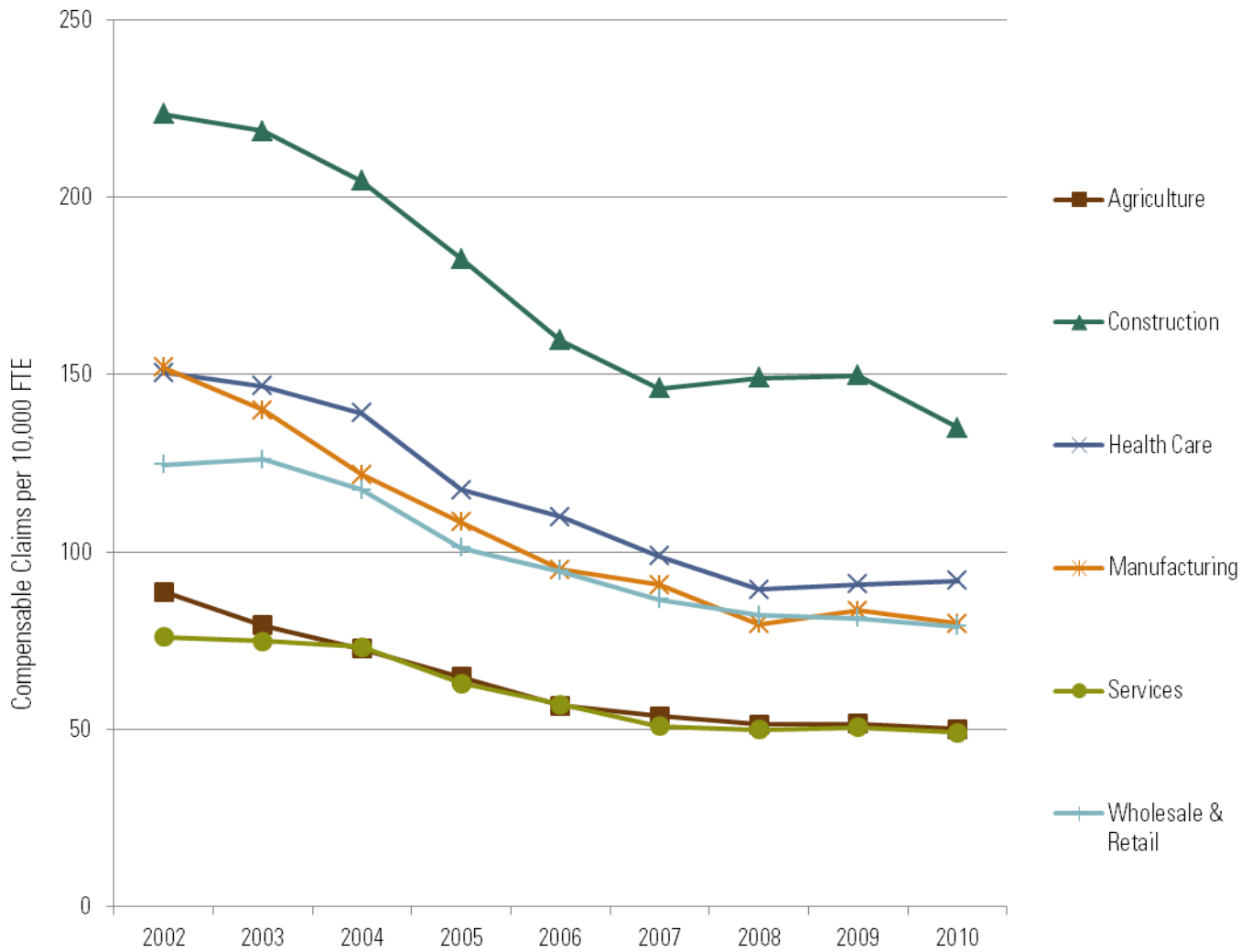
1. Foundation, Structure, and Building Exterior Contractors
2. Building Finishing Contractors
3. Residential Building Construction
4. Other Specialty Trade Contractors
5. Highway, Street, and Bridge Construction

Foundation, Structure, and Building Exterior Contractors has the highest number of lost work days among all Construction industry groups (1,685,562 lost days). When ranked by non-medical costs, Foundation, Structure, and Building Exterior Contractors is, again, the highest industry group (\$213,156,922).

Injuries of the back are the most commonly reported WMSD injury, compared to other body areas.

How does Construction compare to other industry sectors in Washington State?

Washington State, Compensable WMSD Claims Rates, 2002-2010^{1 2}



¹ Compensable Claim = a claim that involved more than 3 days away from work

² FTE = full time equivalent, an employee working 2000 hours/year

Which industry groups in Construction have high WMSD claims rates?

Top 25 Study Industry Groups by Claims Rate, 2002-2010*

Industry Sector	Industry Group Description	Incidence Rate Per 100 FTE**
Services	Waste Collection	2.92
Health Care	Residential Mental Retardation, Mental Health and Substance Abuse Facilities	2.76
Health Care	Psychiatric and Substance Abuse Hospitals	2.64
Wholesale & Retail Trade	Beer, Wine, and Liquor Stores	2.41
Health Care	Other Ambulatory Health Care Services	2.40
Wholesale & Retail Trade	Vending Machine Operators	2.31
Construction	Foundation, Structure, and Building Exterior Contractors	2.15
Manufacturing	Other Furniture Related Product Manufacturing	2.12
Services	Spectator Sports	1.98
Health Care	Nursing Care Facilities	1.98
Manufacturing	Dairy Product Manufacturing	1.96
Wholesale & Retail Trade	Beer, Wine, and Distilled Alcoholic Beverage Merchant Wholesalers	1.86
Health Care	Community Care Facilities for the Elderly	1.81
Construction	Building Finishing Contractors	1.81
Construction	Residential Building Construction	1.73
Agriculture	Aquaculture	1.71
Wholesale & Retail Trade	Grocery and Related Product Merchant Wholesalers	1.68
Manufacturing	Clay Product and Refractory Manufacturing	1.65
Health Care	General Medical and Surgical Hospitals	1.65
Agriculture	Poultry and Egg Production	1.64
Wholesale & Retail Trade	Grocery Stores	1.64
Wholesale & Retail Trade	Department Stores	1.60
Manufacturing	Sawmills and Wood Preservation	1.59
Manufacturing	Electric Lighting Equipment Manufacturing	1.59
Health Care	Other Residential Care Facilities	1.58

*Washington State, all compensable WMSD claims. This table lists only those industry groups included in the present study, such that the Transportation & Utilities industry group has been omitted. Very small industry groups (those with 50 companies or fewer) have also been excluded.

**FTE = full time equivalent, an employee working 2000 hours/year

What is the burden of WMSDs in Construction?

Cost and Lost Days in Construction (Industry Groups by Rate Rank), 2002-2010*

Industry Group	Non-Medical Costs	Lost Work Days**	Incidence Rate Per 100 FTE***	Rate Rank
All Industries	\$3,881,386,921	28,354,928	0.89	--
All Construction	\$899,944,408	6,559,872	1.55	--
Foundation, Structure, and Building Exterior Contractors	\$213,156,922	1,685,562	2.15	1
Building Finishing Contractors	\$136,993,620	1,059,588	1.81	2
Residential Building Construction	\$113,541,123	943,956	1.73	3
Other Specialty Trade Contractors	\$73,875,962	545,271	1.54	4
Highway, Street, and Bridge Construction	\$49,967,092	245,558	1.35	5
Building Equipment Contractors	\$168,885,865	1,162,231	1.26	6
Nonresidential Building Construction	\$69,653,625	434,805	1.23	7
Utility System Construction	\$50,992,708	339,910	1.23	8
Other Heavy and Civil Engineering Construction	\$17,830,539	109,970	1.06	9
Land Subdivision	\$5,046,952	33,021	0.53	10

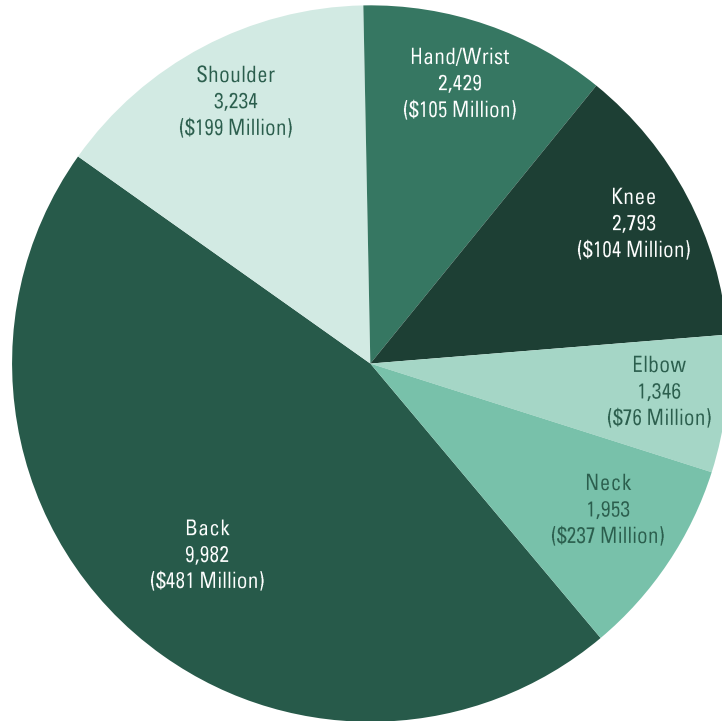
*Washington State, All Compensable WMSD Claims

**Lost work days included total time loss for state fund claims only; does not include self-insured employers.

***FTE = full time equivalent, an employee working 2000 hours/year

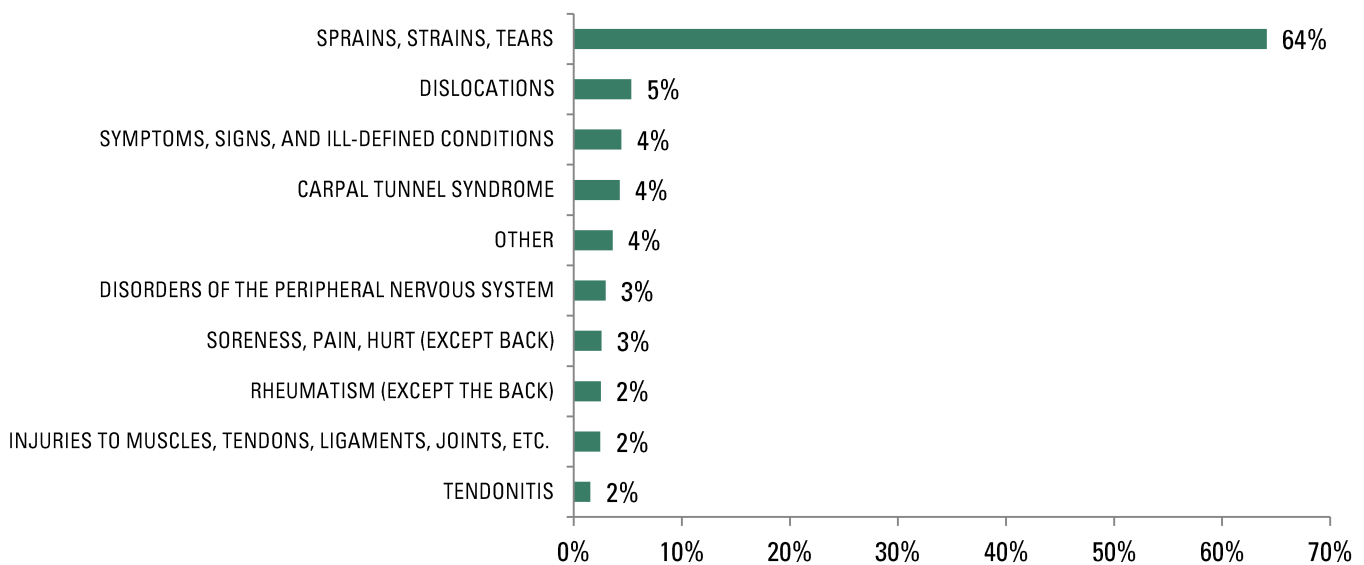
What kind of WMSD injuries are occurring in Construction?

WMSD Claims & Non-Medical Costs in Construction by Body Area, 2002-2010³



Number of Claims (and Non-Medical Costs)

WMSD Claims in Construction – Top 10 “Nature of Injury” Categories, 2002-2010⁴



³ Washington State, All Compensable WMSD Claims. A claim may include more than one body area. WMSD claims with uncategorized body area have been excluded.

⁴ Washington State, All Compensable WMSD Claims. Excluded categories include remaining 4% of claims.

What are the physical risks in Construction?

Focus Industry Groups:

- ▶ Foundation, Structure, and Building Exterior Contractors
- ▶ Building Equipment Contractors

Methods

To assess the physical risk factors in Construction, SHARP researchers visited 16 companies; 4 classified as “foundation, structure and building exterior contractors” and 12 companies classified as “building equipment contractors”. At each site, we assessed risk factors specific to 4 body parts; the back, the shoulder, the hand and wrist, and the knee. We evaluated 436 jobs for WMSD risk factors. Based on the exposure to these risk factors, we then determined the magnitude of risk of injury as either low, moderate, high, or very high.

The physical risk factors that were evaluated are those that have been associated with WMSDs. These risk factors are:

- Awkward postures
- Lifting
- Pushing, pulling, carrying
- High hand forces
- Highly repetitive motions
- Repeated impacts of the hand or knee
- Vibration (whole body, hand)

Results

The charts in the following pages display some of the notable findings from our analyses.

- Job Categories Assessed
- Level of Risk of Back Injury from Prolonged Standing
- Level of Risk for Back Injury from Static Back Postures
- Level of Risk for Back Injury from Movement of the Back
- Level of Risk of Injury from Awkward Shoulder Postures
- Level of Risk of Injury from Heavy, Awkward or Frequent Lifting

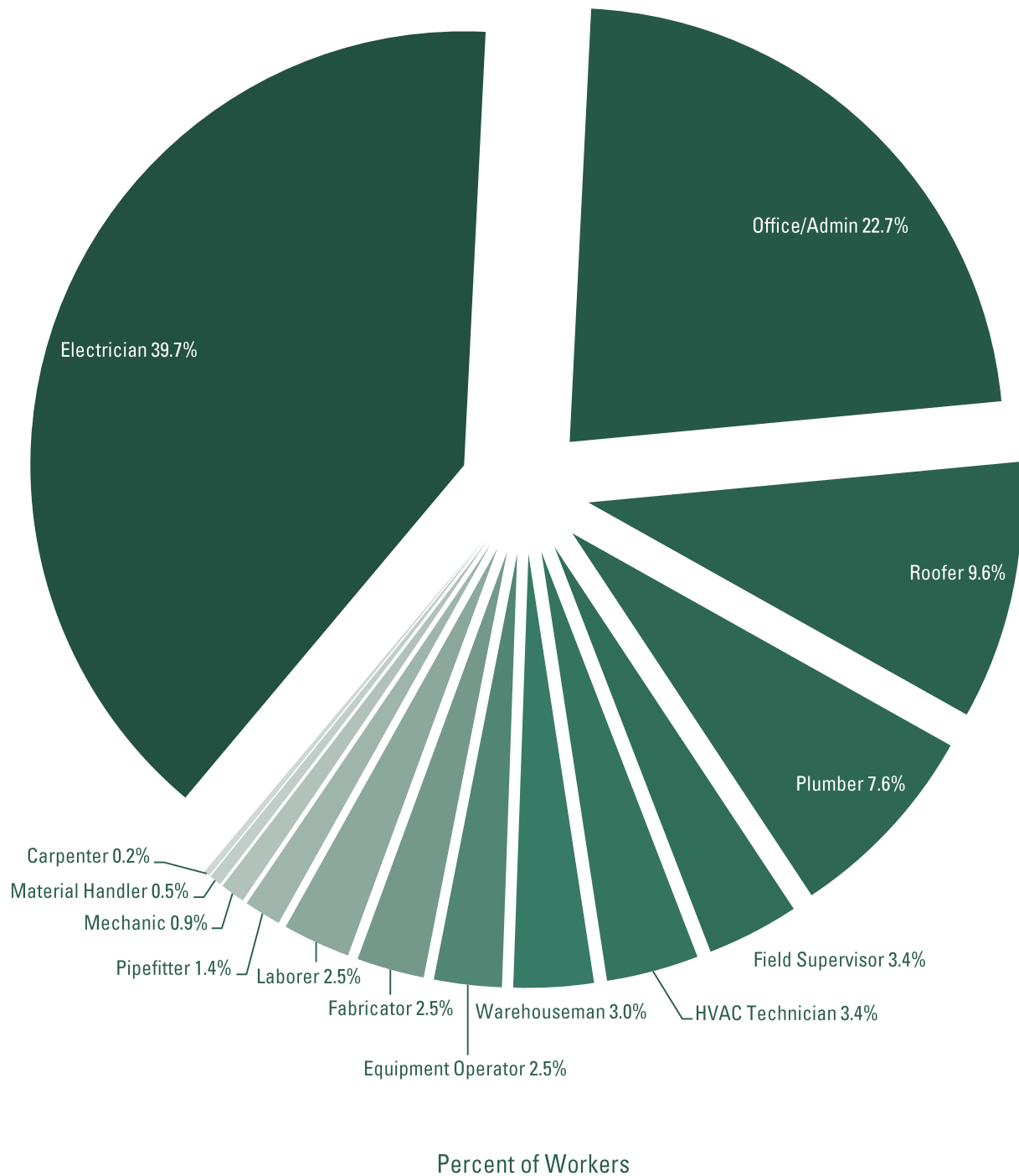
The charts that follow illustrate the level of risk (very high, high, moderate, low) posed by exposure to each risk factor.

The level of risk is determined by these factors:

- The duration of exposure to the risk factor (How long?)
- The frequency of exposure to the risk factor (How often?)
- The intensity of the exposure to the risk factor (How much?)

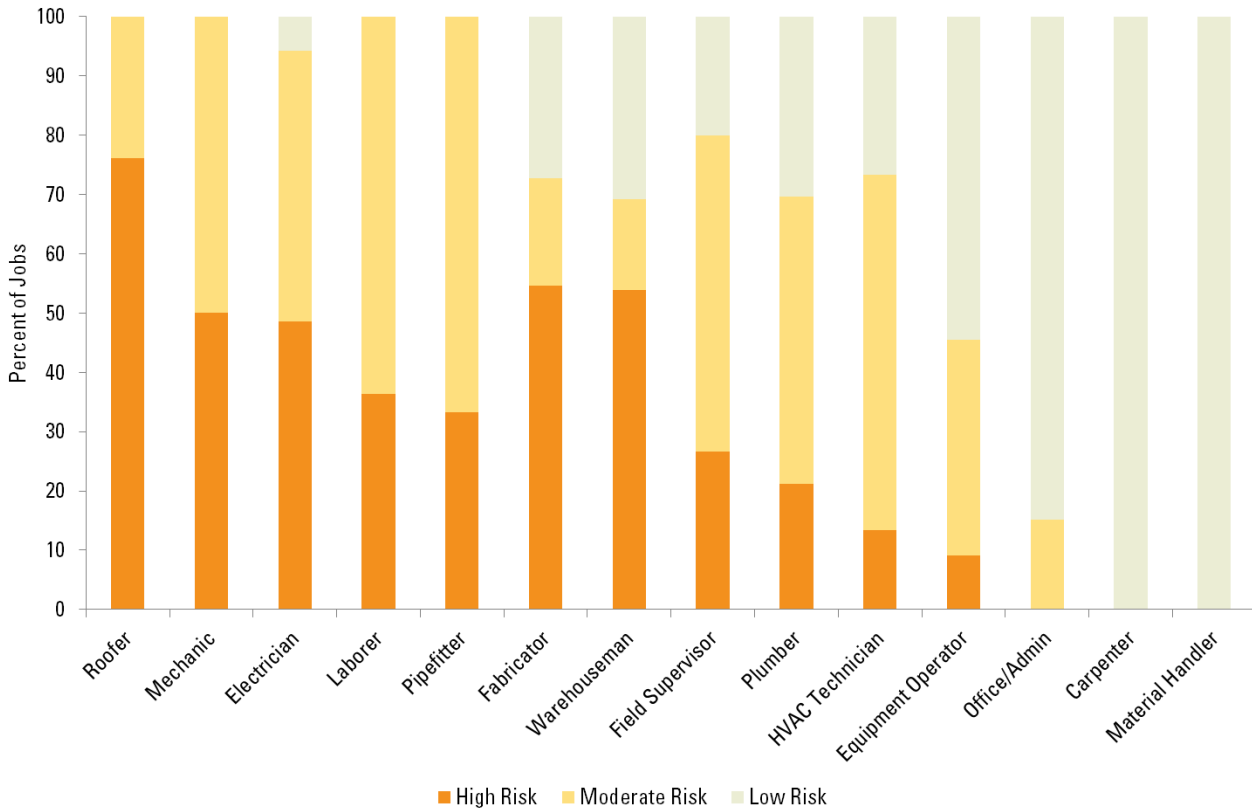
Job Categories Assessed

We assessed a representative sample of each site's job categories. Each item below shows the percentage of all workers observed in the study.



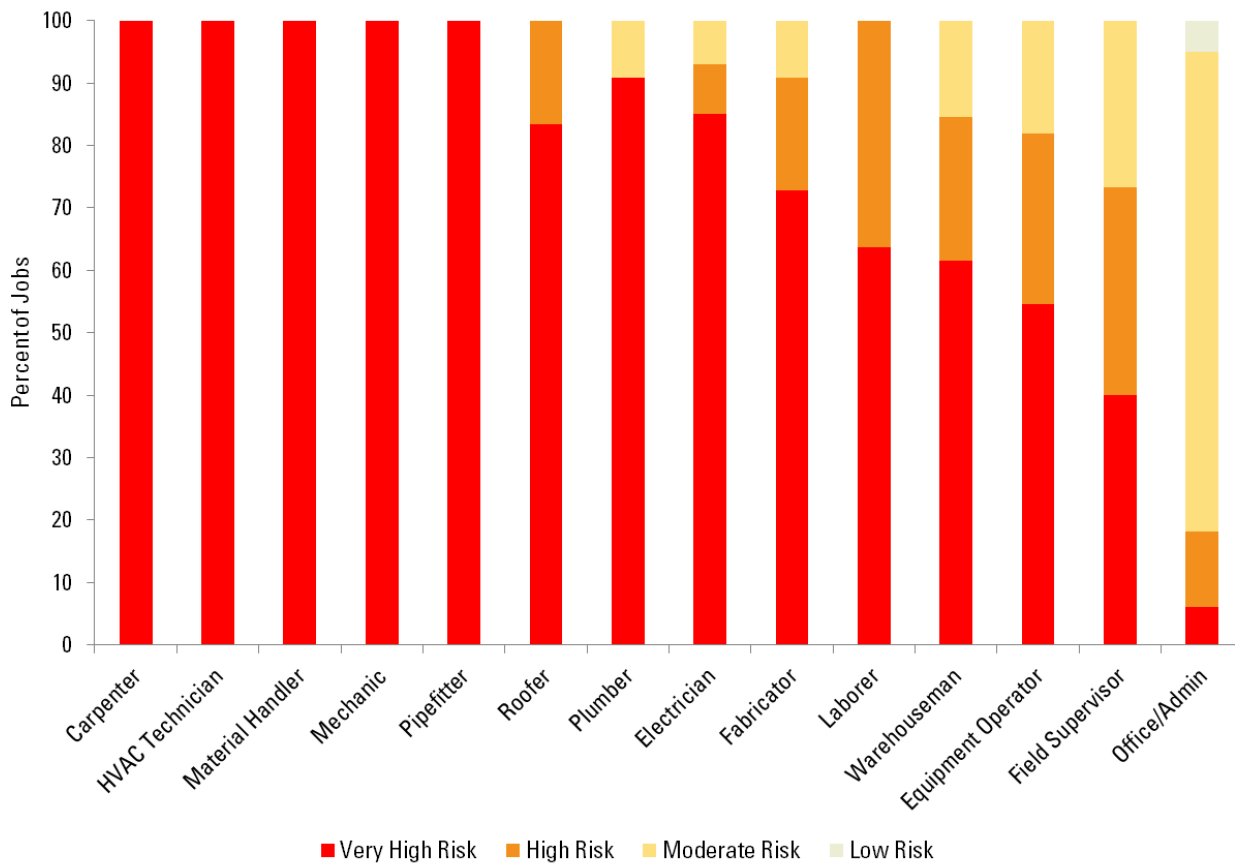
Level of Risk of Back Injury from Prolonged Standing

The construction job with the highest risk of injury from prolonged standing is roofer.



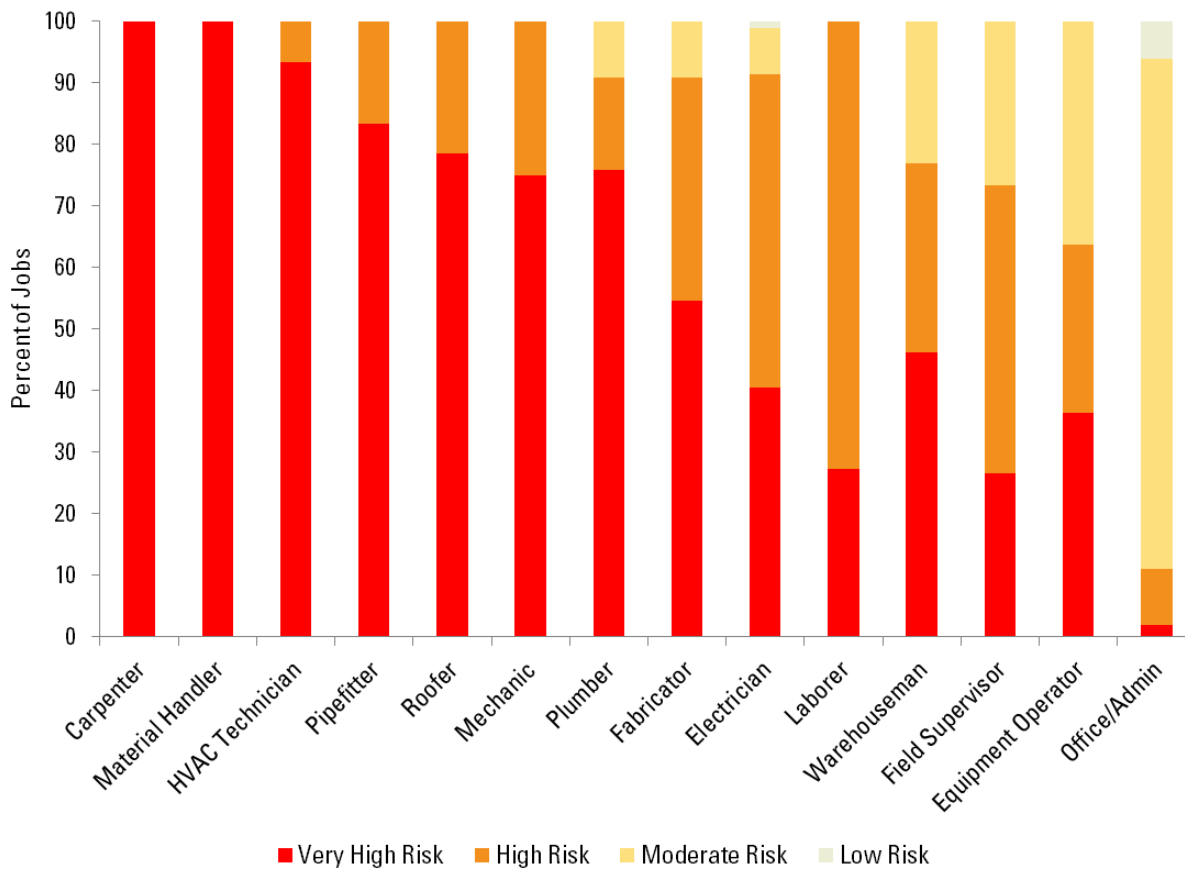
Level of Risk for Back Injury from Static Back Postures

All the pipefitters, mechanics, HVAC technicians and material handlers whose work was assessed in this study had a very high risk of injury from static back postures.



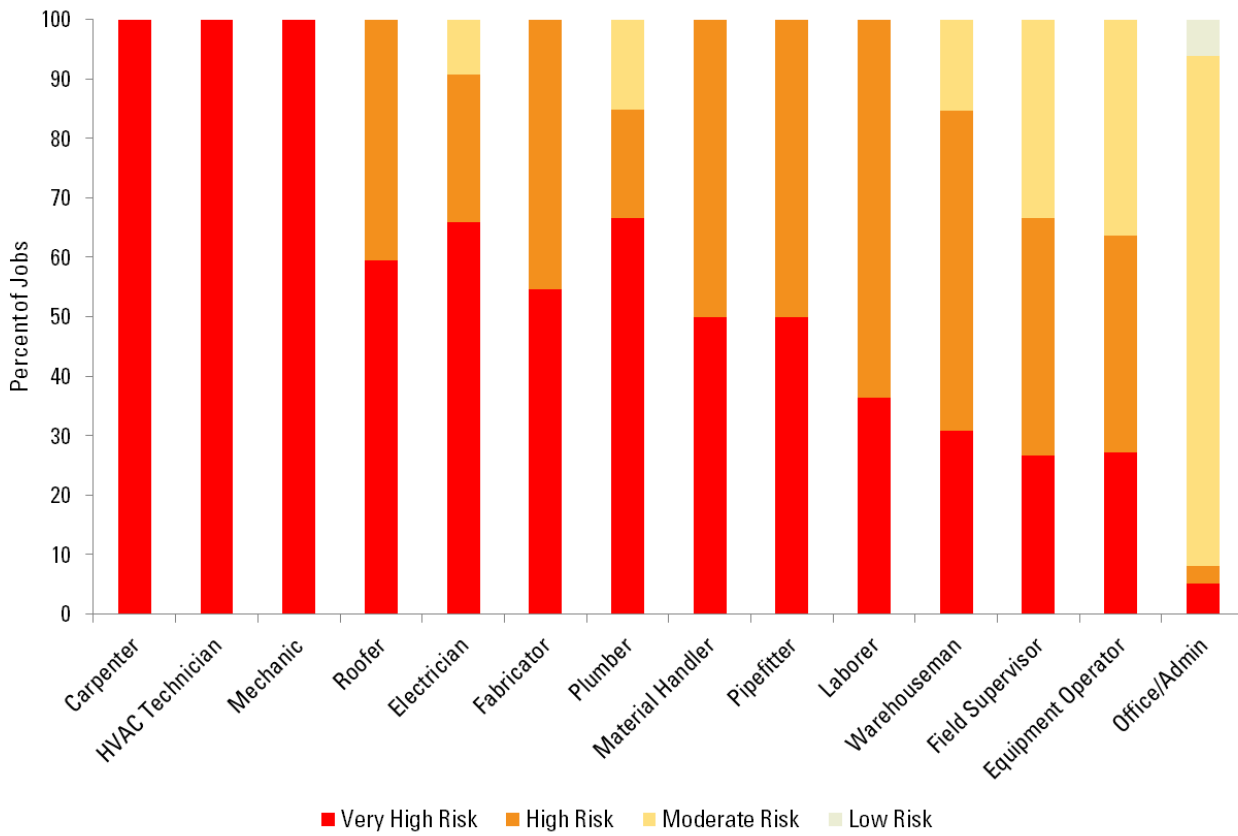
Level of Risk for Back Injury from Back Movements

Although all carpenters and material handlers had a very high risk of injury from back movements, overall, fewer jobs had a very high risk of injury from back movements than from static back postures.



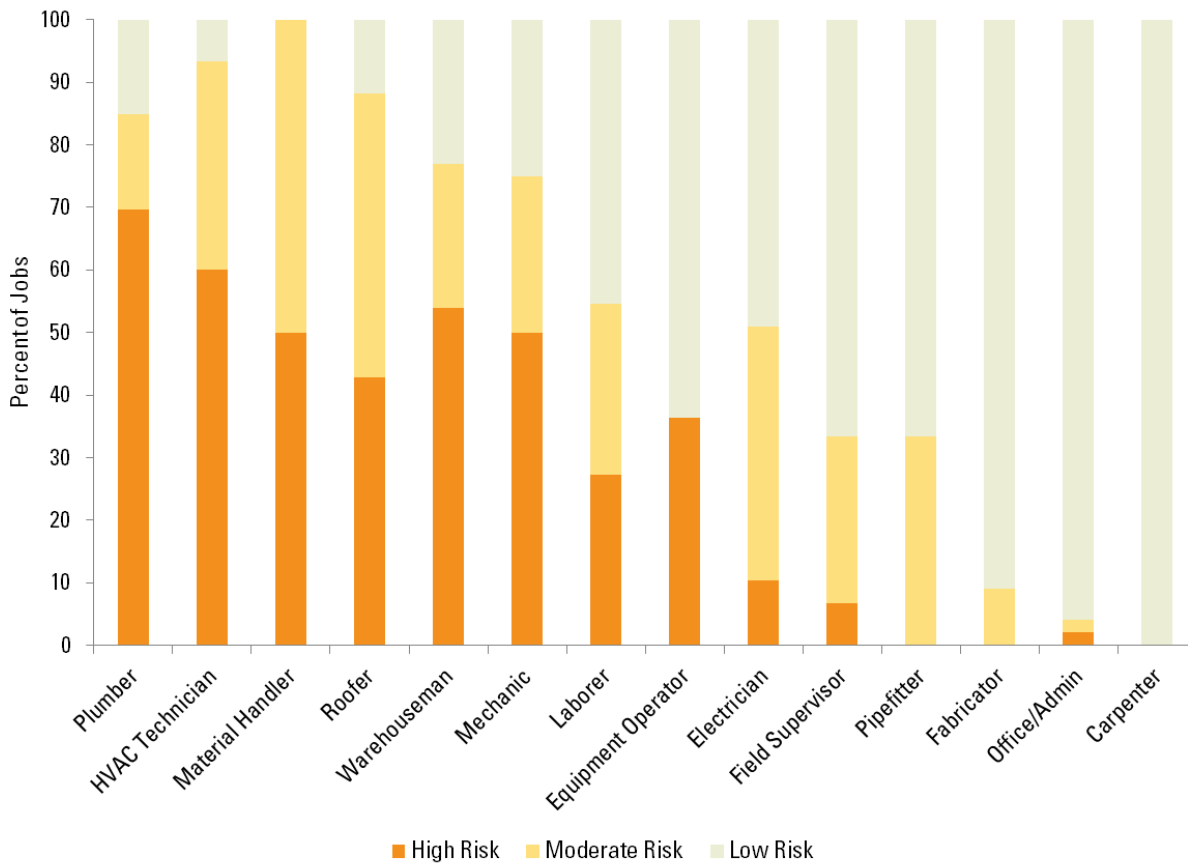
Level of Risk of Injury from Awkward Shoulder Postures

In all the jobs assessed, with the exception of the office/administrative jobs, awkward shoulder postures posed a high or very high risk of injury.



Level of Risk of Injury from Heavy, Awkward or Frequent Lifting

In nearly half of the jobs assessed (46.8%), lifting activities (heavy, awkward or frequent) posed a moderate or high risk of injury. Lifting posed a high risk of injury most often for plumbers.



Discussion

Among the construction companies involved in our study, there was some diversity in the services provided. As a result, collectively within this industry, every risk factor of interest, with the exception of repeated impacts of the hands or knees, posed more than a minimal risk. Several assessed risk factors produced interesting results:

- Prolonged standing was common among the jobs in construction – 35% of the jobs required standing for more than 6 hours per day.
- In over 37% of the jobs, manual material handling (carrying, pushing/pulling, and lifting) posed a high or very high risk of injury.
- In 20% of the jobs, kneeling or squatting occurred more than 2 hours per day and posed moderate risk of injury.

Exposure to a single risk factor can pose a high risk but exposure to a combination of risk factors increases the risk of injury. Risk factor combinations that have been associated with increased WMSD injury risk include awkward back postures with frequent/heavy lifting, working overhead while handling heavy objects, and awkward wrist postures with forceful hand exertions.

Although the design of our study did not allow us to determine if risk factors occurred simultaneously, it was possible to identify where these risk factors occurred in the same job. Additionally, if the duration of exposure to each of these risk factors were for longer periods, then the likelihood that these risk factors occurred at the same time was high. The following risk combinations were found among the jobs in Construction:

- The combination of high risk from forceful gripping (more than 10 lbs. of grip force) and bent wrist postures was most often seen in electricians.
- The combination of the forward bending of the back (back flexion) more than 45° and manually handling weight more than 10 lbs. was seen in roofers.
- The combination of working with the elbows above shoulder level for more than 2 hours per day and manually handling weights more than 10 lbs. was frequently seen in electricians.

This study identified physical risk factors specific to the construction sector using commonly used evaluation tools. However, potential risk factors were observed that were not assessed by the evaluation tools we used. These risk factors included working in confined spaces and climbing up and down equipment such as ladders and heavy equipment. Confined work spaces can force the worker into awkward and static postures. Climbing up and down ladders and steps can place stress on the knees and back.

Physical Job Evaluation Checklist for Construction

In an effort to help increase general awareness of physical factors that contribute to work-related musculoskeletal disorders and injuries (WMSDs), such as sprains and strains, SHARP researchers developed a Physical Job Evaluation Checklist tailored especially for work performed in the Construction sector. This checklist can quickly assess levels of risk of injury for the back, shoulder, hand/wrist, and knee in a given job.

The Physical Job Evaluation Checklist was developed from observations of the more common jobs performed in foundation, structure, building exterior and building equipment contractors, and the evaluation of WMSD risk based on those observations. The checklist is comprised of items for WMSD risk factors that were assessed to pose more than a minimal risk.

While the checklist was developed using observations from foundation, structure, building exterior and building equipment contractors, other industries in Construction may have similar job activities and may benefit from the use of the Physical Job Evaluation Checklist.

This checklist is **not** intended to predict injury. Instead, the purpose of the Physical Job Evaluation Checklist is:

- 1) To help identify aspects of the job that pose a risk for the back, shoulder, hand/wrist and knee injury
- 2) To help prioritize injury prevention efforts by identifying the jobs or the aspects of the job that pose the greatest risk of injury

Download the
checklist
(click here)

<http://www.lni.wa.gov/Safety/Research/Wmsd/WMSD2010.asp>

Start With the Basics: General Principles for Preventing Musculoskeletal Injuries and Disorders

The physical risk factors in a workplace that can contribute to the development of musculoskeletal injuries and disorders can be both numerous and complicated. However, there are several basic principles and “best practices” that should be considered when attempting to eliminate or reduce these physical risk factors. If you have jobs that have more than one of these risk factors occurring at the same time (combination exposures), these should be your first priority for improvement. Finally, involve workers in brainstorming solutions if physical risk factors are found.

Awkward Postures:

Avoid holding the body in the same position for long periods of time (static postures).

- Try to move from that posture, even if for a short period of time.
- Use a machine to do the task.
- Keep the body moving (dynamic movements)--vary the levels or distance in which the work is performed.

Avoid working with the limbs far from the torso.

- Adjust (lower) the height of the work to below shoulder level.
- Frequently performed activities should be performed directly in front of the body.

Avoid hand tools or the orientation of objects that cause the wrist to bend up (extension) or down (flexion) or to the side (wrist deviation).

- Use tools with bent handles.
- Use jigs or work surfaces that can orient the object into a position that keeps the wrist straight.

Avoid working with the back bent forward (back flexion) for long periods of time.

- Raise the work to at least waist level.
- Alternate with work that is performed standing up straight.

High Hand Forces:

When grasping an object with any kind of force, avoid using a pinch grip (grasping with the tips of the fingers). A power grip (holding the object with the fingers wrapped around it) can generate more force.

- Use a tool such as a vise or a jig to hold the object that requires a power grip.

Repetitive Motions:

Avoid having to perform quick motions repeatedly over an extended period of time.

- See if it is possible to use a machine instead.
- Alternate the performance of repetitive tasks with less repetitive ones.

Heavy, Awkward and Frequent Lifting:

- Avoid lifting objects that:
 - can't be lifted close to the body,
 - require twisting during the lift,
 - are too big or of a shape that doesn't allow a good hold by the hands,
 - require the start and end of the lift to be below knee level or above shoulder level, if the object is heavy.
- Use a machine to do the lifting.
- Arrange space so that heavier objects are kept between knee and shoulder height.
- Store less used, lighter, smaller objects below knee level or above shoulder level if there are no other alternatives.

What other factors could be involved in sprains, strains, and overexertions?

Important WMSD risks described by injured Construction workers

A Multitude of Risks for Sprains and Strains

We conducted forty-one interviews with construction workers that had filed workers' compensation claims for work-related musculoskeletal disorders between 2011 and 2014. We asked them to describe the nature of their work and the conditions they felt led to their injuries. We also asked them to describe the steps, if any, that could have been taken to prevent their injuries from developing in the first place.

First we reviewed the responses for WMSD risk factors that we assessed when we visited construction work sites across Washington State. Among these risk factors, lifting, carrying, work pace, and high hand force were the top contributing factors workers most often cited. Each is described further along with supporting excerpts from the interview participants.



Fast Pace of Work

If you're not getting your work done, if you're not getting your footage up, if you're not getting your board count up, you're down the road. You have to be on the top of your game every day. If you don't produce, you're laid off, that's it. You have to go go go. Don't forget, you're wearing 25 pounds worth of tools and screws and stuff like that on you all day long. When you walk somewhere, you have to walk as fast as you can go. All day long, as fast as you can go. All day long, all the time. You have to have a purpose when you're working, otherwise, the foreman will see it and you're down the road. If you're slacking around, if you're moping around, if you don't have purpose whenever you're moving, you're a slacker and you're gone. That is just how it is. --Drywall carpenter, hand/wrist injury

Next, we noted risks that were mentioned but not assessed in our construction work site visits. Experiencing years of cumulative trauma, working through injury, self-blame, and heavy workloads were among the most frequently cited themes in this category.

Finally, we reviewed the responses regarding potential injury prevention measures. Workers most often felt that increased staffing, early reporting of symptoms, providing quality tools and materials, or implementing job or task rotation would have the greatest impact on reducing risks.

Years of Cumulative Trauma

I've been doing this now for about thirty nine years now. My shoulders are pretty well worn down. -- Brick mason, shoulder injury

Working Through Injury

I worked two and a half hours after that, and finally one of the crew guys said I was done. 'You're better off just to stop, so that way you don't injure it worse than what it was when you started.' I need the money so I tried to keep working, and it didn't work. -- Laborer, hand/wrist injury

Performing physically demanding work over the course of years and years can lead to injury, especially when fatigued or overly stressed muscles and tendons do not receive sufficient time to rest and recover. Athletes push their bodies to their limits, but they vary their activities from day to day, and they make sure to schedule ample recovery time to prevent injury.

Heavy Workloads

It was a ridiculous amount of work, but it was an everyday thing. I mean that was a little more than anything else I've done in a day drastically, but, at the same time, it was my everyday job for three months -- Laborer

Self-Blame

Maybe I just wasn't in the right position. It's something I do a thousand times. You don't really sit there and think about it. I don't know if it's just wear and tear over time and all of a sudden it just gave out on me. I could have been pulling too hard. -- Plumber

Quality Tools and Materials

If you have a guy to help you carry sheets everywhere you go, and have more guys hanging board that would help. They do have lightweight drywall now that weighs 30% less and still has the R-rating for insulation and fire codes, but that costs a lot more money. -- Drywall carpenter

Early Report of Symptoms

If someone reports any symptoms of soreness, etc., we won't put them back doing the same work. We'll put them somewhere else so they can rest those muscles. That helps prevent symptoms from getting worse and turning into claims -- General Superintendant

Job/Task Rotation

Another thing they could do is they could rotate around their staff there. While one person's achy, put somebody on the bender, switch them around. Because that's such a dangerous and labor intensive job that nobody should have to work that sixty hours a week. -- Production assistant

Industry Prevention Strategies

Lessons learned from Construction insiders

In addition to conducting interviews with injured construction workers, we also conducted 67 interviews with management and non-management representatives from construction employers throughout the state to help us gain additional insights into the pros and cons of various strategies for engaging workers to identify and promote safety practices. Two recurring themes were light duty options and crowded jobsites.

Alternative Approaches to Light Duty

When a worker is injured, the first option for light duty may be to perform miscellaneous office duties like filing or making copies. This option has its benefits. There may be a need for additional office support. In the words of one employer:

In the past, we would bring them into our office and find something. As part of the AGC⁵ retro that we belong to, we are obligated to keep them on salary for a certain amount of time. --Electrical Contractor

However, office work as light duty was reported as having its down sides as well. Workers may find office work boring or even demoralizing. As one framing contractor said,

Sticking someone in an office makes them feel detached and dejected.

Instead, several employers we spoke to have taken a more proactive approach to utilizing light duty for injured workers as an opportunity to strengthen existing safety processes and maintain high levels of productivity. Tasks considered full duty but requiring low physical exertion can help workers feel engaged with the work.

If they can get up onto a roof, then they can be the safety monitor. That's the easiest job. Some can run a forklift and help load trucks. The last resort is office duties. --President, roofing company

Additional safety training is also a viable alternative to office work, and can serve to bolster a company's safety culture through continued education and awareness of safety issues.

We utilize the AGC classroom to keep them engaged; we can send them there for supplementary education-- like OSHA-30, skills training, traffic control--to improve their skill set. If someone has a back injury and they need a week off, we will pay for them to take classes to get up to speed on other things or catch up on CPR, lead awareness, etc. --Framing Contractor

While injured construction workers may be limited in terms of the physical demands they can handle, providing helpful services such as safety inspections (once properly trained) keeps them working and promotes a safer working environment for others.

Injured workers are sometimes asked to drive to jobsites to conduct random inspections and complete standard safety checklists regarding basic safety issues--shoring security, safety cone visibility, etc. --Electrical Contractor

Putting an injured employee to work in the office can be an effective method of keeping them at work, but consideration should be given as to whether this is the most productive use of their time. Consider offering alternatives such as safety training, safety inspections, or other tasks with low physical demands.

⁵ The Associated General Contractors of America, construction industry trade association.

Controlling the Chaos of Multiple Trades Onsite

While skilled construction workers can often find the hands-on nature of their work intensely gratifying, having to negotiate limited physical space with other trades can quickly lead to taking shortcuts and working at an accelerated pace. In the words of one electrical contractor:

It's just a lot of physically demanding work combined with a sense of controlled chaos that comes from working on busy jobsites with lots of other trades. --Construction Superintendent

Sometimes these situations arise because quality issues force companies to return to jobs to rework projects where quality was not up to standard. Other times a tight contract schedule forces multiple trades to begin work simultaneously so as to meet their individual obligations to the customer. In either case, the result is the same: additional challenges for workers trying to perform their jobs.

It used to be that each trade went on to a section or a job, did their job, and left, and the next trade came on. That didn't work for the general contractors or the customers because it took too long. Now you've got the demolition guys going in and clearing out, and then you've got the framers, the sheet rockers, the painters, the electricians, and the plumbers. And everybody is tripping over everybody because you've gotta meet the schedule. --Painter

When too many contractors are working in the same space at the same time, it can create a stressful work environment. The pace of work can increase as workers struggle to complete work. Communication can also break down when overall noise levels increase, making it harder to hear one another. Lifting and carrying hazards occur when unfamiliar tools and materials are stored in unexpected places. Controlling the chaos is difficult. Avoiding it altogether is too.

When a contractor tells you that you have to be there and you're under contract, it doesn't matter. You have to be there. If the timing would have been better, I don't think I'd ever been hurt. Timing as far as when we got there and everybody started crowding in to this particular job. I never would have went up on the ladder. The pavement would have been done, and we'd have been using lifts. Everything of ours would have been set up like any other job we'd done. --Pipe fitter

It is important that the industry recognize the hazards of putting multiple trades on a jobsite. Planners should strive to avoid it. Encourage workers to focus on the task at hand, and avoid having to return to jobsites a second time. When working alongside other trades is unavoidable, encourage workers to recognize when the pace of work starts speeding up. Working faster doesn't equal working smarter.

Additional Resources

WMSDs

- Work-Related Musculoskeletal Disorders of the Back, Upper Extremity, and Knee in Washington State, 2002-2010
 - Report Summary
http://www.lni.wa.gov/Safety/Research/Files/WMSD_TR_EXP_Summary2.pdf
 - Full Report
http://www.lni.wa.gov/Safety/Research/Files/WMSD_TechReport2015.pdf
- Perceptions of risk from workers in high risk industries with work related musculoskeletal disorders
<http://iospress.metapress.com/content/e3553913x0503461/>
- Job Organization and Worker Health
<http://www.tandfonline.com/doi/full/10.1080/00140139.2015.1065347>

L&I Programs

- SHARP Program
<http://www.lni.wa.gov/Safety/Research/default.asp>
- Sprains & Strains Prevention Resources
<http://www.lni.wa.gov/safety/SprainsStrains/>
- DOSH Consultations
<http://www.lni.wa.gov/Safety/Consultation/default.asp>