



## Trends of Musculoskeletal Disorders and Interventions in the Construction Industry

Xiuwen Sue Dong, DrPH<sup>\*1</sup>, Eileen Betit<sup>1</sup>, Ann Marie Dale, PhD<sup>2</sup>, Grace Barlet, MPH<sup>1</sup>, Qiying Wei<sup>3</sup>

Musculoskeletal disorders (MSDs) are soft-tissue injuries caused by sudden or sustained exposure to repetitive motion, force, vibration, and awkward positions (NIOSH, 2018). In addition to discomfort, pain, and physical suffering for injured workers, MSDs have brought financial burdens to workers and their families, employers, and society with loss of income and productivity, increasing medical expenses and workers' compensation, and Social Security disability payments. It is estimated that the costs of MSDs (work- and non-work-related) in the United States accounted for 5.8% of GDP in 2014, exceeding defense spending for that year (USBJI, 2018). MSDs and the hazards that cause them are common in the construction industry (CPWR, 2018). To identify high-risk worker groups and prioritize areas for intervention in construction, this Quarterly Data Report analyzes trends and patterns of work- and non-work-related MSDs among construction workers using employer-reported data as well as worker self-reported data. CPWR's *Ergonomics Community of Practice* has developed programs and compiled information to address this hazard. Due to complex definitions and measures used in this report, users should review the accompanying notes and text with the charts.

### KEY FINDINGS

- In 2017, the rate of work-related musculoskeletal disorders (WMSDs) was 31.2 cases per 10,000 full-time equivalent (FTE) workers in construction, less than 23% of the 1992 level.
- Median days away from work due to WMSDs among construction workers increased from 8 days in 1992 to 13 days in 2017.
- Back injury remained the predominant body part affected by WMSDs in construction, accounting for about 42% of WMSDs in 2017.
- Almost 46% of construction workers self-reported they had one or more MSD-related symptoms.
- Over 27% of construction workers aged 55 and older reported that arthritis or joint pain symptoms limited their activities.

YES 😊



NO 😞



\* Correspondence to: Xiuwen Sue Dong, SDong@cpwr.com.

1. CPWR-The Center for Construction Research and Training.

2. Associate Professor, Washington University School of Medicine

3. MPH student, Emory University

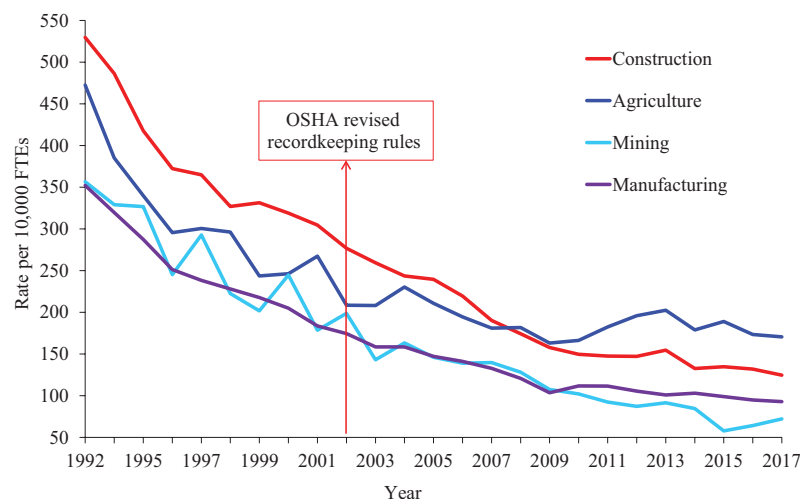
Photos courtesy of the Mechanical Contractors Association of America

## SECTION 1: Trends of Work-Related Musculoskeletal Disorders in Construction (employer reported data from the Survey of Occupational Injuries and Illnesses)

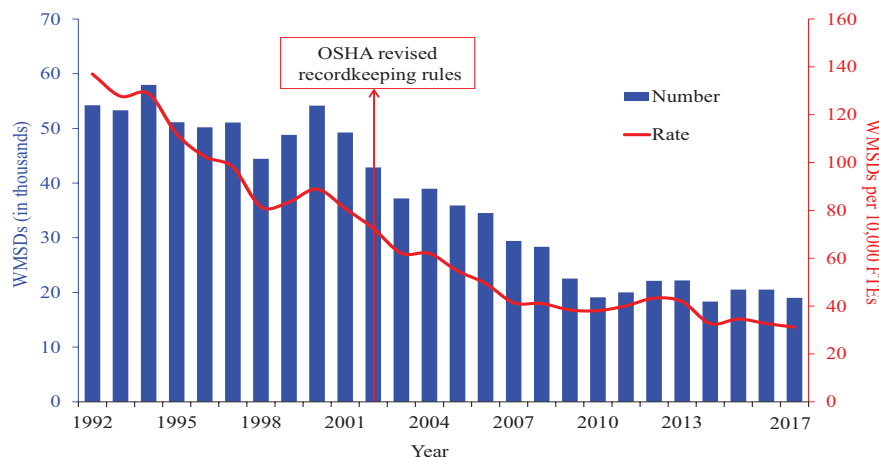
The rate of nonfatal injuries resulting in days away from work (DAFW) in construction has dramatically decreased since 1992 (chart 1). In 2017, the injury rate was 124.7 per 10,000 full-time equivalent (FTE) workers, more than 76% lower than its level in 1992 (529.5 per 10,000 FTEs). The rate of the overall nonfatal injuries in construction has consistently exceeded mining and manufacturing, and has been lower than agriculture since 2008.

Following the overall nonfatal injury trend, the number of work-related musculoskeletal disorders (WMSDs) with DAFW dropped to a record low in 2014 and remained at a low level from 2015 to 2017, at about 20,000 reported cases annually (chart 2). The rate of WMSDs also dropped to 31.2 cases per 10,000 FTEs in 2017, less than 23% of the 1992 level.

**1. Rate of nonfatal injuries resulting in days away from work, selected industries, 1992-2017**



**2. Number and rate of WMSDs resulting in days away from work in construction, 1992-2017**



**Note:** Due to the revised recordkeeping rules, the estimates since the 2002 survey are not comparable with previous years for nonfatal injuries.

**Source:** U.S. Bureau of Labor Statistics, 1992-2017 Survey of Occupational Injuries and Illnesses.

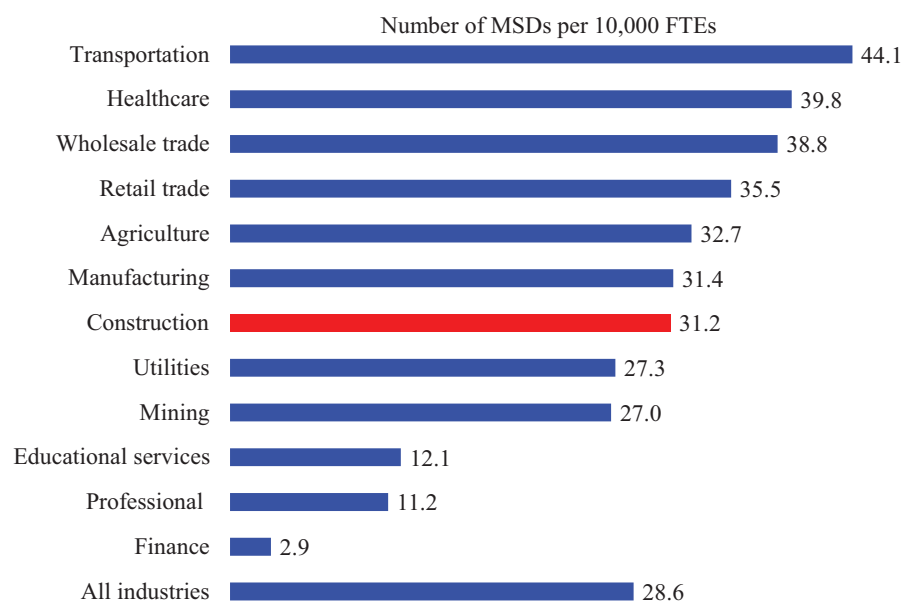
*Section 1: Trends of Work-Related Musculoskeletal Disorders in Construction (employer reported data from the Survey of Occupational Injuries and Illnesses)*

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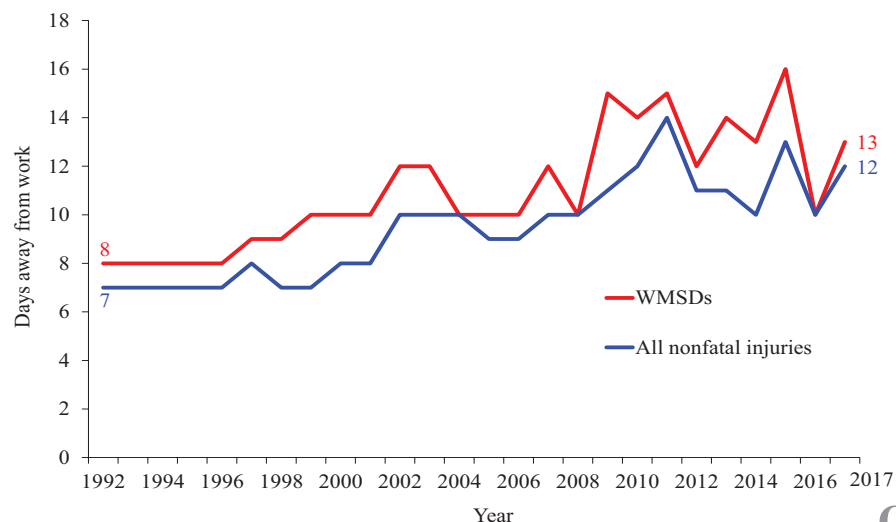
In 2017, the rate of WMSDs in construction was about 9% higher than the rate of 28.6 per 10,000 FTEs for all industries combined (chart 3). Among major industries, transportation reported the highest rate of WMSDs.

Despite the overall declining trends since 1992, the median DAFW during the study period increased from 8 to 13 days for WMSDs, and from 7 to 12 days for nonfatal injuries overall (chart 4). Generally, workers with WMSDs have longer recovery periods.

**3. Rate of WMSDs resulting in days away from work, by major industry, 2017**



**4. Median days away from work, WMSDs versus all nonfatal injuries in construction, 1992-2017**



Source: U.S. Bureau of Labor Statistics, 2017 Survey of Occupational Injuries and Illnesses.

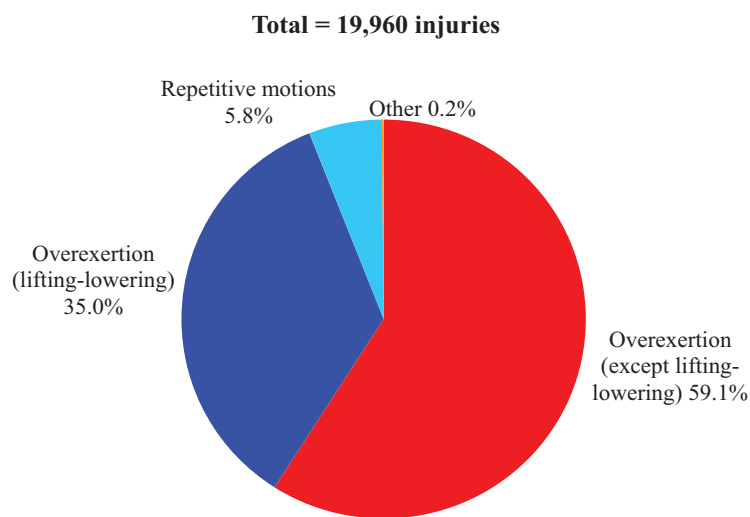
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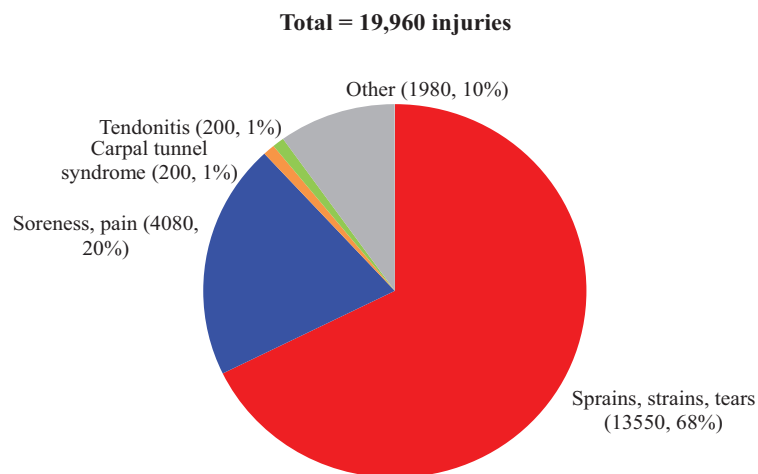
The majority of WMSDs among construction workers were caused by overexertion. In 2017, overexertion involving pushing, pulling, holding, carrying, and catching accounted for over 59% of WMSDs, and another 35% were from overexertion with lifting and lowering (chart 5). The remaining 6% were caused by repetitive motions and other activities.

In terms of types of injury, sprains/strains/tears are common injuries leading to WMSDs among construction workers, accounting for 68% of WMSDs in 2017 (chart 6). Such injuries may develop into chronic conditions (Marcum et al., 2017; West et al., 2016).

**5. Causes of WMSDs resulting in days away from work in construction, 2017**



**6. WMSDs resulting in days away from work in construction, by nature of injury, 2017**



*Note:* Chart 5 - “Other” includes overexertion and bodily reaction, unspecified; and multiple types of overexertion and bodily reactions.

Chart 6 - “Other” includes bruises, contusions, multiple traumatic injuries with sprains or fractures, etc.

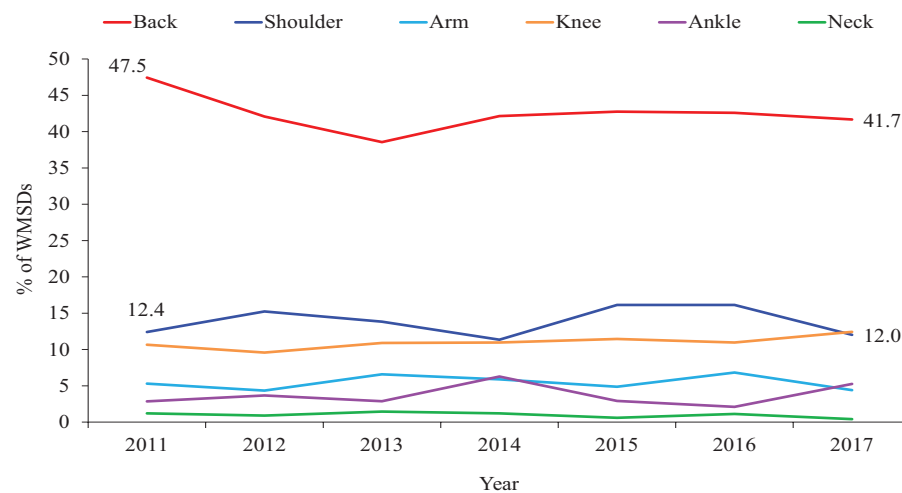
*Source:* U.S. Bureau of Labor Statistics, 2017 Survey of Occupational Injuries and Illnesses.

*Section 1: Trends of Work-Related Musculoskeletal Disorders in Construction (employer reported data from the Survey of Occupational Injuries and Illnesses)*

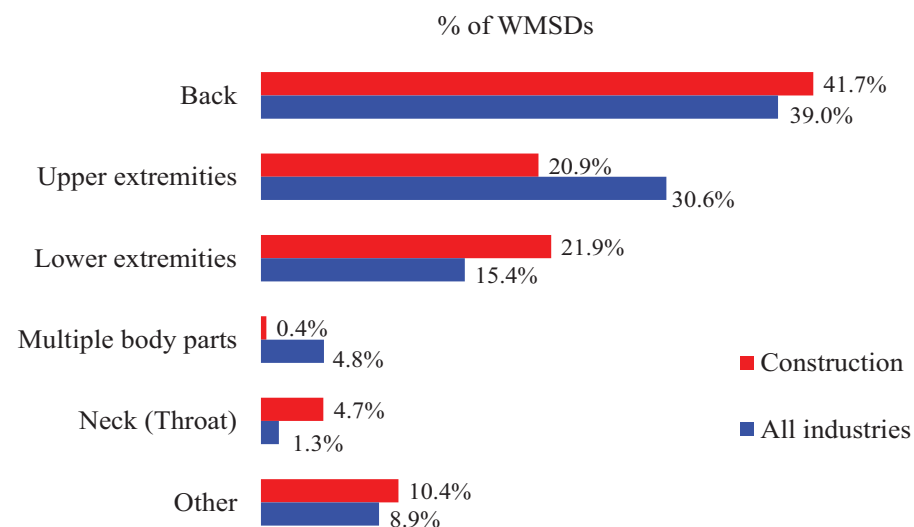
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By body part, back injuries remained the predominant body part affected by WMSDs in construction (chart 7). Although the proportion of back injuries decreased from 47.5% in 2011 to 41.7% in 2017, they were still almost 3.5 times higher than shoulder injuries, the second leading body part affected by WMSDs. Back injuries were also more common in construction than all industries combined (chart 8). The proportion of back injuries in construction was almost 2.6 times higher than all industries combined.

**7. WMSDs resulting in days away from work in construction, by body part, 2011-2017**



**8. Distribution of WMSDs resulting in days away from work, by body part, construction versus all industries, 2017**

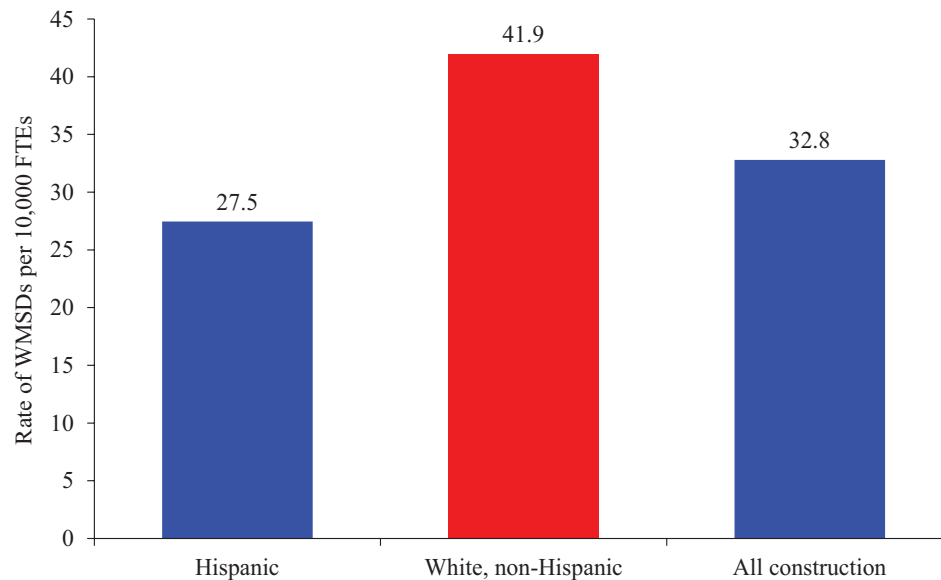


*Note:* Chart 8 - Upper extremities include shoulder, arm, wrist, and hand; Lower extremities include knee, ankle, and foot (toe, toenail); other includes trunk (except back) and all other uncategorized body parts.  
*Source:* U.S. Bureau of Labor Statistics, 2011-2017 Survey of Occupational Injuries and Illnesses.

## SECTION 2: Patterns of Work-Related Musculoskeletal Disorders Among Construction Subgroups (from the SOII Data)

By demographics, the average WMSD rate between 2015 and 2017 for white, non-Hispanic construction workers was 41.9 per 10,000 FTEs, about 52% higher than their Hispanic counterparts (27.5 per 10,000 FTEs; chart 9). Several factors could contribute to the rate disparity in addition to race and ethnicity, such as age differentials between the two populations (see subsequent charts) and potential injury underreporting for Hispanic workers (Dong et al., 2011).

### 9. Rate of WMSDs resulting in days away from work in construction, by race/ethnicity, 2015-2017 average



Source: U.S. Bureau of Labor Statistics, 2015-2017 Survey of Occupational Injuries and Illnesses, and Current Population Survey. Calculations by the CPWR Data Center.

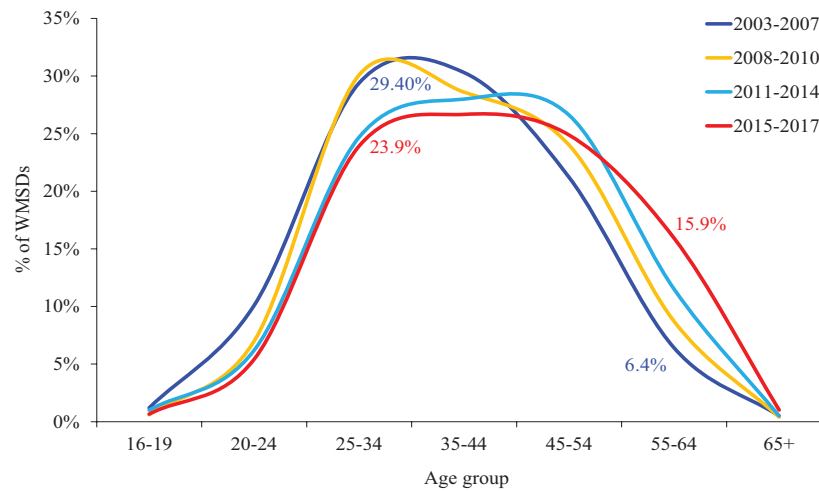
Section 2: Patterns of Work-Related Musculoskeletal Disorders  
Among Construction Subgroups (from the SOII Data)

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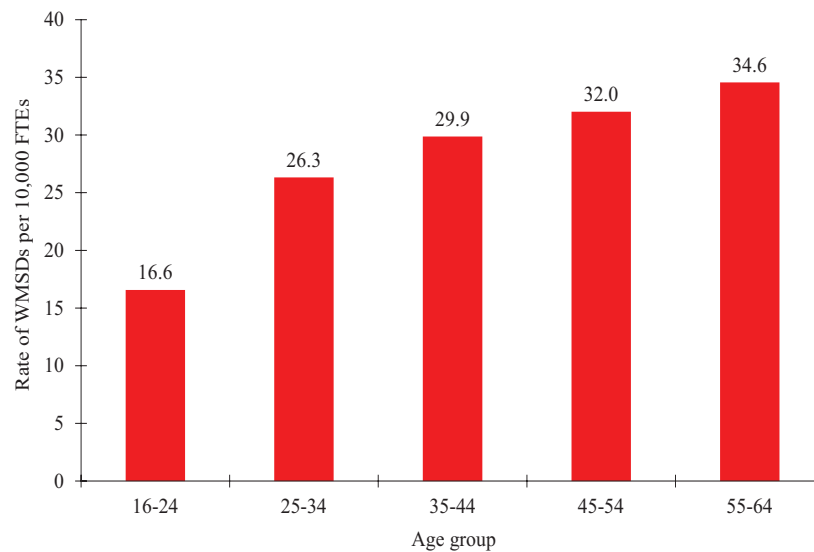
Age distribution of WMSDs among construction workers considerably shifted in the past decades. The proportion of WMSDs among workers aged 55-64 years more than doubled from 6.4% in 2003-2007 to 15.9% in 2015-2017 (chart 10). At the same time, the proportion of WMSDs among workers aged 25-34 years dropped nearly 20% from 29.4% to 23.9%. These changes reflect the aging workforce trends in the construction industry.

The rate of WMSDs generally increased with age (chart 11). The rate of WMSDs increased gradually after the age of 25, reaching 34.6 per 10,000 FTEs when aged 55 and older, more than double the rate for workers under 25 years of age (16.6 per 10,000 FTEs).

**10. Distribution of WMSDs resulting in days away from work by age group in construction, 2003-2017**



**11. Rate of WMSDs resulting in days away from work by age group in construction, 2015-2017 average**



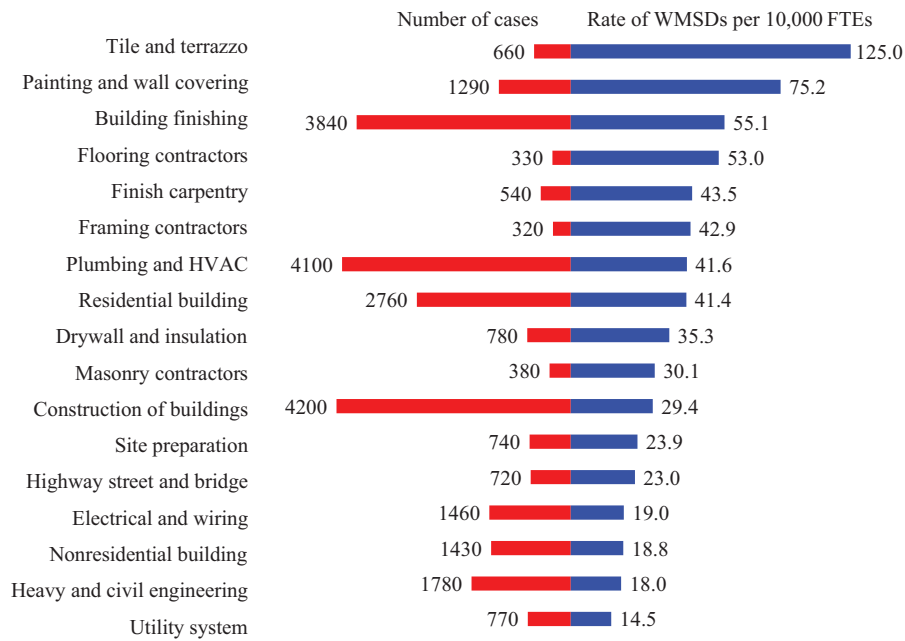
Source: Chart 10 - U.S. Bureau of Labor Statistics, 2003-2017 Survey of Occupational Injuries and Illnesses.  
Chart 11 - U.S. Bureau of Labor Statistics, 2015-2017 Survey of Occupational Injuries and Illnesses, and Current Population Survey

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The risk of WMSDs varies among construction subsectors. In 2017, Tile and Terrazzo Contractors (NAICS 23834) had the highest rate of WMSDs (125 per 10,000 FTEs; chart 12), followed by Painting and Wall Covering (NAICS 23832; 75.2 per 10,000 FTEs), and Building Finishing (NAICS 23839; 55.1 per 10,000 FTEs).

**12. Number and rate of WMSDs, selected construction subsectors, 2017**



Source: U.S. Bureau of Labor Statistics, 2017 Survey of Occupational Injuries and Illnesses.

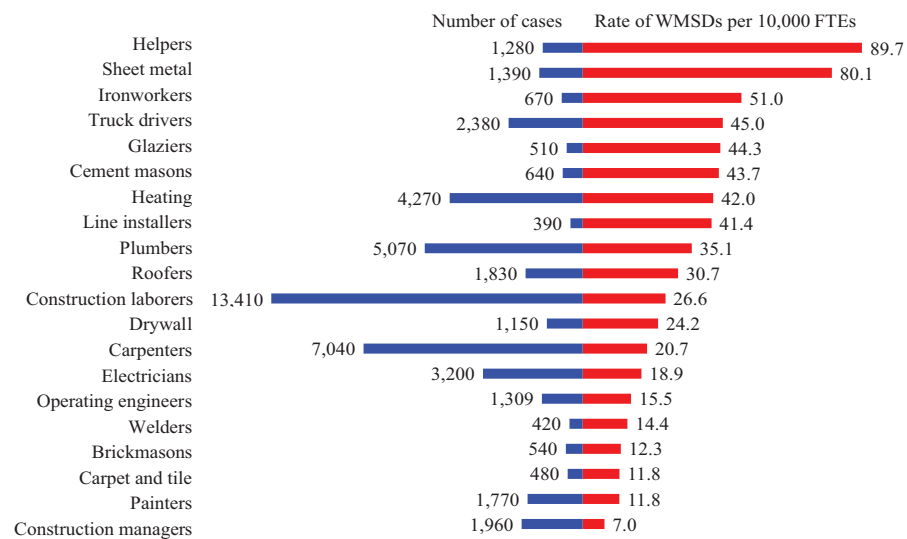


Section 2: Patterns of Work-Related Musculoskeletal Disorders  
Among Construction Subgroups (from the SOII Data)

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By occupation, construction helpers and sheet metal workers had a higher rate of WMSDs than other occupations in construction (chart 13). Between 2015 and 2017, the WMSD rate was 89.7 per 10,000 FTEs among construction helpers, almost 3 times higher than the overall construction industry, followed by sheet metal workers at 80.1 per 10,000 FTEs. Construction laborers, the largest occupation in construction, had a moderate rate of WMSDs at 26.6 per 10,000 FTEs, but the number of WMSDs exceeded all other occupations in construction.

**13. Number and rate of WMSDs resulting in days away from work, selected construction occupations, sum of 2015 to 2017**

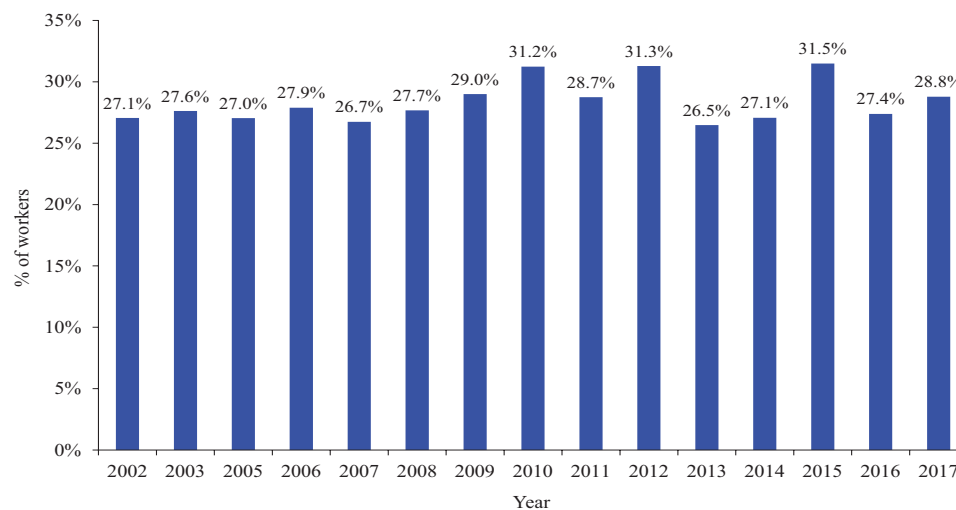


Sources: U.S. Bureau of Labor Statistics, 2015-2017 Survey of Occupational Injuries and Illnesses. 2015-2017 Current Population Surveys. Calculations by the CPWR Data Center.

### SECTION 3: Low Back Pain and Other MSD Symptoms Among Construction Workers (self-reported data from the National Health Interview Survey)

In contrast to a descending trend of work-related back injuries featured in Section 1, the rate of self-reported low back pain among construction workers remained relatively flat at around 30% from 2002 to 2017 (chart 14). These self-reported conditions can be work-related or non-work-related; thus, they are not directly comparable with the employer-reported numbers from the SOII data.

**14. Rate of self-reported low back pain (in the past three months) among construction workers, 2002-2017**



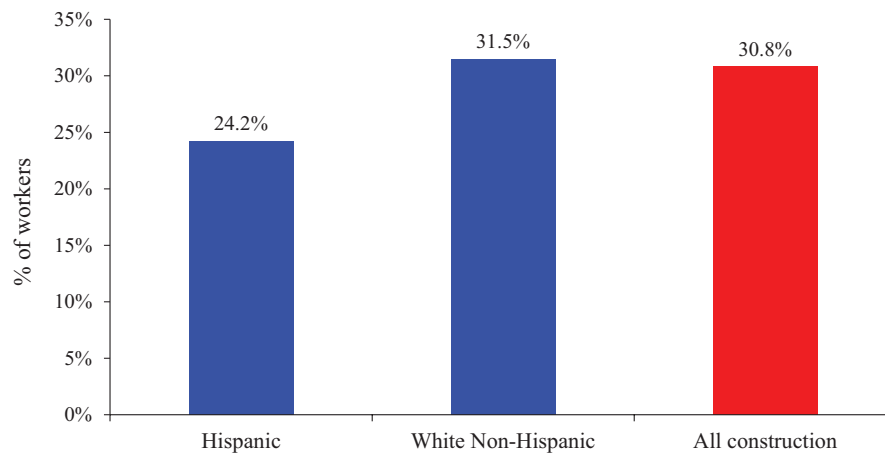
Source: National Center for Health Statistics, 2002-2017 National Health Interview Survey. Calculations by the CPWR Data Center.

*Section 3: Low Back Pain and Other MSD Symptoms Among Construction Workers (self-reported data from the National Health Interview Survey)*

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Similar to WMSDs, white, non-Hispanic workers were more likely to report low back pain than Hispanic workers. However, the gap between the two groups was somewhat smaller. Between 2015 and 2017, the average rate of self-reported low back pain for all construction workers was 30.8%, and only 24.2% among Hispanic construction workers (chart 15).

**15. Rate of self-reported low back pain (in the past three months) among construction workers by race/ethnicity, 2015-2017 average**



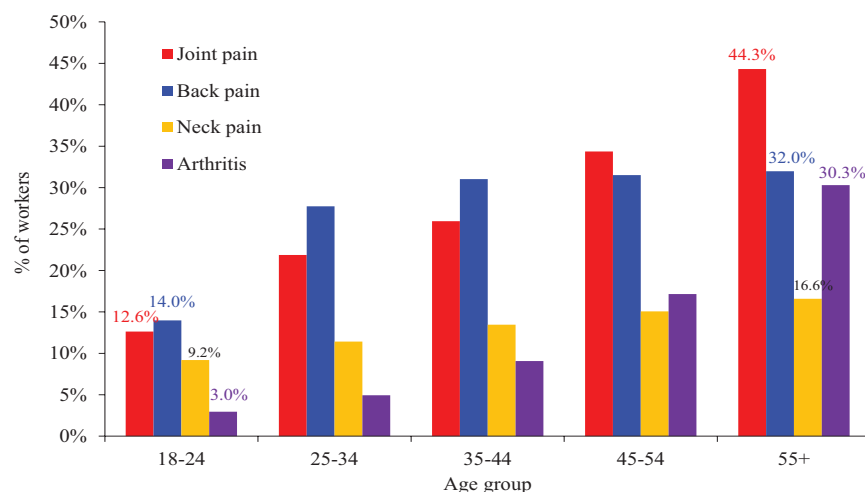
*Source:* National Center for Health Statistics, 2015-2017 National Health Interview Survey. Calculations by the CPWR Data Center.

*Section 3: Low Back Pain and Other MSD Symptoms Among Construction Workers (self-reported data from the National Health Interview Survey)*

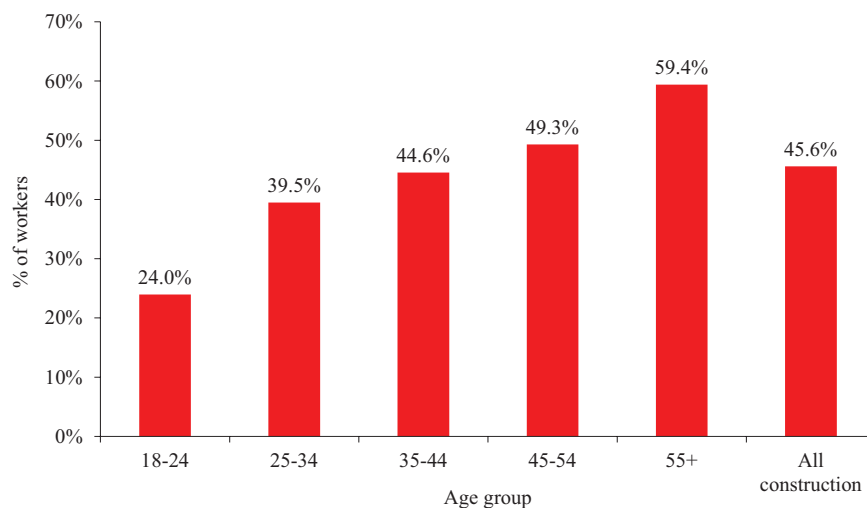
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Self-reported MSD symptoms were more common among older construction workers. In addition to low back pain, older construction workers were more likely to experience neck pain, joint pain, and arthritis. Over 44% of construction workers aged 55 years and older reported they had joint pain, 3.5 times higher than workers younger than 25 years (chart 16). Overall, nearly 60% of construction workers in the older age group (55+ years) had at least one of the four conditions (chart 17), which was 30% higher than all construction workers on average, and about 2.5 times higher than workers under 25 years old.

**16. Rate of self-reported MSD symptoms among construction workers, by age group, 2015-2017 average**



**17. Rate of self-reported MSD symptoms (combined) among construction workers, by age group, 2015-2017 average**



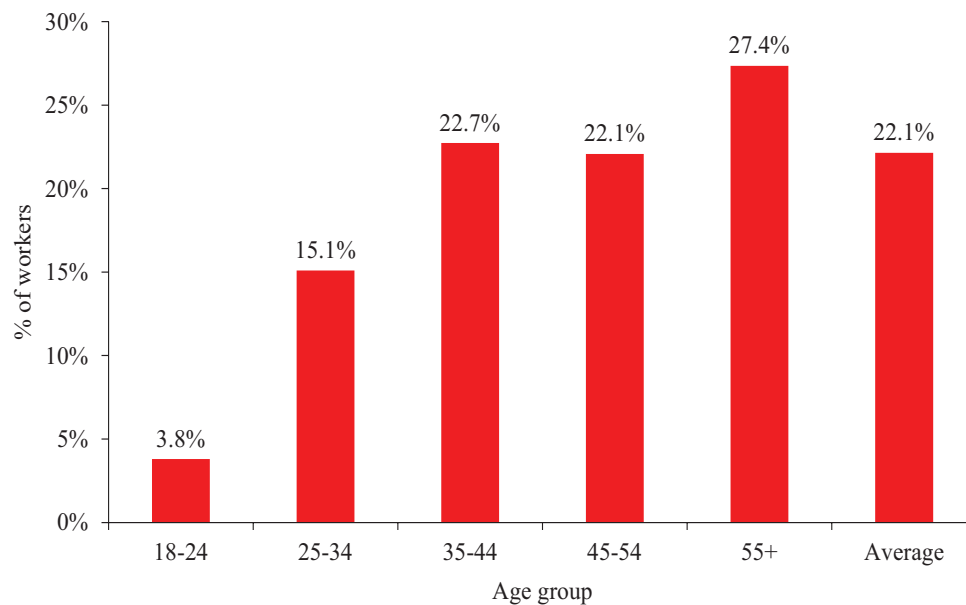
Source: National Center for Health Statistics, 2015-2017 National Health Interview Survey. Calculations by the CPWR Data Center.

*Section 3: Low Back Pain and Other MSD Symptoms Among Construction Workers (self-reported data from the National Health Interview Survey)*

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MSD conditions substantially limited construction workers' usual activities. Among construction workers who reported they had arthritis or joint pain, one out of five (22.1%) reported that these symptoms limited their usual activities (chart 18). While less than 4% of the youngest worker group had such limitations, the rate was more than 27% for workers aged 55 years and older.

**18. Rate of work limitations due to arthritis or joint pain among construction workers, by age group, 2015-2017 average**



*Source:* National Center for Health Statistics, 2015-2017 National Health Interview Survey. Calculations by the CPWR Data Center.

## SECTION 4: Resources to Address the Barriers to Preventing MSDs Among Construction Workers

CPWR's Ergonomics Community of Practice, which includes researchers, practitioners, industry stakeholders and representatives from the insurance industry, is working to promote the use of research findings and interventions that could mitigate the risk for MSDs. This collaboration has already led to an online repository of [ergonomic research and solutions](#), research on the barriers and facilitators to engaging in practices that would reduce the risks for strain and sprain injuries, and the development of the [Best Built Plans](#) program.

The Best Built Plans program is a materials handling program. It includes information and tools to help contractors plan at each stage of a project for how materials will be safely stored, lifted, and moved. The program also includes training resources for use on the job (e.g., toolbox talks), as part of a training program, or by workers on their own to reinforce safe material handling practices (e.g., smartphone games). Launched in 2018, this program has generated national interest. A small group of contractors who helped pilot the program identified additional resource needs, including a Spanish version of the online planning tool and related materials, a video on how to use the program, and an app for Apple and Android devices that provides ready access to the planning, and interactive training and coaching materials. The following is a list of resources currently available in the Best Built Plans program:

- ✓ Planning resources ([English](#) and [Spanish](#))
- ✓ [Infographics/posters](#) (English and Spanish)
- ✓ [Games](#) (English and Spanish)
- ✓ Toolbox Talks ([English](#) and [Spanish](#))
- ✓ Hazard Alert Card ([English](#) and [Spanish](#))
- ✓ Video ([English](#) and [Spanish](#))
- ✓ [PC](#) and [App](#) versions of Planning, Training & Coaching resources

This pilot also identified the need for more training materials. In collaboration with the United Association of Journeymen and Apprentices of the Plumbing and Pipe Fitting Industry (UA), the Mechanical Contractors Association of America (MCAA), and researchers from Washington University in St. Louis, CPWR developed a more comprehensive ergonomics training program for the construction industry. This program builds on the materials in the Best Built Plans program and makes the connection between pain prevention, treatment, and the use of opioids. This new training program, which will be available for use with all trades in the construction industry, includes simple to use materials designed for workers, trainers, and contractors.

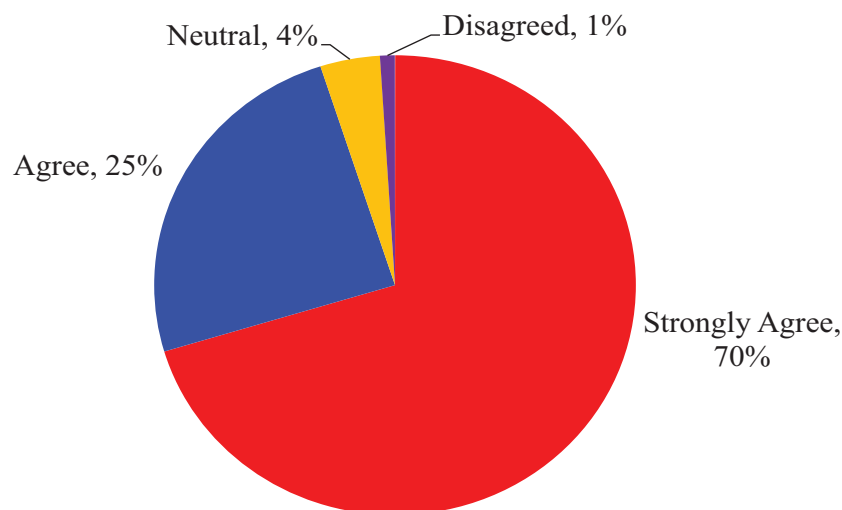
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The worker portion of the training program was piloted and evaluated with more than 100 UA apprentices, and 95% felt it was valuable (chart 19). By the end of the training, 60% were able to correctly answer what ergonomics is, 85% were able to identify sprain and strain injuries, and 95% correctly identified ergonomic hazards and ways to avoid them. The results of the evaluation conducted after the “train-the-trainer” pilot on use of the worker training program were also positive. Almost all (98.6%) of the trainers strongly agreed (63.4%) or agreed (35.2%) that construction workers need the information in this training program. Roughly three out of four (74.3%) said they would use the training program in their classes (25.7% said they were not sure).

**19. Evaluation results from the pilot workers’ ergonomics training program**

**I learned something today that I will be able to apply to my work.**

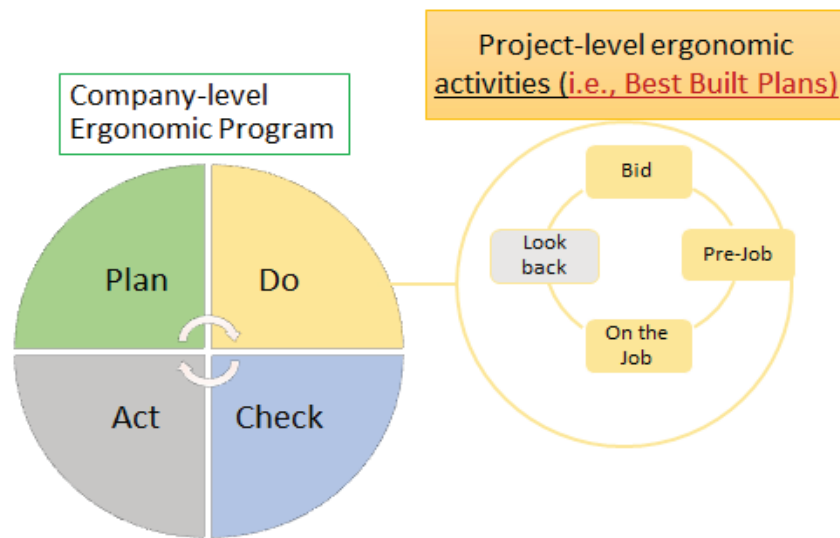


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The Best Built Plans program is also serving as a platform to disseminate and promote other related CPWR-funded research findings and interventions, including the Safety Voice for Ergonomics (SAVE) training program, which is designed to teach masonry brick and block apprentices problem solving skills and ergonomics, and a separate project that evaluated the effectiveness of incorporating ergonomics into an overall construction safety management system (chart 20).

20. Company-level ergonomic program and project-level activities





## Conclusion/Discussion

Employer-reported WMSDs in construction decreased dramatically in the past decades, following overall injury trends. At the same time, the median DAFW due to WMSDs has increased. In addition, the proportion of WMSD cases for workers aged 55 to 64 years more than doubled in the past decades, and the risk of WMSDs increased with age. The rate of WMSDs varies by occupation. While construction laborers made up the largest number of WMSDs, construction helpers experienced a higher rate than any other construction occupation. This study also found that the major cause of WMSDs among construction workers was overexertion, and the back was the primary body part affected.

Although both the number and rate of WMSDs in construction have dramatically dropped since 1992, estimates based on self-reported data suggest that the prevalence of MSD-related problems may be more severe than reported by the SOII data alone. While it is unclear the extent to which such self-reported problems were related to a worker's job, a longitudinal study found that construction workers who were once injured at work were twice as likely to report back pain and joint pain in a ten-year follow-up compared to those who had never been injured (Dong et al., 2015). Moreover, MSD symptoms significantly limited the usual activities of workers who had such symptoms, especially older workers.

Effective ergonomic innovations to reduce the physical workload of construction workers are essential to mitigate the risk of WMSDs and to facilitate sustained employment, in particular for older construction workers given the aging workforce trend. CPWR and its partners have developed an ergonomic program, targeting company and project-level ergonomic activities. The evaluation of the pilot training program indicates that it is needed and well-received by workers and trainers. To learn more and find the Best Built Plans program and other resources, visit [CPWR's Construction Ergonomic Research & Solutions](#) and NIOSH's [Musculoskeletal Health Program](#) websites.

## Data Sources:

- National Center for Health Statistics, National Health Interview Survey (NHIS), 2002-2017
- U.S. Bureau of Labor Statistics, Current Population Survey (CPS), 2015-2017
- U.S. Bureau of Labor Statistics, Survey of Occupational Injuries and Illnesses (SOII), 1992-2017

## References

- CPWR - The Center for Construction Research and Training. [2018]. The Construction Chart Book, Sixth edition, page 33, <https://www.cpwr.com/publications/research-findings-articles/construction-chart-book> (Accessed September 2019).
- Dong XS, Fujimoto A, Ringen K, Stafford E, Platner J, Gittleman J, Wang X. [2011]. Injury underreporting among small establishments in the construction industry. *Am J Ind Med.*, 54(5):339-349. PMID: 21246588
- Dong XS, Wang X, Largay JA, Sokas R. [2015]. Long-term health outcomes of work-related injuries among construction workers: findings from the National Longitudinal Survey of Youth. *Am J Ind Med.* Mar;58(3):308-18. PMID: 25678458.
- Marcum J, Adams D. 2017. Work-related musculoskeletal disorder surveillance using the Washington state workers' compensation system: Recent declines and patters by industry, 1999-2013. *American Journal of Industrial Medicine*, 60(5): 457-471.
- National Institute for Occupational Safety and Health (NIOSH). [2018]. Musculoskeletal Health Program, <https://www.cdc.gov/niosh/programs/msd/default.html> (Accessed September 2019).
- United States Bone and Joint Initiative (USBJI). [2018]. The Burden of Musculoskeletal Diseases in the United States (BMUS), Fourth edition. Rosemont, IL. <http://www.boneandjointburden.org> (Accessed September 2019).
- West GH, Dawson J, Teitelbaum C, Novello R, Hunting K, Welch LS. [2016]. An analysis of permanent work disability among construction sheet metal workers. *American Journal of Industrial Medicine*, 59(3):186-195.

## Definitions and Measures:

### Sections 1 and 2 (SOII Data, Employer reported)

- **Back injury** – Body part of WMSDs.
- **Risk of WMSD** – Risk of WMSDs was measured by injury rate, which is the number of WMSDs per 10,000 FTEs, assuming that a full-time employee works 2,000 hours per year (or 40 hours × 50 weeks). Risk was also measured by an index using the average rate of WMSDs in a subgroup divided by the average rate of WMSDs in construction.
- **WMSD** – The definitions of WMSDs differ before and after 2011 due to changes in the OIICS used by the BLS (<http://www.bls.gov/iif/oshdef.htm>). Since 2011, under OIICS v.2.01, WMSDs include cases where the nature of the injury or illness is a pinched nerve (nature codes: 1131xx); herniated disc (1211xx); meniscus tear (1221xx); sprains, strains, tears (123xxx);

traumatic hernia (124xxx); pain, swelling, and numbness (1972xx, 1973xx, and 1974xx); carpal or tarsal tunnel syndrome (2241xx and 2244xx); Raynaud's syndrome or phenomenon (2371xx); or non-traumatic hernia (253xxx). Diseases or disorders affecting the musculoskeletal system, including tendonitis and bursitis, which generally occur over time due to repetitive activities, are also included and coded in Musculoskeletal System and Connective Tissue Diseases and Disorders (27xxxx). The events or exposures leading to the injury or illness include overexertion and bodily reaction, repetitive motion involving multi-tasks, vibration, and others. Different from OIICS v.2.01, Raynaud's syndrome or phenomenon, tarsal tunnel syndrome, and herniated spinal discs were not counted as WMSDs in the previous OIICS. Therefore, WMSD data prior to 2011 and after are not directly comparable.

### Section 3 (NHIS Data, Self-reported)

- **Activity limit** (by arthritis or joint symptoms) – Are you now limited in any way in any of your usual activities because of arthritis or joint symptoms?
- **Arthritis** – Have you ever been told you have arthritis?
- **Joint pain** – Did you have symptoms of joint pain, aching, stiffness in the past 30 days?
- **Low back pain** – During the past three months, did you have low back pain?
- **MSD symptoms** – Combination of 4 symptoms: Arthritis = yes, or Joint pain = yes, or Low back pain = yes, or Neck pain = yes.
- **Neck pain** – During the past three months, did you have neck pain?
- **Rate** – The NHIS survey items were measured by cases per 100 workers.

## About the CPWR Data Center

The CPWR Data Center is part of CPWR – The Center for Construction Research and Training. CPWR is a 501(c)(3) nonprofit research and training institution created by North America’s Building Trades Unions, and serves as its research arm. CPWR has focused on construction safety and health research since 1990. The Quarterly Data Reports – a series of publications analyzing construction-related data, is part of our ongoing surveillance project funded by the National Institute for Occupational Safety and Health (NIOSH).

Please visit CPWR’s other resources to help reduce construction safety and health hazards:

Construction Solutions <http://www.cpwrconstructionsolutions.org/>  
Construction Solutions ROI Calculator <http://www.safecalc.org/>  
Exposure Control Database <http://ecd.cpwrconstructionsolutions.org/>  
The Electronic Library of Construction OSH <http://www.elcosh.org/index.php>  
Falls Campaign <http://stopconstructionfalls.com/>  
Hand Safety <http://choosehandsafety.org/>  
Safety and Health Network <https://safeconstructionnetwork.org/>  
Work Safely with Silica <http://www.silica-safe.org/>

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