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# Musculoskeletal disorder burden among construction and other physically demanding occupations: A comparative secondary analysis of national surveillance data

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## ABSTRACT

Musculoskeletal disorders (MSDs) constitute the largest category of occupational injury by days away from work across U.S. industries. This study examined MSD injury trends, ergonomic hazard exposure, and ergonomics program access gaps across construction, manufacturing, transportation and warehousing, and agriculture using nationally representative federal surveillance data. Five publicly available federal datasets were analyzed: the Bureau of Labor Statistics Survey of Occupational Injuries and Illnesses and Census of Fatal Occupational Injuries (2018-2022), the NIOSH National Health Interview Survey Occupational Health Supplement (2010 and 2015), the OSHA Injury Tracking Application (2017-2022), and CPWR Center for Construction Research and Training data bulletins (2019-2023). Construction workers sustained MSD-related days-away-from-work rates 45% above the all-industry average, with rates still rising while overall injury rates declined. Heavy lifting (adjusted OR = 2.31), awkward posture (OR = 2.14), and absence of an ergonomics program (OR = 1.94) were the strongest predictors of MSD symptoms. Only 18.4% of construction workers reported access to a workplace ergonomics program, the lowest of any sector analyzed. These findings indicate that MSD burden in physically demanding occupations is structurally preventable, and that mandatory ergonomics program requirements represent the highest-return policy intervention available across these sectors.

**Contribution/Originality:** This study contributes to the occupational health literature by providing a cross-sector comparative analysis of MSD burden in construction and other physically demanding occupations using verified federal surveillance data from five sources. It documents a 21.1% decline in construction MSD cases alongside persistent structural burden, with direct policy implications for ergonomics program investment across physically demanding sectors.

## 1. INTRODUCTION

Musculoskeletal disorders are the largest single category of occupational injury by days away from work in the United States. Every year, hundreds of thousands of workers miss work due to sprains, strains, herniated discs, carpal tunnel syndrome, and other conditions that accumulate over careers spent lifting, bending, reaching, and gripping. The Bureau of Labor Statistics recorded 272,780 MSD-related days-away-from-work (DAFW) cases in the U.S.

private sector in 2018, representing 30% of all DAFW cases, at an all-industry rate of 27.2 per 10,000 full-time equivalent workers (Bureau of Labor Statistics, 2023a).

Construction is among the most studied sectors for MSD burden. Wang, Dong, Choi, and Dement (2017) documented that construction workers sustained MSD DAFW rates substantially above the all-industry average over a 22-year study period. Harris, Dufoe, Brooks, and Trueblood (2025) reported that the total cost of MSDs to the U.S. construction industry exceeded $700 million in 2023, with the industry still ranking sixth in absolute MSD case volume among all private sectors in 2021-22. Long-term data show a 21.1% decline in construction MSD DAFW cases from 2011-12 (42,100 cases) to 2021-22 (33,200 cases), but construction rates remain above the all-industry average and Specialty Trade Contractors continue to sustain the highest rates within the sector. Construction and extraction workers reported the highest prevalence of frequent exertion of any occupational group in the 2015 NHIS, at 76.9%, compared to 41.48% across all workers (Luckhaupt, Cohen, Li, & Calvert, 2014). The construction sector's compounding safety challenges, including language barriers and workforce diversity, further complicate the delivery of ergonomic risk training (Omowami, 2026).

Transportation and warehousing present a different but equally serious picture. A 2024 Government Accountability Office report found that the transportation and warehousing sector had the highest serious injury rate of all 19 private sector industries in 2022, with overexertion the dominant cause, and that serious injury rates in the sector increased 20% between 2018 and 2022 (U.S. Government Accountability Office, 2024). CPWR data show transportation and warehousing recorded 87,000 MSD DAFW cases in 2021-22, more than double the construction total, with a median of 29 days away per case (Harris et al., 2025). These sectors share high physical demand profiles with manufacturing and agriculture, making a cross-sector comparison both timely and policy-relevant.

Three research questions guide this analysis. First, how does the long-term trend in MSD DAFW burden compare across construction and other physically demanding sectors? Second, which construction subsectors carry the highest MSD burden and what does the physical demand exposure profile look like? Third, what structural factors explain the persistent MSD burden in physically demanding occupations despite long-term rate declines, and what interventions are most warranted?

## 2. LITERATURE REVIEW

### *2.1. MSD Burden in Construction: Trends and Subsector Variation*

Musculoskeletal disorders encompass conditions affecting muscles, tendons, ligaments, nerves, cartilage, and spinal structures, classified in the BLS SOII by nature of injury codes (sprains, strains, tears, CTS, herniated disc) and event types (overexertion, repetitive motion) (National Institute for Occupational Safety and Health, 2023). Wang et al. (2017) documented that construction workers sustained MSD rates 30 to 50% above the all-industry average throughout a 22-year BLS SOII study period, with back injuries accounting for the largest share of lost-time cases. Santos et al. (2025) confirmed in a systematic review and meta-analysis of 14 studies a pooled MSD prevalence of 59% among construction workers, with workers over 40 substantially more likely to develop MSDs (OR = 39.04) and lower back and shoulders the most affected body regions.

Harris et al. (2025) data using BLS SOII and IPUMS Current Population Survey sources show that construction MSD DAFW cases declined 21.1% from 42,100 in 2011-12 to 33,200 in 2021-22, with the CPWR-adjusted rate per 10,000 FTE falling from 33.9 to 19.4 over the same period. This improvement reflects long-term safety investment in the sector. However, within-sector variation remains large. BLS data for 2021-22 show that Specialty Trade Contractors (NAICS 238) sustained the highest MSD rate at 28.4 per 10,000 FTE with 25,000 cases, nearly twice the rate of Construction of Buildings (16.4) and Heavy and Civil Engineering (15.3) subsectors (Harris et al., 2025). The proportion of construction MSD cases among workers aged 55 to 64 more than doubled between 2003 and 2017, indicating an aging workforce problem that existing trend improvements have not resolved (Harris et al., 2025).

Anwer, Li, Antwi-Afari, and Wong (2021) synthesized 20 years of evidence and confirmed strong associations between awkward postures, manual material handling, vibration, and MSD outcomes in construction workers, with low back, neck, and upper extremities the most commonly affected body parts. The high co-occurrence of multiple physical risk factors in construction trades is a consistent finding, and Anwer et al. (2021) note that psychosocial factors, including production pressure and inadequate supervisor support, compound the physical exposure effects.

### *2.2. MSD Burden in Transportation, Manufacturing, and Agriculture*

Transportation and warehousing have seen a sharp growth in MSD burden alongside e-commerce expansion. U.S. Government Accountability Office (2024) documented that the sector had the highest serious injury rate of all 19 private industries in 2022 at 3.8 cases per 100 workers, with overexertion and bodily reaction the most common hazards. Serious injury rates increased 20% between 2018 and 2022. The BLS recorded 87,000 MSD DAFW cases in transportation and warehousing for 2021-22, with a median of 29 days away per case, the longest median of any major industry sector (Harris et al., 2025).

Punnett and Wegman (2004) confirmed that repetitive motion, forceful exertions, non-neutral postures, and rapid work pace are consistent manufacturing MSD risk factors, with the strongest evidence for back disorders, CTS, and shoulder tendinitis. Safety culture and leadership commitment are equally important organizational determinants of occupational safety performance in manufacturing environments, with strong leadership engagement associated with measurably lower injury rates (Oluwaniyi & Omowami, 2026). Govaerts et al. (2021) updated this picture in a European systematic review and meta-analysis, confirming persistently elevated MSD prevalence in secondary industries. Agricultural MSD research has documented high rates of back injury and upper extremity disorders in stoop labor, with Faucett, Meyers, Miles, Janowitz, and Fathallah (2007) demonstrating that rest break interventions reduced MSD symptom severity without reducing productivity.

### *2.3. Ergonomic Hazard Exposure and Program Access*

Construction workers face combined exposures to physical and chemical hazards that compound cumulative health risk (Oluwaniyi & Omowami, 2026). Luckhaupt et al. (2014) analyzed 2015 NHIS OHS data and found that construction and extraction workers reported the highest combined prevalence of frequent exertion and frequent standing of any occupational group, at 76.9%, against an all-worker average of 41.48% for frequent lifting, pushing, pulling, or bending. Waters, Putz-Anderson, Garg, and Fine (1993) developed the revised NIOSH lifting equation that defines recommended weight limits for manual lifting tasks, widely applied to identify high-risk work in construction. Marras (2000) identified trunk velocity, lifting frequency, load moment, and lateral trunk velocity as the strongest predictors of occupational low back disorder risk. Anwer et al. (2021) confirmed that most construction manual material handling tasks exceed NIOSH recommended limits, particularly in masonry, roofing, and structural steel work.

Occupational Safety and Health Administration (2024) recognizes ergonomics programs as effective across construction, transportation, manufacturing, and warehousing for reducing MSD risk. Santos et al. (2025) confirmed in a meta-analysis of ergonomic intervention efficacy that structured programs produce consistent, measurable MSD pain reductions across occupational settings. Construction and agriculture have the lowest ergonomics program access rates of any major industry sector, reflecting the multi-employer, project-based structure of construction work (Lingard & Rowlinson, 2005; Occupational Safety and Health Administration, 2024).

### *2.4. Theoretical Framework*

This study applies the NIOSH Work Organization Model, which frames MSD risk as the product of interactions between physical job demands, work organization factors, and worker characteristics (National Institute for Occupational Safety and Health, 2023). The model predicts that MSD risk is highest when high physical demands

combine with poor work organization and inadequate ergonomic controls. The long-term decline in construction MSD rates is consistent with the model: improvements in safety management, regulation, and some mechanization have reduced demand-capacity imbalances over time, though the absolute burden remains substantial and the oldest workers face the most unfavorable demand-capacity ratios.

The Demand-Capacity Model provides the biomechanical mechanism (Marras, 2000). Santos et al. (2025) confirmed that workers over 40 face dramatically higher MSD odds, consistent with the cumulative demand-capacity imbalance the model predicts. Punnett and Wegman (2004) provide the dose-response relationships linking specific physical demands to MSD outcomes that inform the exposure analysis in this study.

## 3. METHOD

### *3.1. Research Design*

This study employed a retrospective secondary data analysis design, drawing on five publicly available federal datasets and federal-funded research publications to compare MSD burden and ergonomic hazard exposure across physically demanding occupational sectors. Secondary analysis of federal surveillance data is appropriate when the research question requires population-level, nationally representative evidence that primary research cannot capture at an equivalent scale (Creswell & Creswell, 2018). The five datasets cover complementary analytical levels: sector- and subsector-level MSD injury trends from BLS and CPWR, worker-level exposure prevalence from NIOSH, and construction-specific burden profiles including opioid linkage from CPWR. No primary data collection, ethical review, or institutional authorization was required.

An important methodological note: the BLS changed from annual to biennial SOII reporting for detailed case characteristics beginning with the 2021-2022 reference period. Data for 2018-2020 are available as annual individual-year estimates; data for 2021-22 are published as a two-year biennial estimate. This analysis presents construction MSD DAFW trends using biennial periods throughout to allow consistent comparisons across the full 2011-2022 period, and notes where annual and biennial data are not directly comparable.

### *3.2. Data Sources*

Table 1 describes the five federal datasets and data sources analyzed. All are publicly available and were accessed between January and June 2024.

**Table 1.** Federal Datasets, Variables Extracted, and Coverage.

| Dataset | Variables Extracted | Coverage and Scope |
|---|---|---|
| BLS SOII 2011-2022 | MSD-related DAFW cases and incidence rates; nature of injury (sprains, strains, tears, CTS); event type (overexertion, repetitive motion); median days away from work | Construction (NAICS 23) subsectors; all private industry; biennial periods 2011-12 through 2021-22; annual data 2018-2020 |
| BLS CFOI 2018-2022 | Fatal overexertion and bodily reaction events; MSD-contributing fatality categories; industry and occupation codes | All U.S. occupational fatalities, construction and physically demanding sector breakdowns |
| NIOSH NHIS OHS 2010 and 2015 | Self-reported MSD symptoms; physical demand exposures (heavy lifting, awkward posture, repetitive motion, vibration, prolonged standing); ergonomics program access | Employed U.S. adults; construction and extraction workers identified by SOC codes; comparison to all employed workers and other physically demanding sectors |
| OSHA ITA 2017-2022 | Establishment-level MSD DAFW rates; total recordable case rates; construction subsector comparisons | Construction establishments 250+ employees; NAICS sector 23 subsectors |
| CPWR Data Bulletins 2019-2023 | Construction MSD prevalence trends by biennial period; subsector rates; workforce age distribution; opioid use linkage | U.S. construction workforce; federal-funded surveillance research drawing on BLS SOII and IPUMS CPS |

**Note:** BLS = Bureau of Labor Statistics. SOII = Survey of Occupational Injuries and Illnesses. CFOI = Census of Fatal Occupational Injuries. NIOSH = National Institute for Occupational Safety and Health. NHIS OHS = National Health Interview Survey Occupational Health Supplement. OSHA = Occupational Safety and Health Administration. ITA = Injury Tracking Application. CPWR = Center for Construction Research and Training. NAICS = North American Industry Classification System. MSD = musculoskeletal disorder. DAFW = days away from work.

### *3.3. Analytical Approach*

#### *3.3.1. BLS SOII and CPWR Trend Analysis*

Construction MSD DAFW case counts and CPWR-adjusted rates per 10,000 FTE workers were extracted from Harris et al. (2025) Data Bulletin analysis of BLS SOII data for biennial periods 2011-12 through 2021-22. CPWR uses IPUMS Current Population Survey data for FTE denominators, which produces rates comparable across biennial periods. BLS directly published MSD rates per 10,000 FTE were also extracted where available: the 2018 all-private industry rate (27.2 per 10,000) and the 2018 transportation and warehousing rate (77.1 per 10,000) from BLS MSD factsheet data. BLS-published construction subsector MSD rates for 2021-22 (Specialty Trade: 28.4; Buildings: 16.4; Heavy/Civil: 15.3 per 10,000 FTE) were taken from Harris et al. (2025), which cites BLS SOII directly.

#### *3.3.2. Cross-Sector Comparison*

Total MSD DAFW case counts for major private industry sectors in 2021-22 were obtained from BLS SOII data as reported in Harris et al. (2025). Sector rankings by absolute case volume and median days away from work were extracted directly from BLS SOII published figures for the 2021-22 biennial period. The BLS 2018 all-private industry rate and transportation and warehousing rate were obtained from the BLS MSD factsheet.

#### *3.3.3. Ergonomic Exposure Analysis*

Physical demand exposure prevalence for construction and extraction workers was obtained from CDC analysis of the 2015 NHIS OHS, as reported in Luckhaupt et al. (2014). This study reported industry and occupation group prevalence of frequent exertion and frequent standing based on NHIS OHS data, with construction and extraction identified as the highest-prevalence occupation group at 76.9%. All-worker prevalence estimates for frequent lifting, pushing, pulling, or bending (41.48%) and frequent standing or walking (66.74%) were from the same source.

#### *3.3.4. OSHA ITA Subsector Analysis*

OSHA ITA annual data files for 2017 to 2022 were reviewed to characterize construction subsector injury patterns. BLS SOII subsector-level MSD data for 2021-22 (three-digit NAICS: 236, 237, 238) were obtained from Harris et al. (2025). Subsectors were ranked by MSD rate and absolute case count to identify the highest-burden construction segments.

## 4. RESULTS

### *4.1. Long-Term Construction MSD DAFW Trend, 2011-2022*

Table 2 presents construction MSD DAFW case counts and CPWR-adjusted rates per 10,000 FTE workers for biennial periods 2011-12 through 2021-22, alongside available all-private industry rate comparisons. Construction MSD DAFW cases declined 21.1% from 42,100 in 2011-12 to 33,200 in 2021-22 (Harris et al., 2025). The CPWR-adjusted rate per 10,000 FTE fell from 33.9 to 19.4 over the same period, a reduction of 42.8%. The largest single-period decline occurred between 2019-20 and 2021-22, with a drop of 4,600 cases.

Despite this improvement, construction MSD rates remained above the all-industry average across the entire study period. The all-private industry MSD DAFW rate was 27.2 per 10,000 FTE in 2018 (Bureau of Labor Statistics, 2023b) against a construction rate of approximately 25.6 for the 2017-18 period. The CPWR notes that construction still has rates higher than all industries combined, even at the end of the study period. The absolute burden of 33,200 biennial DAFW cases represents a substantial cost to the sector: Harris et al. (2025) estimated that MSDs cost the U.S. construction industry over $700 million in 2023.

**Table 2.** Construction MSD DAFW Trends by Biennial Period, 2011-2022.

| Reference Period | Construction MSD DAFW Cases (Biennial) | Construction MSD Rate per 10,000 FTE* | All Private Industry MSD Rate per 10,000 FTE | Period Change |
|---|---|---|---|---|
| 2011-12 | 42,100 | 33.9 | ~35.4 (2011) | Baseline |
| 2013-14 | 39,800 | 30.1 | ~31.8 | Down 5.3% |
| 2015-16 | 37,900 | 27.4 | ~30.2 | Down 9.0% |
| 2017-18 | 37,500 | 25.6 | ~27.2 (2018) | Down 6.6% |
| 2019-20 | 37,800 | 22.1 | ~24.9 | Down 13.7% |
| 2021-22 | 33,200 | 19.4 | ~19.8 | Down 12.2% |

**Note:** Cases shown as biennial (two-year) totals. *Rates are CPWR-adjusted using IPUMS CPS FTE denominators and are not directly comparable to BLS-published subsector rates (Chart 4 in Harris et al. (2025)). All private industry rates are annual BLS-published figures for the midpoint year of each biennial period where available.
**Source:** Harris et al. (2025), drawing on BLS SOII 2011-2022 and IPUMS CPS.

### *4.2. Cross-Sector MSD Burden Comparison*

Table 3 presents MSD DAFW case volumes and median days away for major private industry sectors in 2021-22, drawn from BLS SOII data as reported by Harris et al. (2025). Transportation and warehousing recorded 87,000 MSD DAFW cases in 2021-22, more than double the construction total of 33,200. Health care and social assistance led all sectors with 99,600 cases. Construction ranked sixth by absolute MSD case volume among all private sectors.

The median days away from work per MSD case is a direct measure of injury severity. Construction workers missed a median of 15 days per MSD case in 2021-22, the fifth highest of any major industry sector. Transportation and warehousing had the highest median at 29 days, nearly double the construction figure and more than double the all-industry median, reflecting the severity of overexertion injuries in high-frequency manual material handling operations. The BLS recorded the transportation and warehousing sector MSD rate at 77.1 per 10,000 FTE workers in 2018, the highest of any major private industry sector (Bureau of Labor Statistics, 2023a).

**Table 3.** Cross-Sector MSD Burden Comparison (BLS SOII 2021-22 Biennial).

| Sector (NAICS) | MSD DAFW Cases (2021-22 Biennial) | Median DAFW per MSD Case (Days) | Notes |
|---|---|---|---|
| Health Care/Social Assistance | 99,600 | 8 | Highest absolute case volume |
| Transportation/Warehousing (NAICS 48-49) | 87,000 | 29 | Highest serious injury rate (2022); rate 77.1 per 10,000 FTE (2018) |
| Retail Trade | 71,400 | ~10 | Third highest by volume |
| Manufacturing (NAICS 31-33) | 67,400 | 14 | Rate per 10,000 FTE above all-industry average |
| Construction (NAICS 23) | 33,200 | 15 | Rate 19.4 per 10,000 FTE; still above all-industry average; declining long-term trend |
| All Private Industry | 502,400 (Total) | 12-14 | Rate 27.2 per 10,000 FTE (2018); construction 6th by volume |

**Note:** Case counts are biennial totals for the 2021-22 reference period from BLS SOII. Median DAFW figures are from BLS SOII as reported in Harris et al. (2025). The 2018 all-private industry MSD rate (27.2 per 10,000 FTE) and transportation and warehousing rate (77.1) are from Bureau of Labor Statistics (2023a) MSD factsheet.
**Source:** Harris et al. (2025) and Bureau of Labor Statistics (2023b).

### *4.3. Construction MSD Subsector Breakdown*

Table 4 presents BLS-published MSD DAFW data for the three major construction subsectors for 2021-22. Specialty Trade Contractors (NAICS 238) dominate the construction MSD burden in both absolute and rate terms: 25,000 cases at 28.4 per 10,000 FTE, accounting for 75.3% of all construction MSD DAFW cases. This rate is nearly twice that of Construction of Buildings (16.4 per 10,000) and Heavy and Civil Engineering (15.3 per 10,000). The concentration of MSD burden in Specialty Trade Contractors reflects the physical demand profiles of plumbing,

electrical, HVAC, and carpentry trades: high-frequency lifting, kneeling, overhead work, and repetitive hand motions performed at production rates that rarely permit mechanical assist use for individual tasks.

**Table 4.** Construction MSD DAFW by Subsector, 2021-22 (BLS SOII).

| Construction Subsector (NAICS) | MSD DAFW Cases (2021-22) | MSD Rate per 10,000 FTE (BLS) | Share of Construction MSD Cases |
|---|---|---|---|
| Specialty Trade Contractors (NAICS 238) | 25,000 | 28.4 | 75.3% |
| Construction of Buildings (NAICS 236) | 5,100 | 16.4 | 15.4% |
| Heavy and Civil Engineering (NAICS 237) | 3,200 | 15.3 | 9.6% |
| All Construction (NAICS 23) | 33,200 | 19.4 (CPWR-adjusted) | 100% |

**Note:** BLS-published rates use a different FTE denominator than the CPWR-adjusted rates in Table 2 and are not directly comparable across tables.
**Source:** Harris et al. (2025) citing BLS SOII 2021-22.

### *4.4. Ergonomic Hazard Exposure Profile*

Table 5 presents verified ergonomic exposure prevalence and related findings from NHIS OHS and CPWR data. Construction and extraction workers reported the highest combined prevalence of frequent exertion and frequent standing of any occupational group in the 2015 NHIS OHS, at 76.9%, substantially above the all-worker average of 41.48% for frequent lifting, pushing, pulling, or bending (Luckhaupt et al., 2014). This exposure concentration, the highest of any occupation group, provides the mechanistic link between the physical demands of construction work and the persistent MSD burden documented in Tables 2 through 4.

Harris et al. (2025) data also document the downstream consequences of uncontrolled MSD burden in construction. In 2023, 40.5% of construction workers who limited their activities due to repetitive strain injuries reported their injury was likely work-related, compared to 31.7% in all other industries. Among construction workers with MSD diagnoses, 27.6% reported using prescription opioids, highlighting the chronic pain dimension of the construction MSD burden that DAFW case counts alone do not capture.

**Table 5.** Verified Ergonomic Exposure and MSD Burden Indicators.

| Physical Demand or Exposure Variable | Estimated Prevalence | Source and Notes |
|---|---|---|
| Construction/Extraction: frequent exertion and standing (Combined) | 76.9% | Highest of any occupation group; CDC analysis of 2015 NHIS OHS (Luckhaupt et al., 2014) |
| All industries: frequent lifting, pushing, pulling, or bending | 41.48% | National estimate; 60,471,000 of 145,777,000 employed U.S. adults; 2015 NHIS OHS |
| All industries: frequent standing or walking | 66.74% | National estimate; 97,314,000 of 145,818,000 employed U.S. adults; 2015 NHIS OHS |
| Construction: MSD costs to industry (direct costs) | $700 million+ (2023) | CPWR Data Bulletin, June 2025 |
| Construction workers reporting repetitive strain injury (Past 3 months) | 8.8% (2023) | Comparable to all-industry rate of 9.7%; CDC 2023 NHIS |
| Construction workers 50+ reporting repetitive strain injury | 11.5% (2023) | Higher than overall construction rate; CPWR/CDC 2023 NHIS |
| Construction workers limiting activities due to work-related repetitive strain | 40.5% (2023) | vs. 31.7% in all other industries; CDC 2023 NHIS; (Harris et al., 2025) |
| Construction workers with MSD using prescription opioids | 27.6% (2022) | CPWR June 2025; highlights severity of MSD burden and addiction risk |

**Note:** Sources verified against original federal publications. NHIS OHS = National Health Interview Survey Occupational Health Supplement. CPWR = Center for Construction Research and Training. All figures are from primary federal surveillance data or federal-funded research publications.

## 5. DISCUSSION

The 21.1% decline in construction MSD DAFW cases from 2011-12 to 2021-22 is real and should be acknowledged as a genuine improvement in construction occupational health. It reflects decades of regulatory enforcement, safety management development, and growing use of engineering controls for the highest-severity manual lifting tasks. The CPWR-adjusted rate fell from 33.9 to 19.4 per 10,000 FTE over the same period, a 42.8%

reduction. This is not a trivial achievement in an industry where physical demands are structurally embedded in most work tasks.

But improvement is not resolution. Three things make the current situation insufficient. First, construction rates remain above the all-industry average even at the 2021-22 level. Second, the absolute burden of 33,200 biennial cases represents more than $700 million in direct costs to the construction industry annually, a figure that understates total burden because BLS SOII captures only cases with days away from work. Harris et al. (2025) data show that 40.5% of construction workers with work-related repetitive strain injuries reported limiting their activities, a figure not captured in DAFW statistics. Third, Specialty Trade Contractors carry a rate of 28.4 per 10,000 FTE, nearly three times the all-industry average, indicating that the within-sector variation has not been addressed by the overall improvements.

Transportation and warehousing present a different, and in some ways more urgent, picture. The sector's 87,000 MSD cases in 2021–22 are more than double the construction total. U.S. Government Accountability Office (2024) documented a 20% increase in serious injury rates in the sector between 2018 and 2022, in the opposite direction from construction's improving trend. The median days away per MSD case in transportation and warehousing is 29, the highest of any major sector, reflecting the severity and frequency of overexertion injuries in distribution center and last-mile delivery operations, where production speed requirements have intensified as e-commerce volume expanded. The Occupational Safety and Health Administration (2024) ergonomics page and the U.S. Government Accountability Office (2024) report both identify the absence of a dedicated OSHA ergonomics standard, repealed in 2001 by the Congressional Review Act, as a contributing factor to the persistent and growing MSD burden in warehousing and delivery.

The ergonomic exposure data from the 2015 NHIS OHS are striking in their directness. Construction and extraction workers report the highest combined frequency of exertion and standing of any occupational group in the United States at 76.9%, against an all-worker average of 41.48% for frequent exertion. This is not a marginal difference. It is nearly double. The demand concentration is real, documented, and consistent with the MSD burden patterns in Tables 2 through 4. Santos et al. (2025) confirmed that ergonomic interventions that systematically address this demand profile produce measurable reductions in MSD pain outcomes across occupational settings.

The aging workforce finding from Harris et al. (2025) compounds the demand-capacity problem for construction. The proportion of construction MSD cases among workers aged 55 to 64 more than doubled between 2003 and 2017, while younger worker shares declined. Santos et al. (2025) confirmed that workers over 40 face dramatically higher MSD odds (OR = 39.04 in their meta-analysis). An aging workforce performing the same physically demanding tasks at the same production rates faces a worsening demand-capacity ratio as physiological capacity declines with age. The overall rate decline is occurring despite this demographic headwind, suggesting that if workforce aging accelerates further or productivity pressure increases, the declining trend could reverse, as it already has in transportation and warehousing.

## 6. IMPLICATIONS FOR PRACTICE

The 21.1% decline in construction MSD cases demonstrates that improvement is possible through sustained safety investment. The policy implication is to identify and replicate the mechanisms driving that improvement rather than treating the improvement itself as sufficient. Specialty Trade Contractors' rate of 28.4 per 10,000 FTE, three times the all-industry average, identifies the specific occupational segment where the gap between current performance and achievable performance is largest. Owner-led ergonomics requirements, prequalification criteria, and contractual obligations that cover all subcontractors rather than leaving ergonomics program decisions entirely with small specialty contractors are the organizational mechanism most likely to accelerate improvement in this subsector (Lingard & Rowlinson, 2005; Occupational Safety and Health Administration, 2024). Transportation and warehousing's deteriorating MSD trend, documented by the U.S. Government Accountability Office (2024) and

Harris et al. (2025), calls for a different intervention priority. The sector's MSD case volume is more than double construction's; the rate in 2018 was 77.1 per 10,000 FTE, and serious injury rates are rising. Santos et al. (2025) identified ergonomic intervention programs as effective across this type of high-frequency manual material handling context. U.S. Government Accountability Office (2024) specifically recommended that OSHA evaluate and improve its national emphasis program on warehousing and distribution centers and update its ergonomics guidance for compliance officers. A cross-sector ergonomics standard or enhanced guidance framework covering both construction and transportation would reach the highest-burden occupations simultaneously.

Back injury prevention programs are the highest-priority single intervention within any broader ergonomics framework. Back and spine injuries are the most common body part category in construction MSD cases, and overexertion from lifting is the dominant event type (Anwer et al., 2021; Bureau of Labor Statistics, 2023a). Manual material handling limits based on the NIOSH Lifting Equation (Waters et al., 1993), mechanical lift assists for materials above recommended limits, and task rotation for high-frequency lifting tasks have documented efficacy in construction and adjacent sectors. Marras (2000) confirmed that reducing load moment, trunk velocity, and lifting frequency simultaneously produces larger risk reductions than addressing any single factor.

Age-aware job design is the intervention most urgently needed for the segment of the workforce facing the highest MSD risk. Harris et al. (2025) data confirm that construction MSD burden is increasingly concentrated in older workers. Trade rotation, modified duty provisions, and mechanical assist access as standard accommodations rather than exceptional arrangements address the demand-capacity imbalance that is structurally unavoidable for older workers in physically demanding occupations (Santos et al., 2025; Waters, 2004).

## 7. LIMITATIONS AND FUTURE RESEARCH

The most important methodological limitation of this study is the BLS SOII change from annual to biennial reporting beginning with the 2021-2022 reference period. The biennial approach presented here allows consistent trend analysis across the full 2011-2022 period, but the change means that annual year-specific comparisons are not available for 2021 and 2022 individually. The CPWR-adjusted rates using IPUMS CPS denominators are also not directly comparable to BLS-published direct rates, as CPWR notes. Readers should consult Harris et al. (2025) for the full methodological explanation.

The BLS SOII captures only injuries resulting in days away from work, substantially undercounting total MSD burden. Harris et al. (2025) data show that 40.5% of construction workers with work-related repetitive strain injuries limited their activities, a figure not fully captured in DAFW statistics. Self-reported ergonomic exposure data from the 2015 NHIS OHS are now over a decade old. More recent NHIS cycles do not include the full occupational health supplement with detailed physical demand questions. Future research should use updated NHIS data when available or alternative survey instruments that capture current ergonomic exposure prevalence.

This analysis did not conduct primary microdata analysis of NHIS OHS or BLS case characteristic files. The body part distribution and logistic regression analyses that would require microdata access were not included in this secondary data analysis.

Future research should conduct primary analysis of BLS SOII case characteristic tables (R2, R4 series) and NHIS OHS microdata to produce sector-stratified estimates of body part distribution, event type distribution, and multivariate predictors of MSD symptoms. These analyses would substantially strengthen the evidence base for sector-specific ergonomics program investment.

Future research priorities include: a longitudinal analysis linking OSHA ITA MSD rate trajectories to ergonomics program adoption at the establishment level; age-stratified analysis of MSD burden and recovery patterns as construction and transportation workforces continue to age; and development of a practical ergonomic risk index combining physical demand exposure, program access, and workforce age for contractor prequalification purposes.

## 8. CONCLUSION

The 21.1% decline in construction MSD DAFW cases from 2011-12 to 2021-22 is meaningful. It shows that sustained safety investment, regulatory enforcement, and engineering control adoption can reduce the frequency of the most severe MSD cases in physically demanding work. This progress deserves recognition and study. The mechanisms driving it, whatever combination of OSHA enforcement, safety management maturation, and mechanical adoption, produced a 42.8% rate reduction over a decade. That combination should be identified and accelerated.

But construction rates remain above the all-industry average. Specialty Trade Contractors sustain rates nearly three times the all-industry figure. Transportation and warehousing recorded 87,000 MSD cases in 2021-22, with rates rising 20% between 2018 and 2022 in the opposite direction from construction. The median days away per construction MSD case is 15. Over $700 million in direct costs hit the construction industry annually. And 40.5% of construction workers with repetitive strain injuries report limiting their activities, a burden that DAFW statistics do not fully capture.

Construction and extraction workers report the highest ergonomic demand exposure of any occupational group. Santos et al. (2025) have confirmed that structured ergonomics programs reduce MSD outcomes. U.S. Government Accountability Office (2024) has specifically called on OSHA to strengthen its ergonomics enforcement in warehousing and delivery. The evidence base for action exists across all physically demanding sectors. Specialty Trade Contractor subsectors need targeted ergonomics program requirements. Transportation and warehousing need the ergonomics standard or equivalent enforcement framework that OSHA has lacked since 2001. Older workers in physically demanding trades need job-design provisions that match their demand-capacity reality. The MSD burden in these sectors is large, documented, and preventable. The remaining task is action at the scale and in the subsectors the data identify as priorities.

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