Musculoskeletal Disorders and Prescription Opioid Use Among U.S. Construction Workers

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Background: Musculoskeletal disorders (MSDs) and opioid use are a combined burden for construction safety and health. This study examines both issues among construction workers using a large population-based survey. **Methods:** The prevalence of MSDs in construction was estimated using multi-year data from the Medical Expenditure Panel Survey. Prescription opioid use among workers with MSDs was compared to those without MSDs. **Results:** About 34% of construction workers had at least one MSD symptom. Compared to those without MSDs, prescription opioid use tripled (aOR = 3.28, 95% CI: 2.44 to 4.41) among construction workers with MSDs. **Conclusions:** MSDs are prevalent among construction workers, and prescription opioid use significantly increased among workers with MSDs. It is critical to adopt ergonomic solutions in construction to reduce MSDs, and support workers in injury recovery with effective pain management.

Keywords: aging, construction, MEPS, musculoskeletal disorders, prescription opioids, surveillance, work-related injury

Since the turn of the twenty-first century, the opioid crisis has seriously damaged the health, social, and economic well-being of the United States.[1–5] Opioids were involved in 446,032 deaths nationwide from 1999 to 2018, and were responsible for the majority (70%) of the total 67,367 U.S. overdose deaths in 2018.[1] Rising opioid overdose deaths were initially triggered by a sharp growth in prescription opioid use and misuse, which began increasing in the late 1990s and grew rapidly in the first decade of the twenty-first century.[6,7] In 2018, nearly 170 million opioid prescriptions were filled.[7] That same year, 10.3 million Americans misused prescription opioids.[8] Moreover, prescription opioid overdose, misuse, and dependence cost approximately $78.5 billion (in 2013 dollars) annually.[9]

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The authors declare no conflicts of interest.

Clinical significance: More than one-third of construction workers had at least one MSD symptom. Prescription opioid use significantly increased among workers with MSDs. The combined burden in the construction industry revealed from the national population survey may be much larger than previous estimates based on injury and workers' compensation data.

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The opioid crisis has substantially affected the U.S. workforce. While the estimates of prescription opioid use vary due to different study designs, research suggests that prescription opioid use is common among working Americans.[10–14] Construction workers are particularly affected by the opioid epidemic.[11–13,15–18] Between 2011 and 2018, the number of unintentional workplace overdose deaths in construction increased by nine times, more than double the growth change in all industries combined during this period.[12,19] Although the numbers from the U.S. Bureau of Labor Statistics (BLS) could not define whether those overdose deaths were due to opioids, studies using data from workers' compensation and the National Death Index found that the prevalence of opioid use and death rate due to opioid overdoses were higher in construction than in other industries.[16–18,20–23]

Higher opioid use in construction is due at least in part to its high workplace injury rates.[16,24,25] According to the BLS, the rate of lost workday injuries in construction was 20% higher than the rate of all industries on average[25]; of which, about one-quarter were musculoskeletal disorders (MSDs).[26] These numbers could be underestimated since most often MSDs develop gradually, and it is difficult to establish a relationship between MSDs and job exposures. In addition, older construction workers are especially susceptible to MSD symptoms, possibly due to the accelerating degenerative effects of aging and long-term job exposures.[27,28] This has been a significant challenge in occupational health considering the aging construction workforce.[29]

MSDs can cause persistent pain,[30,31] for which prescription opioids are commonly used for treatment.[32–36] Despite the prevalence, most studies about MSDs and opioid use are either clinical research, or estimates based on workers' compensation data[16,37–42] in non-construction settings. Given the combined burden of MSDs and the opioid epidemic on the construction industry, a better understanding of related issues using alternative data sources beyond workers' compensation and BLS is necessary from both occupational surveillance and intervention perspectives. To achieve this research goal, this study examined MSDs and prescription opioid use, and their associations among construction workers using a large national survey dataset. MSDs were also analyzed by age group considering the aging workforce in construction.

METHODS

Data Source

This study analyzed 2011 to 2017 Medical Expenditure Panel Survey (MEPS) data. MEPS is composed of a group of surveys gathering various health-related data on Americans. Detailed information about MEPS is available at http://www.meps.ahrq.gov/. A dataset[43] created from three MEPS household component data files between 2011 and 2017 was expanded for the study analysis. Detailed information regarding the linked MEPS dataset was reported before.[43]

Measures

This study focuses on workers in any occupation who were employed in the construction industry during the study period. These workers will be referred to as *construction workers* from here onward.

TABLE 1. Characteristics of Musculoskeletal Disorders (MSDs) Among Construction Workers ($n = 7{,}994$)

Characteristic	Subcategory	Sample Distribution %	Prevalence of MSDs %	95% CI		*P* value*
Age group	16–24 y	11.8	25.2	20.8	29.6	**<0.0001**
	25–34 y	24.1	25.0	22.2	27.8	
	35–44 y	22.9	32.8	29.4	36.1	
	45–54 y	22.1	40.2	36.0	44.4	
	55+ y	19.0	46.3	41.6	51.0	
Gender	Men	91.0	33.8	31.7	35.9	0.0716
	Women	9.0	38.7	33.5	43.8	
Race/ethnicity	Hispanic	26.0	21.6	19.3	24.0	**<0.0001**
	White, non-Hispanic	64.4	40.0	37.5	42.5	
	Black, non-Hispanic	5.3	29.1	24.6	33.6	
	Other, non-Hispanic	4.3	30.6	23.4	37.9	
Education	No college	59.9	32.5	30.1	35.0	**0.0109**
	College	40.1	37.1	34.2	40.0	
Region	Northeast	15.6	33.8	29.2	38.4	**0.0004**
	Midwest	20.3	40.2	36.2	44.2	
	South	41.7	30.2	26.9	33.6	
	West	22.4	36.7	33.5	39.9	
Self-employed	Yes	27.6	37.3	33.3	41.3	**0.0427**
	No	72.4	33.1	31.0	35.1	
Hours worked per week	35–40	56.0	31.2	28.8	33.6	**0.0002**
	<35	16.9	40.0	35.7	44.3	
	>40	27.1	36.1	32.6	39.6	
Occupation	*White collar*					
	Management/professional	22.2	36.2	32.0	40.3	0.2638
	Admin supp./sale/service	8.5	36.5	31.1	42.0	
	Blue collar					
	Construction trade	62.3	33.0	30.6	35.4	
	Other production	7.0	37.0	30.9	43.0	
Work-related injury	Yes	9.2	75.4	70.6	80.3	**<0.0001**
	No	90.8	30.1	28.1	32.1	
Health insurance	Insured	70.1	38.3	36.1	40.5	**<0.0001**
	Uninsured	29.9	24.7	22.0	27.4	
Physical health	Excellent/very good	63.0	28.5	26.2	30.8	**<0.0001**
	Good	27.3	40.8	37.8	43.9	
	Fair/poor	9.7	53.2	48.0	58.3	
Mental health	Excellent/very good	73.9	31.6	29.4	33.8	**<0.0001**
	Good	22.3	39.2	36.0	42.3	
	Fair/poor	3.8	56.8	49.6	64.0	
Total (weighted)		100% (11.3 million)	34.2% (3.8 million)	32.3	36.2	

Boldface indicates statistical significance ($P < 0.05$).
95% CI, 95% confidence interval.
*Rao-Scott Chi-square test used to calculate *P* values.

Musculoskeletal disorders (MSDs) were divided into two categories: *musculoskeletal diseases* and *musculoskeletal injuries*. Major types of MSDs were also selected for the study analysis, including *fracture or contusion*, *nerve injury*, *dislocation*, *arthropathies*, *dorsopathies*, *rheumatism*, and *osteopathies*. All categories and types of MSDs were identified according to the International Classification of Diseases (ICD) codes adopted by MEPS, with the ICD 9th version (ICD-9) for data ranging from 2011 to 2015, and the ICD 10th version (ICD-10) for data from 2016 to 2017. Work-relatedness was defined based on ''two questions that the respondent was asked when he or she reported a medical condition: (1) whether the condition was due to an accident or injury, and (2) whether the accident or injury occurred at work''.[43] If the answers were ''Yes'' to both questions, a work-related MSD was counted.

Opioids in this study only cover outpatient prescription fills of opioids, including narcotic analgesics and narcotic analgesic combinations. Details about *prescription opioid*, *non-opioid analgesics,* and other terms used in the study have been described elsewhere.[12,43]

Statistical Analysis

Seven years of MEPS data were pooled together to increase sample size and statistical power. Stratified analyses were conducted to examine MSD status by subgroups among construction workers. Differences in analgesic use were analyzed according to number and type of MSDs. Since one worker may have more than one MSD symptom or multiple records of prescription opioid or non-opioid analgesic use, person-times were used in percentage calculations for each category.

Pearson correlation coefficients were calculated to assess the relationships between MSDs, opioid use, and selected variables. Multinomial logistic regression models[44] were constructed using ''not any analgesic use'' as a base outcome to tabulate odds ratios by MSD status. Adjusted odds ratios were calculated controlling for possible confounders displayed in Table 1. Unadjusted odds ratios (OR) and adjusted odds ratios (aOR) and their 95% confidence intervals (CIs) were reported. MEPS survey weight, strata, and cluster were used in all statistical analyses with SAS SURVEY procedures.[43]

TABLE 2. Prescription Analgesic Use by Number and Type of Musculoskeletal Disorders (MSDs) Among Construction Workers ($n = 7{,}994$)

MSD Status	% of Workers	Any %	95% CI		Opioid %	95% CI		Non-Opioid %	95% CI		Persistent Opioid %	95% CI	
No MSD	65.8	7.0	6.0	8.1	4.4	3.6	5.2	3.3	2.5	4.1	0.6	0.3	0.9
MSD (disease or injury)	34.2	34.3	31.5	37.0	22.0	19.4	24.5	21.5	19.0	24.1	6.9	5.1	8.7
1 MSD	20.7	25.1	22.2	28.1	15.1	12.5	17.8	15.6	13.0	18.2	3.1	1.7	4.5
2+ MSD	13.5	48.3	44.1	52.6	32.5	28.0	37.0	30.7	26.5	34.9	12.9	9.1	16.6
MSD disease	27.5	35.1	31.9	38.2	21.5	18.7	24.4	22.7	19.9	25.5	7.8	5.9	9.8
1 disease	18.0	27.2	23.4	31.1	16.8	13.1	20.4	17.1	14.2	20.1	5.1	2.9	7.3
2+ diseases	9.5	49.9	45.2	54.6	30.5	25.7	35.4	33.2	28.1	38.3	13.0	9.5	16.6
MSD injury	11.4	39.7	34.9	44.5	30.9	26.1	35.6	20.7	16.7	24.8	8.5	5.3	11.7
1 injury	9.6	36.4	31.5	41.2	28.2	23.6	32.9	18.5	14.5	22.4	7.4	4.4	10.4
2+ injuries	1.8	56.8	42.9	70.7	44.5	28.9	60.2	32.5	20.1	44.9	14.3	1.7	27.0
Average (weighted)		16.4%			10.4%			9.5%			2.8%		

95% CI, 95% confidence interval.

Human Research Protection

This study is exempt from human subjects review by the Institutional Review Board of CPWR-The Center for Construction Research and Training.

RESULTS

MSDs and Worker Characteristics

More than 11 million (weighted) workers were employed in the construction industry per year on average during the study period (Table 1). Overall, about 34.2% of construction workers reported at least one musculoskeletal disorder (MSD) during the study period, slightly lower than the prevalence for all industries combined (Table S1, http://links.lww.com/JOM/A806). Prevalence of MSDs varied significantly by age, race/ethnicity, education, and region (Table 1). MSDs increased with age ($P < 0.01$); workers aged 55 years and older were almost twice as likely to have a MSD (46.3%) as those under the age of 35 (<25 years: 25.2%; 25 to 34 years: 25.0%). MSDs were more prevalent among white construction workers (40.0%; $P < 0.01$) and those with a college education (37.1%; $P < 0.05$). MSDs were also higher among workers in the Midwest (40.2%; $P < 0.01$) than those in other regions. Moreover, MSDs were more prevalent among workers in poorer physical or mental health (53.2% and 56.8%, respectively).

Regarding occupational characteristics, MSDs were significantly higher among self-employed workers (37.3%; $P < 0.05$) and those who worked less than 35 hours per week (40.0%; $P < 0.01$; Table 1). Furthermore, workers who suffered a work-related injury were 2.5 times more likely to have a MSD symptom compared to those without injury (75.4% vs 30.1%; $P < 0.01$).

MSDs and Prescription Analgesics

Overall, about 34.3% of construction workers with MSDs used opioid or non-opioid prescription analgesics, with 22.0% using opioids, 21.5% using non-opioids, and 6.9% using opioids persistently (Table 2). Among construction workers with MSDs, over one-third (13.5% of 34.2%) had two or more types of MSDs. The majority (27.5% of 34.2%) had MSD diseases (ie, chronic conditions without injury history), accounting for 80% of the construction workers with MSDs. About 11.4% of construction workers had MSD injuries, of which more than one-third (35.8%) were work-related.

In general, analgesic use increased as the number of MSDs increased (Table 2). Opioid and non-opioid analgesic use among workers with two or more MSDs was twice (2.15 and 1.97 times, respectively) that of workers with one MSD. Persistent prescription opioid use among those with two or more MSDs was about 21.5 times that of workers without MSDs (12.9% vs 0.6%). Moreover, workers with MSD injuries were more likely to use opioid analgesics, while non-opioid analgesic use was most common among those with MSD diseases. Prescription analgesic uses, including opioids and non-opioids by detailed types of MSDs are included in Supplemental Table S2, http://links.lww.com/JOM/A806.

While prescription analgesic use (eg, overall, opioid, non-opioid) was higher among workers with MSDs and the prevalence of MSDs increased with age, the combined effect of MSDs and work-related injuries resulted in an even greater increase in prescription opioid use among workers in all age groups (Fig. 1). The compounded effect of work-related injuries and MSDs was especially strong for younger construction workers. Of workers who experienced both MSDs and injuries, the youngest (16 to 24 years) had the sharpest increase in prescription opioid use. Data behind the figure are included in Supplemental Table S3, http://links.lww.com/JOM/A806.

Pearson correlation coefficients among selected variables are displayed in Supplemental Table S4, http://links.lww.com/JOM/A806. Positive correlations were found between MSDs and all types of analgesic use, including opioid analgesic ($r = 0.26$), persistent opioid analgesic ($r = 0.17$), non-opioid analgesic ($r = 0.30$), and any analgesic ($r = 0.35$; Supplemental Table S4, http://links.lww.com/JOM/A806). Work-related injury ($r = 0.29$) and age ($r = 0.18$) showed positive correlations with both MSD status and all types of analgesic use. Other variables with positive but weaker correlations with either MSDs or analgesic use include self-employment and gender (ie, being a woman). Variables having negative correlations included ethnicity (ie, being Hispanic), occupation (ie, being blue-collar), and hours worked per week.

Table 3 summarizes unadjusted and adjusted ORs and their 95% CIs for prescription analgesic use between construction workers with and without MSDs. (Detailed regression results are reported in Supplemental Tables S5a, S5b, and S5c, http://links.lww.com/JOM/A806). Workers with any MSDs were over 3 times as likely to use prescription opioids only (aOR = 3.28, 95% CI: 2.44 to 4.41), and nearly 13 times as likely to use both prescription opioid and non-opioid analgesics (aOR = 12.69, 95% CI: 7.34 to 21.92) as those without MSDs. Among prescription opioid users, the odds of persistent opioid use for those with MSDs was twice that of workers without MSDs (aOR = 2.34, 95% CI: 1.23 to 4.46). Moreover, workers with MSD injuries were over 4 times more likely to use prescription opioids than those without MSDs (aOR = 4.36, 95%

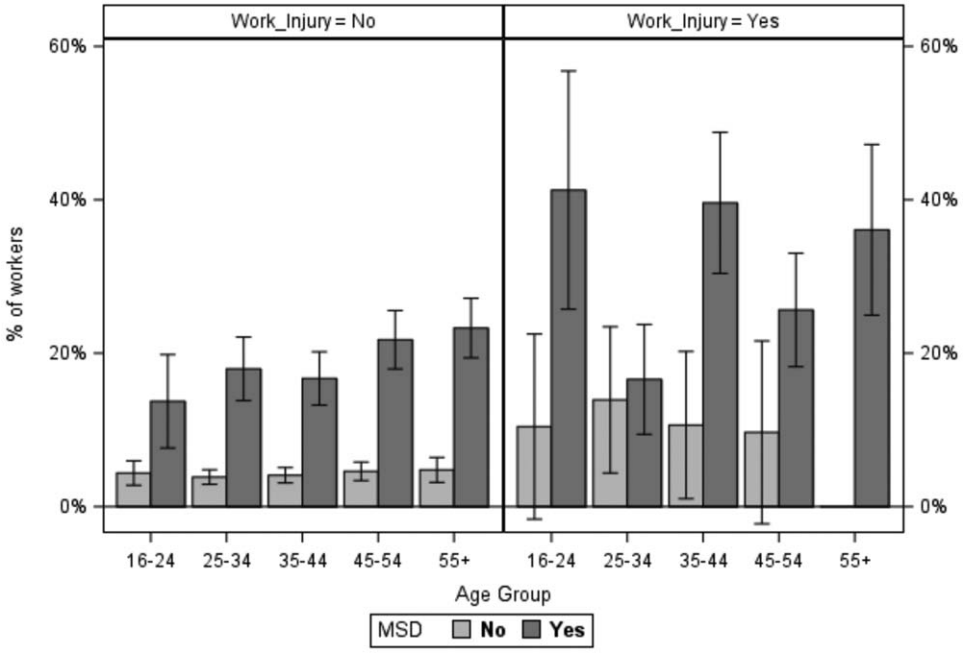

FIGURE 1. Prescription opioid use among construction workers with MSD and work-related injury, by age.

CI: 3.06 to 6.22), whereas workers with MSD diseases were over 4 times more likely to use prescription non-opioids than those without MSDs (aOR = 4.33, 95% CI: 3.04 to 6.17). These differences were statistically significant after demographics and employment factors were controlled.

DISCUSSION

Summary of Results

This study examined two important issues in construction: musculoskeletal disorders (MSDs) and prescription opioid use by analyzing data from a large population survey over 7 years. The results show that MSDs were common among construction workers, and more than one-third of construction workers reported at least one type of MSD. This number is significantly higher than the number recorded in the BLS data,[26] suggesting the burden of MSDs in construction could be underestimated even though the two data sources may not be directly comparable. Both opioid and non-opioid analgesic uses were significantly higher among workers with any type of MSDs. Compared to workers without MSDs, prescription opioid use tripled among workers with any MSDs, and was four times higher among those with MSD injuries. Such differences remained statistically significant when demographic, employment, and other possible confounders were controlled.

MSDs and Age

The results reveal that MSDs were more prevalent among older construction workers, which was consistent with existing studies.[24,27,28] Older construction workers more likely to report chronic conditions than workers in other industries.[28,29,45] MSDs

TABLE 3. Unadjusted and Adjusted Odds Ratios (ORs) for Prescription Analgesic Use Among Construction Workers by Status of Musculoskeletal Disorders (MSDs)

MSD Status	OR*	95% CI		aOR†	95% CI	
Disease or injury						
Prescription opioid only	4.81	3.60	6.41	3.28	2.44	4.41
Prescription non-opioid only	6.68	4.88	9.15	4.85	3.30	7.12
Prescription opioid and non-opioid	18.77	11.50	30.64	12.69	7.34	21.92
Persistent opioid use (vs non persistent use)	2.91	1.69	5.00	2.34	1.23	4.46
Disease only						
Prescription opioid only	3.67	2.75	4.90	2.49	1.84	3.36
Prescription non-opioid only	6.22	4.61	8.40	4.33	3.04	6.17
Prescription opioid and non-opioid	8.49	5.79	12.46	5.71	3.67	8.87
Injury only						
Prescription opioid only	5.18	3.71	7.22	4.36	3.06	6.22
Prescription non-opioid only	2.28	1.60	3.23	2.02	1.23	3.31
Prescription opioid and non-opioid	6.75	4.52	10.06	4.89	3.07	7.77

95% CI, 95% confidence interval; aOR, Adjusted odds ratio.

*Multinomial logistic regression reference category = "No any prescription analgesics" (except for persistent opioid use).

†The following variables were adjusted: age, gender, race/ethnicity, education, region, average hours worked per week, worker type (wage-and-salary or self-employed), insurance coverage, and general perceived physical and mental health, and work-related injury.

were also higher among self-employed construction workers and those with poorer physical and mental health. Age could be a confounder in these results since on average wage-and-salary workers are much younger than self-employed workers, and usually older workers are more likely to have poorer health compared to younger workers.[46] The study also suggests that the prevalence of MSDs was higher among workers who worked less hours per week, indicating MSDs may reduce the workability of construction workers.[31]

Given the increasingly aging workforce trends and skill shortages in construction,[29] the MSD hazards and the higher physical strain for older construction workers require action to promote a sustainable workforce. Potential solutions include pairing experienced older workers as ''walking supervisors'' for younger workers who are typically less experienced but have a higher physical functional capacity.[29] In addition, appropriate work adjustments and re-training should be available for older construction workers.

MSDs and Prescription Opioid Use

The findings suggest a strong association between MSDs and prescription opioid use among construction workers after controlling for key potential confounders. Prescription opioid use was considerably more common than non-opioid analgesic prescriptions among workers with an MSD injury, and about one-third of such MSD injuries were work-related. While MSDs increase with age, the compounded effect of work-related injuries on prescription opioid use was stronger for younger construction workers. These finding confirm previous studies positing that prevalent opioid use in construction is due to high risk of injury in this industry.[11,15,16] Injuries in construction are also more likely to be severe.[25] Previous research found that construction workers who experienced work-related injuries were more likely to use prescription opioids than workers without injuries.[43] Similarly, prescription opioid use was higher among workers with MSD injuries in this study.

Pain Management and Ergonomic Solutions

This study indicates that workers with MSD diseases tended to use non-opioid analgesics. This could be that the pain for such diseases was not as strong as the pain from acute MSD injuries (or the long-term opioid prescriptions were restricted according to CDC guidelines).[32,47] Research suggests that non-opioid alternatives for pain management may be preferable to avoid adverse health outcomes from opioid treatment. One systematic overview of 146 studies found that exercise therapy (strong evidence) and psychosocial therapy (moderate evidence) help alleviate musculoskeletal pain and increase function with a medium-to-large effect, compared to only a modest, short-term effect of opioid prescriptions on musculoskeletal pain relief.[48] Non-opioid pharmacologic treatment has also been found to effectively treat MSDs, such as lower back pain,[49] the most common musculoskeletal symptom among construction workers.[50] Further research is needed to specify the best practices regarding pain management alternatives, including dose optimization.[48]

In addition to pain management, reducing MSD hazards and overall work-related injuries is essential to improve worker health and lower prescription opioid use. Studies have proven practical and effective ergonomic solutions for specific construction tasks.[51,52] OSHA, NIOSH, and CPWR have provided guidance regarding ergonomic programs.[53–57] Moreover, workplace wellness interventions have successfully reduced MSDs. For example, one study found that soft skill training for construction apprentices to vocalize unsafe work environments can improve ergonomic practices.[58] Resistance strength training, worksite stretching practices, and weight management programs have also been shown to prevent and manage MSD symptoms.[52,59,60]

Strengths and Limitations

This is the first study, to the authors' knowledge, to examine the combined burden of MSDs and prescription opioid use among construction workers using a large national household survey. The findings provide an alternative view to the existing literature, incorporating information from a data source beyond workers' compensation data or BLS data. However, the study's limitations should be noted to promote full understanding. First, the study only assessed outpatient prescription opioid use; how illicitly manufactured/obtained opioids are used for MSD treatment remains unknown. Illicit opioids are responsible for most overdose deaths[1,20] and are commonly used by construction workers.[12,15] Further research on the relationship between MSDs and illicit opioid use in construction is needed to fully understand the problem scope. Second, this study did not provide information on detailed construction occupations since the sample sizes by occupation were too small for reliable estimates even when pooling seven years of data together. Third, while the MEPS is a panel survey over a two-year period, the study design is cross-sectional even though the person-time concept was applied in the tabulations. As a result, the relationship between MSDs and job exposures, and the effects of opioid use on MSDs are not fully explored.

CONCLUSION

More than one-third of construction workers had at least one MSD symptom, and the prevalence of MSDs increased with age. Compared to those without MSDs, prescription opioid use tripled among construction workers with any types of MSDs, and quadrupled among those with MSD injuries. These differences remained statistically significant after controlling for potential confounders. To reduce the combined burden, it is essential to reduce MSD hazards at construction sites, and support workers in injury recovery with effective pain management. Further study examining illicit opioid use for MSD treatment is also needed to improve the understanding of the overall opioid crisis in construction.

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