HHS Public Access

Author manuscript

J Occup Environ Med. Author manuscript; available in PMC 2019 April 01.

Published in final edited form as:

J Occup Environ Med. 2018 April ; 60(4): e159–e165. doi:10.1097/JOM.0000000000001267.

Physical Exposures, Work Tasks and OSHA-10 Training among Temporary and Payroll Construction Workers

Alberto J. Caban-Martinez, DO, PhD, MPH[1], **Katerina M. Santiago, MPH**[1], **Jordan Stillman, MS**[1], **Kevin J. Moore, BA**[1], **Danielle Sierra, BS**[1], **Juanita Chalmers, MPH**[2], **Melissa Baniak, BS**[2], and **Melissa M. Jordan, MS**[2]

[1]Division of Environment and Public Health, Department of Public Health Sciences, University of Miami, Miller School of Medicine, Miami, FL USA

[2]Occupational Health and Safety Program, Florida Department of Health, Tallahassee, FL USA

Abstract

Objective—We characterize and compare the self-reported physical exposures, work tasks, and OSHA-10 training in a non-probabilistic sample of temporary and payroll construction workers.

Methods—In June 2016, a total of 250 payroll and temporary general laborers employed at Florida construction sites completed a survey at the job site as part of the Falls Reported Among Minority Employees (FRAME) study.

Results—Workers employed through temp agencies (57.1%) were significantly more likely to report moving or lifting materials more than 100 pounds than payroll workers (38.5%; $p<0.01$). Temporary construction workers with 10-hour OSHA training (22.2%) spent significantly less time with intense hand use/awkward hand posture than temporary workers without 10-hour OSHA training (46.9%; $p=0.048$).

Conclusions—Temp construction workers with OSHA 10-hour training reported less hazardous physical postures than workers without the same training.

The construction industry uses various standard and nonstandard work arrangements to employ the skilled and general labor workforce at commercial and residential projects.[1,2] At U.S. construction worksites, the standard work arrangement includes an hourly or salaried employee that is on the company payroll to a committed labor need. Conversely, in nonstandard work arrangements, construction firms temporarily hire workers through temp agencies that provide limited job assignments such as site clean-up, demolition, and manual

Corresponding Author: Alberto J. Caban-Martinez, Department of Public Health Sciences, University of Miami, Leonard M. Miller School of Medicine, 1120 N.W. 14th Street, 10th Floor (R-669), Don Soffer Clinical Research Center, Rm 1025, Miami, Florida 33136, Phone: (305) 243-7565 | Fax: (305) 243-3651 | acaban@med.miami.edu.

Institution and Ethics Approval: This study has been approved by the Institutional Review Board, Biomedical Research Section of the Florida Department of Health (IRB Protocol #:160008U13).

Disclosures (Authors): All authors express there is no known conflict of interest in this study or the writing of the manuscript.

Contributions: Ms. Santiago, Ms. Chalmers, and Dr. Caban-Martinez, conceived the study, participated in its design, coordination, performed statistical analyses, and co-drafted the manuscript. Mr. Moore, Mr. Stillman, and Ms. Santiago collected field data, entered study data, assisted in data analysis, and interpretation of study results. Ms. Santiago performed statistical analysis and helped with the manuscript draft. All authors read, revised, and approved the final manuscript.

material moving tasks. Temporary workers are often issued a daily ticket by the temp agency to work for a particular construction firm for the day without any further commitment.[3] General construction contractors and sub-contractors are increasingly using temp agencies to provide general labor at construction job sites to support cost control measures, but possibly at the expense of workplace health and safety regulations.[4] Despite the increased use of temporary construction workers for general labor on job sites, little is known of the physical exposures and work tasks experienced by temporary workers and how their exposures compare to those of workers employed through standard work arrangements.

Injury risk between temporary and payroll workers has been documented across several industries.[5–7] Epidemiologic studies have noted differential health risk between standard workers and those individuals employed in nonstandard work arrangements.[8–11] For example, in the healthcare industry, increased needlestick injuries have been associated with nonstandard work arrangements.[12,13] Musculoskeletal injuries and pain have been associated with increased production lines in the manufacturing industry staffed with temporary workers that often have low skill sets and low decision latitude.[14] Rebitzer et al. showed that temp workers in the petrochemical industry experienced higher rates of injury when working in high-paced maintenance and turnaround procedures.[15] Most recently, Smith et al. examined workers' compensation claims from the State of Washington and found claim rates to be twice as high for temporary workers when compared to those workers employed in standard arrangements.[16]

It is not clear why we see differences in injury rates between temporary and payroll workers. In the construction industry, it may be possible that temporary workers experience more injury risk due to them being assigned more hazardous work tasks or feeling limited in their ability to report non-safe work environments.[17] It may also be possible that temporary workers have been provided with less site- or job-specific training, or not provided adequate personal protective equipment to complete their assigned job task. A recent Cochrane review suggested that there is low-quality evidence that construction firm-oriented safety interventions such as multifaceted safety training may reduce non-fatal injuries among the general construction workforce.[18] To begin understanding differences in injury rates between workers employed in standard and nonstandard work arrangements, it is imperative to characterize their workplace exposures and individual job tasks. It is possible that specific worker or worksite-level training, such as OSHA 10-hour, may influence injuries experienced by workers in non-standard work arrangements. In the present study, we leverage data from the Falls Reported Among Minority Employees (FRAME) pilot study to characterize, compare and examine the association between the self-reported physical exposures, work tasks, and OSHA-10 training in a non-probabilistic sample of temporary and payroll construction workers.

METHODS

Study Description

The results presented in this paper are part of a broader pilot study, Falls Reported Among Minority Employees (FRAME) in Residential Construction, with the primary research goal to inform and to develop a unique fall-related near miss measurement instrument for workers

employed in the construction industry. FRAME used a two-phase sequential exploratory mixed-methods study design to initially develop and validate a survey instrument with the aim of collecting information on injuries and near misses in temporary construction workers. Phase 2 was the administration of the survey instrument to a larger sample of temporary and payroll workers employed at large residential (i.e., condominium) construction sites. In the present paper, we used data collected in phase 2 to compare the work-related physical exposures, work tasks, and OSHA-10 training between temporary and payroll construction workers.

Participant Recruitment, Consent and Survey Administration

In June 2016, we recruited payroll and temporary workers from three large south Florida residential condominium construction worksites to complete the FRAME study survey instrument. Before the start of the workday, the research team, with the permission of the general contractor and job site safety director, spoke to the general labor workforce during their stretch and flex period. This pre-work stretch period is organized by the safety director for the general contractor to encourage the workforce to stretch and flex and set the plans for the workday.[19] Immediately after this period, our research team explained the research study, invited, and then consented interested workers to complete the one-time paper-based questionnaire. Inclusion criteria for this study included workers 18 years of age or older who could speak and write in English or Spanish and were employed at the worksite as general labor through payroll or a temp agency work assignment. Workers who completed the survey instrument were provided with a cash incentive of $10. The workers completed this one-time paper-based anonymous questionnaire during their breakfast (20-minutes) or lunch break period (45-minutes).

Survey Instrument and Study Measures

The FRAME instrument is a 68-item questionnaire organized around seven domains including: participant socio-demographic and work characteristics (24-items), cell phone technology use (4-items), health care access and utilization (2-items), alcohol consumption (3-items), tobacco use (2-items), physical exposures and work tasks (5-items), and injuries and near misses at job site (28-items). In the present analysis, we used survey response items from the socio-demographic, work characteristics and physical exposures and work tasks domains. The measures used in the socio-demographic and work characteristics were obtained from the standard and validated 2010 and 2015 NIOSH-sponsored Occupational Health Supplement questionnaire of the annual National Health Interview Survey conducted by the U.S. National Center for Health Statistics.[20] The survey measures assessing physical exposures and work tasks were adapted and validated with the study target population from Nordstrom and colleagues.[21–23] They have developed measures on 1) hand placement under knee-level, 2) body twisting, 3) neck bending in forward or backward positions, 4) knee bending to pick up an object on floor, 5) arms raising and hand held over shoulder height, and 6) intense hand use or awkward hand posture. The response scale for each of these measures is a four-point non-equidistant ordinal scale based on the duration of daily work time spent performing the work activity, including 1) 0 to 30 minutes, 2) 31 to 60 minutes, 3) 1 to 3 hours, and 4) more than 3 hours. We categorized the response scale items for each physical exposure into either 0 to 3 hours or greater than 3 hours to understand differences

between short-term and long-term (> 3 hours) of exposure. Survey respondents were also asked, “Does your work ever involve moving or lifting work more than 100 pounds (lbs)?” with a yes or no response option. They were also asked “On a 1 to 5 scale, please indicate how physically demanding your job was in the LAST 30 DAYS” with a five-point equidistant ordinal scale based on a score of 1 indicating “not at all physically demanding” and a score of 5 indicating “extremely physically demanding.”

Data Management and Analysis

The paper surveys collected at the construction sites were brought back to the research office and underwent data verification procedures including standardized training of research personnel using a data dictionary and double data entry to maximize the quality and completeness of the survey data. Frequency and descriptive statistics were calculated for all study variables. Characteristics of temporary workers were compared to payroll workers using the independent sample t-test or Mann-Whitney U test (continuously measured characteristics) or Pearson’s Chi-square test or Fisher Exact Chi-Square test for two groups (categorical measures). Univariable and multivariable logistic regression models tested the association between employment arrangement (i.e., temporary or payroll worker) and each of the six work-related physical exposure outcome measures controlling for the potential confounders. We operationalized each of the physical exposures measures as low (i.e., 0 to 3 hours) or high (i.e., > 3 hours) exposures. An alpha level of 0.05 was considered statistically significant. All analyses were conducted using Statistical Package for the Social Sciences (IBM SPSS Statistics for Mac, Version 22.0, Armonk, NY). This study has been approved by the Institutional Review Board of the Florida Department of Health, (IRB Protocol #: 160008U13).

RESULTS

Sample Characteristics

In total, 250 construction workers completed the FRAME survey, 97 (38.8%) of which were employed at the construction site through temp agencies, and 153 (61.2%) were on payroll with the contractor or a subcontractor. The sample was predominately male (97.2%) with a mean worker age of 39.5 years (±11.2 years’ standard deviation), the youngest worker being 18 years old and the oldest being 71 years old (See Table 1). The highest proportion of temporary workers were 30–39 years of age (30.7%), male (93.7%), single/never married (42.5%), white race (54.1%), Hispanic/Latino ethnicity (66.7%), high school diploma/GED (48.8%), overweight (46.9%), between 1 year and less than 5 years working in the construction industry (48.6%), and have completed OSHA-10 training (78.9%). Among workers on company payroll, the highest proportion of workers were 30–39 year olds (30.0%), male (99.3%), married (46.7%), white race (60.7%), Hispanic/Latino (66.4%), high school diploma/GED (51.6%), overweight (46.7%) between 1 year and less than 5 years working in the construction industry (38.2%), and have completed OSHA-10 training (73.7%). Temporary construction workers when compared to payroll workers were significantly more likely to have more females (6.3% vs 0.7%; p-value=0.010), be single or never married (42.5% vs 33.6%; p-value=0.008), have less educational attainment (18.8% with > high school diploma GED vs 30.1%; p-value=0.027), and work less years in the

construction industry (20.0% with < 1 year in construction industry vs 9.7%; p-value=0.022).

Physical Exposures and Work Tasks

We examined for differences in eight self-reported work tasks and six work-related physical exposures between temporary and payroll construction workers (see Table 2). Across the eight work tasks, temporary workers were significantly more likely to report engaging in clean-up activities at the construction site, in comparison to payroll workers (60.0% vs. 34.0%; p-value=0.000). Temporary workers, as compared to payroll, spent less time loading and unloading building materials, machinery, and job tools (55.0% vs. 58.2%; p-value=0.643) and operating heavy equipment (7.5% vs. 9.8%; p-value=0.560) although non-significant. Among the six self-reported physical exposures at the job site completed for ≥ 3 hours per day on average, intense hand use and awkward hand posture (39.5% vs. 30.6%) was most completed while twisting was least used (24.0% vs. 18.5%) by both temporary and payroll workers, respectively. Temporary construction workers were significantly more likely to report their job activities involving moving or lifting more than 100 pounds (57.1% vs. 38.5%; p-value=0.014). When comparing self-reported physical demands of the job in the past 30-days since completing the survey, there were no statistically significant differences in the mean demands reported between temporary and payroll workers (3.13 vs. 3.30; p-value=0.263).

OSHA-10 Training and Physical Exposures

Four work-related physical exposures that were engaged for ≥ 3 hours per day were significantly less reported by workers with OSHA-10 training than workers without OSHA-10 training including (see Figure 1): twisting body (temp workers with and without OSHA-10= 10.0% vs. 28.9%; and payroll workers with and without OSHA-10=13.8% vs. 19.2% respectively; p-value=0.023); neck bending forward/backward (temp = 11.1% vs. 31.7%; and payroll=23.8% vs. 24.2%; p-value=0.034), arms raised and hand held over shoulder height (temp = 0.0% vs. 29.7%; and payroll=20.0% vs. 28.1%; p-value=0.024); and intense hand use or awkward hand posture (Temp = 22.2% vs. 46.9%; and Payroll=28.2% vs. 34.4%; p-value=0.048).

Employment Arrangement and Physical Exposures

In the univariable logistic regression analyses, being a temporary worker was not significantly associated with hands placed under knee-level (un-adjusted odds ratio, UOR =1.23; 95% Confidence Interval, CI, [0.63–2.38]), twisting (UOR=1.39 [0.62–3.13]), worker neck being bent forwards or backwards frequently (UOR=1.13 [0.54–2.38]), knee bending to pick up object on floor (UOR=1.27 [0.62–2.59]), arms raised and hand held over shoulder height (UOR=1.10 [0.51–2.39]), or intense/awkward hand use (UOR=1.48 [0.71–3.08]) relative to payroll workers. In the multivariable model (see Table 3), employment arrangement was significantly associated with high exposure (i.e., greater than 3 hours daily) to twisting movements (Adjusted odds ratio, AOR =3.30; 95% CI [1.08–10.10] while controlling for other sociodemographic and work characteristics. In addition, temporary workers were significantly more likely to report high physical exposures to working with their arms raised and hand held over shoulder height (AOR= 5.03 [1.37–18.51]) as compared

to workers on company payroll. Across all six work-related physical exposure models, workers with OSHA 10-hour training were less likely to report high-levels of those physical exposures relative to payroll workers albeit not significant.

DISCUSSION

Studies of injury control and prevention in the construction industry have previously focused on occupational and non-occupational risk factors including individual physical and mental hazards, job task efforts, multiple jobs, and long working hours.[9,24–26] In the present study, we speculated that the type of work arrangement (i.e., temporary or payroll) in the general labor workforce could be associated with individual work-related physical exposures, work tasks, and OSHA training. Using a convenience sample of general laborers employed across three large South Florida construction sites, we found temporary workers employed as general laborers self-report similar physical exposures and job tasks as general labors listed on the construction firm payroll. We identified differences in socio-demographic and work characteristics between the two groups, including differences in physical exposures by OSHA training.

To our knowledge, no previous studies have examined physical exposures, work tasks, and OSHA-10 training by work arrangement in the construction industry. A few studies have documented trends in the use of temporary workers at construction sites in the U.S. and abroad, but none have examined self-reported exposures experienced directly by temporary workers that could inform the disparities in injury rates.[4,27–29] A study conducted in Atlanta, GA, that included building contractors, temporary staffing agencies, and temp workers documented that contractors place agency-supplied temp workers in hazardous working conditions.[4] The interviewed temp workers described workplace hazards with scaffold construction, harmful substances, electrical hazards, insufficient training, unsafe co-worker behavior, hand and power tools use, and falling objects. Some of these hazards directly relate to the physical exposures and work tasks documented in this pilot study. For example, the proportion of temp general labor workers engaging in demolition, worksite clean-up, and disposing of site waste was higher than for those general labors on payroll. These findings support the observation noted by Mehta et al. that even co-workers in the same labor force (general labor) treat temp workers differently regarding the job tasks.[4]

We documented that temporary construction workers were significantly more likely to report their job activities involving moving or lifting more than 100 pounds at the construction worksite. A study by Smith et al., using Washington State claim data, found that temporary agency employed construction workers had higher medical and compensable claims for upper and lower extremity musculoskeletal disorders than those construction workers in standard forms of employment.[16] Similarly, Foley who interviewed 460 workers with time-loss workers compensation claims filed in Washington state documented substantially higher claims rates and less training for temporary workers than for permanent employees. [29] Lifting heavy materials, particularly without proper ergonomic equipment or lifting training, can lead to both acute and chronic musculoskeletal disorders.[30,31] We speculate based on findings from Mehta and this pilot data that given the loose work arrangements with

temporary workers, their day supervisors and/or co-workers may delegate more hazardous work conditions such as high loads of manual materials handling.

Differences in socio-demographic and work characteristics were noted between temporary and payroll workers. The construction industry is traditionally a male-dominated industry, however, in this pilot we found female gender was more represented in the temp workers than the payroll workers. This observation is consistent with analysis from the U.S. National Bureau of Economic Research where they documented that from 2005 to 2015 the percentage of women employed in an alternative work (i.e., temp worker) arrangements had increased from 8.9% to 17.0% during the study period.[2] We also noted differences between the two types of work arrangements regarding marital status, educational attainment, and years in the construction industry. The percentage of workers who self-identified as single/never married and with less than a high school diploma was significantly greater in the temp workers than payroll. Temp workers often have complicated work and personal histories, such as low skills training, limited and scant work history, and criminal backgrounds, which minimize standard employment opportunities.[32] We also found that temp workers had fewer years in the construction industry (< 5 years) as compared to those on company payroll who had > 10 years in construction. Greater tenure in the construction industry may provide valuable experience in safety as compared to workers who bounce between job sites and receive limited training.

The level of OSHA training was associated with differences in the engagement of specific physical exposures lasting ≥ 3 hours per day on average between temporary and payroll workers. We found that in general, the proportion of workers engaging in high risk physical exposures at work was less among the construction workers with OSHA 10-hour training when compared to workers without the same training. This relationship held true when we stratified the sample by type of work arrangement. For example, we found that temporary workers with OSHA 10-hour training participated in significantly less body twisting, neck forward/back bending, raising arms about shoulder higher, and intense hand use than temporary workers without the OSHA-10 training. In multivariable modeling, we found for all six work-related physical exposures that construction workers report fewer high physical exposures (i.e., lasting greater than 3 hours per day) among those who completed the OSHA 10-hour training relative to those who did not undertake the training, albeit not significantly likely due to our small sample size. Nonetheless, this pilot data suggests that OSHA 10-hour training may reduce the level of physical exposures encountered by the temp worker. Wilkins (2011) found that strong occupational health and safety training programs such as OSHA 10-hour training improve compliance with health and safety requirements.[33] It could be that OSHA 10-hour training reminds workers about limiting or using ergonomic solutions when working on repetitive work tasks at the job site.

Limitations/Strengths

This study is not without limitations. We used self-reported measures of physical exposure and work tasks among the construction workers. It is possible that workers were unaware if a specific job task they completed or workplace exposure encountered matches the tasks or exposure presented in the survey instrument and thus the rate of exposures or job tasks might

have been underestimated. However, self-reported job tasks and physical exposures have been validated in several studies.[21–23,34] We did not assess the period in which the OSHA 10-hour training was completed. Despite both worker groups (i.e., temp vs payroll) having a similar proportion of workers with OSHA 10-hour training (78.9% vs 73.7%, respectively), it may be possible that temporary workers recently completed training as compared to the payroll workers given their differences in job tenure length. We also had a relatively small sample of temporary workers yielding large confidence intervals in our regression models. Occupational researchers should consider replicating study findings using a large sample of construction workers. Nonetheless, this pilot has several strengths, including a focus on standard and nonstandard work arrangements among general laborers in the construction industry. This is the first study to document self-reported physical exposures and work tasks in this growing temporary construction labor workforce. This study also highlights the association of OSHA 10-hour training on worker self-reported tasks and occupational exposures.

Conclusions

We identified differences in self-reported physical exposures and work tasks by type of work arrangement in a sample of general construction laborers. Workers employed through temp agencies spent less time loading and unloading building materials, machinery, and job tools and operating heavy equipment while spending more time performing site clean-up as compared to payroll workers. Differential work-related exposures due to specific work task may lead to different injury risk between the two types of workers. We also found that workers with OSHA 10-hour training engaged in less duration of hazardous physical postures while at the worksite compared to workers without the same training. Further studies are needed to clarify how OSHA 10-hour training impacts the physical exposures and work tasks encountered by temporary workers.

Acknowledgments

Funding: The State-Based Occupational Health and Safety Surveillance program in Florida Grant 1U60OH010900 from the National Institute for Occupational Safety and Health (NIOSH)

The authors would like to acknowledge Philip P. Cavicchia, Ph.D. for his efforts and contributions to the study design.

References

1. Howard J. Nonstandard work arrangements and worker health and safety. American journal of industrial medicine. 2017; 60(1):1–10. [PubMed: 27779787]
2. Katz, LF., Krueger, AB. The rise and nature of alternative work arrangements in the United States, 1995–2015. National Bureau of Economic Research; 2016.
3. Underhill E, Quinlan M. How precarious employment affects health and safety at work: the case of temporary agency workers. Relations Industrielles/Industrial Relations. 2011; 66(3):397–421.
4. Mehta C, Theodore N. Workplace safety in Atlanta's construction industry: Institutional failure in temporary staffing arrangements. Journal of Labor and Society. 2006; 9(1):59–77.
5. Foley M, Ruser J, Shor G, Shuford H, Sygnatur E. Contingent workers: Workers' compensation data analysis strategies and limitations. American journal of industrial medicine. 2014; 57(7):764–775. [PubMed: 24464742]

6. Ellen M, Lippel K, Ron S, et al. Workers' compensation experience-rating rules and the danger to workers' safety in the temporary work agency sector. Policy and Practice in Health and Safety. 2012; 10(1):77–95.
7. Hopkins B. Explaining variations in absence rates: temporary and agency workers in the food manufacturing sector. Human Resource Management Journal. 2014; 24(2):227–240.
8. Biggs D, Burchell B, Millmore M. The changing world of the temporary worker: the potential HR impact of legislation. Personnel Review. 2006; 35(2):191–206.
9. Landsbergis PA, Grzywacz JG, LaMontagne AD. Work organization, job insecurity, and occupational health disparities. American journal of industrial medicine. 2014; 57(5):495–515. [PubMed: 23074099]
10. Kim I-H, Muntaner C, Khang Y-H, Paek D, Cho S-I. The relationship between nonstandard working and mental health in a representative sample of the South Korean population. Social science & medicine. 2006; 63(3):566–574. [PubMed: 16580108]
11. Virtanen M, Kivimäki M, Joensuu M, Virtanen P, Elovainio M, Vahtera J. Temporary employment and health: a review. International journal of epidemiology. 2005; 34(3):610–622. [PubMed: 15737968]
12. De Castro A, Fujishiro K, Rue T, Tagalog E, Samaco-Paquiz L, Gee G. Associations between work schedule characteristics and occupational injury and illness. International nursing review. 2010; 57(2):188–194. [PubMed: 20579153]
13. Jeanne Geiger Brown R PhD, Kenneth Rempher R MS, Kathleen McPhaul R PhD, Barbara Brady R MS, Jane Lipscomb R PhD. Nurses' inclination to report work-related injuries: Organizational, work-group, and individual factors associated with reporting. Workplace Health & Safety. 2005; 53(5):213.
14. Morris JA. Injury experience of temporary workers in a manufacturing setting: factors that increase vulnerability. AAOHN journal. 1999; 47(10):470–478. [PubMed: 10818827]
15. Rebitzer JB. Job safety and contract workers in the petrochemical industry. Industrial Relations: A Journal of Economy and Society. 1995; 34(1):40–57.
16. Smith CK, Silverstein BA, Bonauto DK, Adams D, Fan ZJ. Temporary workers in Washington state. American journal of industrial medicine. 2010; 53(2):135–145. [PubMed: 19618410]
17. Burkhart G, Schulte PA, Robinson C, Sieber WK, Vossenas P, Ringen K. Job tasks, potential exposures, and health risks of laborers employed in the construction industry. American journal of industrial medicine. 1993; 24(4):413–425. [PubMed: 8250061]
18. van der Molen HF, Lehtola MM, Lappalainen J, et al. Interventions to prevent injuries in construction workers. Cochrane Database of Systematic Reviews. 2012; (12)
19. Goldenhar LM, Stafford P. If you've seen one construction worksite stretch and flex program… you've seen one construction worksite stretch and flex program. Journal of safety research. 2015; 55:73–79. [PubMed: 26683549]
20. Luckhaupt SE, Calvert GM. Work-relatedness of selected chronic medical conditions and workers' compensation utilization: National health interview survey occupational health supplement data. American journal of industrial medicine. 2010; 53(12):1252–1263. [PubMed: 20721967]
21. Nordstrom DL, Vierkant RA, Layde PM, Smith MJ. Comparison of self-reported and expert-observed physical activities at work in a general population. American journal of industrial medicine. 1998; 34(1):29–35. [PubMed: 9617385]
22. Nordstrom DL, Vierkant RA, DeStefano F, Layde PM. Risk factors for carpal tunnel syndrome in a general population. Occupational and environmental medicine. 1997; 54(10):734–740. [PubMed: 9404321]
23. Nordstrom, DL. A population-based, case control study of carpal tunnel syndrome. 1997.
24. Sunindijo RY, Kamardeen I. Work stress is a threat to gender diversity in the construction industry. Journal of Construction Engineering and Management. 2017; 143(10):04017073.
25. Hu K, Rahmandad H, Smith-Jackson T, Winchester W. Factors influencing the risk of falls in the construction industry: a review of the evidence. Construction Management and Economics. 2011; 29(4):397–416.
26. Larsson S, Pousette A, Törner M. Psychological climate and safety in the construction industry-mediated influence on safety behaviour. Safety Science. 2008; 46(3):405–412.

27. Quinlan M, Mayhew C, Bohle P. The global expansion of precarious employment, work disorganization, and consequences for occupational health: a review of recent research. International journal of health services. 2001; 31(2):335–414. [PubMed: 11407174]

28. Amuedo-Dorantes C. Work transitions into and out of involuntary temporary employment in a segmented market: evidence from Spain. ILR Review. 2000; 53(2):309–325.

29. Foley M. Factors underlying observed injury rate differences between temporary workers and permanent peers. American journal of industrial medicine. 2017; 60(10):841–851. [PubMed: 28869311]

30. Punnett L, Wegman DH. Work-related musculoskeletal disorders: the epidemiologic evidence and the debate. Journal of electromyography and kinesiology. 2004; 14(1):13–23. [PubMed: 14759746]

31. Yeung SS, Genaidy A, Deddens J, Alhemood A, Leung P. Prevalence of musculoskeletal symptoms in single and multiple body regions and effects of perceived risk of injury among manual handling workers. Spine. 2002; 27(19):2166–2172. [PubMed: 12394933]

32. Doleac, JL., Hansen, B. Does “ban the box” help or hurt low-skilled workers? Statistical discrimination and employment outcomes when criminal histories are hidden. National Bureau of Economic Research; 2016.

33. Wilkins JR. Construction workers’ perceptions of health and safety training programmes. Construction Management and Economics. 2011; 29(10):1017–1026.

34. Dale AM, Strickland J, Gardner B, Symanzik J, Evanoff BA. Assessing agreement of self-reported and observed physical exposures of the upper extremity. International journal of occupational and environmental health. 2010; 16(1):1–10. [PubMed: 20166314]

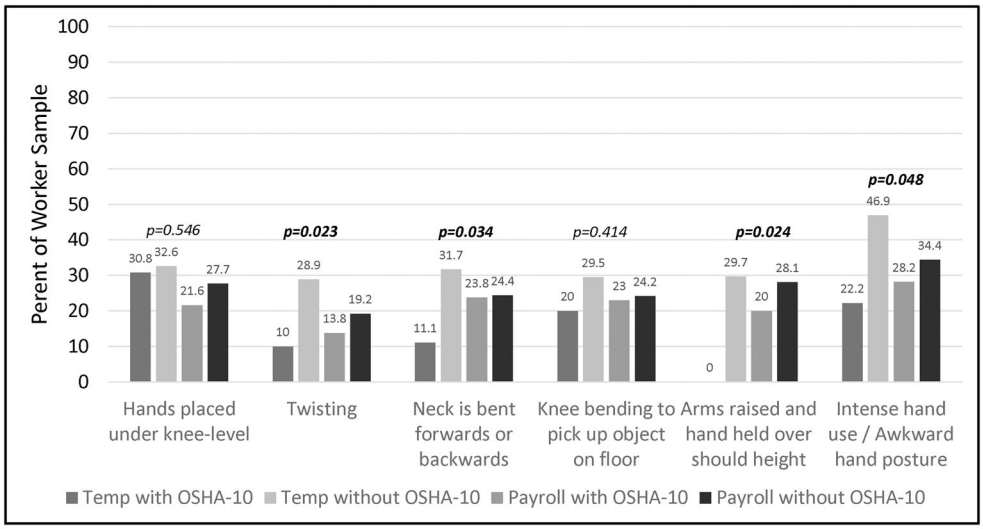

Figure 1.

Proportion of construction workers engaged in varied physical exposure postures (≥ 3 hours per day on average) stratified by work arrangement and OSHA-10 training

Table 1

Socio-demographic and Work Characteristics among Temporary and Payroll Construction Workers Stratified by Work-Arrangement Participating in the Fall Reported among Minority Employees (FRAME) Construction study (n=250 workers)

Characteristics	Total Sample† n (%)	Temporary n (%)	Payroll n (%)	p-value
Age				
18–24 year olds	22 (9.8)	14 (18.7)	8 (5.3)	
25–29 year olds	28 (12.4)	7 (9.3)	21 (14.0)	
30–39 year olds	68 (30.2)	23 (30.7)	45 (30.0)	**0.040**
40–49 year olds	58 (25.8)	17 (22.7)	41 (27.3)	
50–59 year olds	42 (18.7)	11 (14.7)	31 (20.7)	
60 years and older	7 (3.1)	3 (4.0)	4 (2.7)	
Gender				
Male	239 (97.2)	74 (93.7)	150 (99.3)	**0.010**
Female	7 (2.8)	5 (6.3)	1 (0.7)	
Marital Status				
Married	99 (39.8)	21 (26.3)	71 (46.7)	**0.008**
Divorced, Widowed, Separated	58 (23.3)	25 (31.3)	30 (19.7)	
Single/Never Married	92 (36.9)	34 (42.5)	51 (33.6)	
Race				
White	130 (57.8)	40 (54.1)	82 (60.7)	0.612
Black	80 (35.6)	28 (37.8)	45 (33.3)	
Other	15 (6.7)	6 (8.1)	8 (5.9)	
Ethnicity				
Hispanic\Latino	161 (66.0)	52 (66.7)	99 (66.4)	0.973
Non-Hispanic\Latino	83 (33.2)	26 (33.3)	50 (33.6)	
Educational Attainment				
< High School	58 (23.3)	26 (32.5)	28 (18.3)	**0.027**
High School Diploma/GED	124 (49.8)	39 (48.8)	79 (51.6)	
> High School	67 (26.9)	15 (18.8)	46 (30.1)	
Body Mass Index (BMI, lb/in^2)				
Normal Weight (18.5–24.9)	68 (34.2)	26 (40.6)	42 (31.1)	0.192
Overweight (25–29.9)	93 (46.7)	30 (46.9)	63 (46.7)	
Obesity (≥30.0)	38 (19.1)	8 (12.5)	30 (22.2)	
Years in Construction				
< 1 year	30 (13.3)	14 (20.0)	14 (9.7)	
1 year to < 5 years	95 (42.2)	34 (48.6)	55 (38.2)	**0.022**
5 years to < 10 years	27 (12.0)	5 (7.1)	21 (14.6)	
>= 10 years	73 (32.4)	17 (24.3)	54 (37.5)	

Characteristics	Total Sample† n (%)	Temporary n (%)	Payroll n (%)	p-value
OSHA-10 Training				
Yes	179 (73.7)	60 (78.9)	112 (73.7)	0.384
No	64 (26.3)	16 (21.1)	40 (26.3)	

†Differences in sub-total population sample due to item non-response or missing.

Table 2

Self-reported Work Tasks and Physical Exposures among Construction workers participating in the Fall Reported among Minority Employees (FRAME) Construction study (n=250 workers)

Work Tasks & Physical Exposures	Total Sample† n (%)	Temporary n (%)	Payroll n (%)	p-value
Work Tasks				
Load/unload building materials, machinery, & tools				
Yes	133 (57.1)	44 (55.0)	89 (58.2)	0.643
No	100 (42.9)	36 (45.0)	64 (41.8)	
Clean up construction site				
Yes	100 (42.9)	48 (60.0)	52 (34.0)	**0.000**
No	133 (57.1)	32 (40.0)	101 (66.0)	
Install barricades				
Yes	34 (14.6)	13 (16.3)	21 (13.7)	0.604
No	199 (85.4)	67 (83.8)	132 (86.3)	
Demolition				
Yes	48 (20.6)	21 (26.3)	27 (17.6)	0.123
No	185 (79.4)	59 (73.8)	126 (82.4)	
Provide Assistance				
Yes	26 (11.2)	9 (11.3)	17 (11.1)	0.974
No	207 (88.8)	71 (88.8)	136 (88.9)	
Operate heavy equipment				
Yes	21 (9.0)	6 (7.5)	15 (9.8)	0.560
No	212 (91.0)	74 (92.5)	138 (90.2)	
Assist in concrete or asphalt installations				
Yes	30 (12.9)	11 (13.8)	19 (12.4)	0.773
No	203 (87.1)	69 (86.3)	69 (86.3)	
Disposing Waste				
Yes	66 (28.3)	27 (33.8)	39 (25.5)	0.184
No	167 (71.7)	53 (66.3)	114 (74.5)	
Physical Exposures				

Work Tasks & Physical Exposures	Total Sample[†] n (%)	Temporary n (%)	Payroll n (%)	p-value
Hands placed under knee-level				
0 to 3 hours	140 (72.2)	43 (69.4)	97 (73.5)	0.549
> 3 hours	54 (27.8)	19 (30.6)	35 (26.5)	
Twisting				
0 to 3 hours	126 (79.7)	38 (76.0)	88 (81.5)	0.425
> 3 hours	32 (20.3)	12 (24.0)	20 (18.5)	
Neck is bent forwards or backwards				
0 to 3 hours	127 (74.7)	38 (73.1)	89 (75.4)	0.746
> 3 hours	43 (25.3)	14 (26.9)	29 (24.6)	
Knee bending to pick up object on floor				
0 to 3 hours	132 (74.6)	40 (71.4)	92 (76.0)	0.513
> 3 hours	45 (25.4)	16 (28.6)	29 (24.0)	
Arms raised and hand held over shoulder height				
0 to 3 hours	132 (76.7)	37 (75.5)	95 (77.2)	0.809
> 3 hours	40 (23.3)	12 (24.5)	28 (22.8)	
Intense hand use/Awkward hand posture				
0 to 3 hours	103 (66.9)	26 (60.5)	77 (69.4)	0.292
> 3 hours	51 (33.1)	17 (39.5)	34 (30.6)	

[†]Differences in sub-total population sample due to item non-response or missing.

Table 3

Univariable and Multivariable Logistic Regression on Five Physical Exposures among Temporary and Payroll Construction Workers: Evidence from the Falls Reported Among Minority Employees (FRAME) in Residential Construction

	Hands placed under knee-level		Twisting		Neck is bent forwards or backwards		Knee bending to pick up object on floor		Arms raised and hand held over shoulder height		Intense hand use/ Awkward hand posture	
Characteristics	**UOR**	**AOR [95%CI]**	**UOR**	**AOR [95%CI]**	**UOR**	**AOR [95%CI]**	**UOR**	**AOR [95%CI]**	**UOR**	**AOR [95%CI]**	**UOR**	**AOR [95%CI]**
Employment Type												
Payroll	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Temporary	1.23	1.82 [0.71–4.63]	1.39	**3.30 [1.08–10.10]**	1.13	2.68 [0.87–8.20]	1.27	1.10 [0.42–2.89]	1.10	**5.03 [1.37–18.51]**	1.48	1.63 [0.54–4.91]
OSHA-10 Training												
No		1.00		1.00		1.00		1.00		1.00		1.00
Yes		0.57 [0.20–1.70]		0.57 [0.15–2.15]		0.60 [0.17–2.08]		0.88 [0.31–2.56]		0.92 [0.27–3.15]		0.62 [0.21–1.84]
Age												
Continuous Age		1.00 [0.95–1.04]		1.01 [0.95–1.06]		1.00 [0.94–1.06]		0.99 [0.94–1.04]		1.03 [0.96–1.09]		1.01 [0.96–1.06]
Race												
White		1.00		1.00		1.00		1.00		1.00		1.00
Black		1.02 [0.41–2.52]		0.90 [0.30–2.66]		1.08 [0.35–3.32]		1.58 [0.63–3.95]		2.58 [0.79–8.48]		1.03 [0.41–2.60]
Other		3.97 [0.69–33.13]		0.84 [0.11–9.14]		4.41 [0.54–35.91]		0.86 [0.09–8.76]		9.56 [1.45–63.18]		0.55 [0.09–3.32]
Educational Attainment												
< High School		1.00		1.00		1.00		1.00		1.00		1.00
High School Diploma		1.19 [0.41–3.50]		0.93 [0.25–3.50]		1.69 [0.41–7.02]		0.51 [0.17–1.48]		3.11 [0.58–16.60]		0.94 [0.28–3.18]
> High School		0.42 [0.10–1.82]		0.41 [0.07–2.23]		0.97 [0.18–5.38]		0.31 [0.08–1.22]		4.34 [0.61–30.89]		1.75 [0.43–7.05]
Marital Status												
Married		1.00		1.00		1.00		1.00		1.00		1.00
Divorced, Widowed, Separated		1.26 [0.38–4.20]		0.58 [0.13–2.55]		0.23 [0.05–1.11]		0.81 [0.24–2.75]		0.59 [0.15–2.37]		2.03 [0.63–6.51]
Single/Never Married		0.82 [0.26–2.55]		0.58 [0.15–2.29]		0.63 [0.18–2.18]		1.08 [0.34–3.41]		0.62 [0.16–2.42]		1.81 [0.57–5.69]
Body Mass Index (BMI, lb/in2)												
Normal Weight (18.5–24.9)		1.00		1.00		1.00		1.00		1.00		1.00
Overweight (25–29.9)		0.65 [0.24–1.75]		0.62 [0.20–1.93]		1.84 [0.58–5.86]		0.84 [0.30–2.33]		1.58 [0.46–5.38]		1.70 [0.61–4.78]
Obesity (≥30.0)		1.38 [0.40–4.72]		0.80 [0.18–3.49]		1.98 [0.65–7.11]		1.39 [0.42–4.6]		1.81 [0.39–8.33]		1.83 [0.52–6.43]

Characteristics	Hands placed under knee-level		Twisting		Neck is bent forwards or backwards		Knee bending to pick up object on floor		Arms raised and hand held over shoulder height		Intense hand use/ Awkward hand posture	
	UOR	AOR [95%CI]	UOR	AOR [95%CI]	UOR	AOR [95%CI]	UOR	AOR [95%CI]	UOR	AOR [95%CI]	UOR	AOR [95%CI]
Years in Construction												
< 1 year		1.00		1.00		1.00		1.00		1.00		1.00
1 year to < 5years		0.41 [0.12–1.34]		1.19 [0.25–5.61]		1.12 [0.23–5.53]		0.99 [0.27–3.57]		1.13 [0.17–4.98]		2.11 [0.42–10.63]
5 years to < 10 years		0.37 [0.06–2.48]		1.29 [0.09–18.30]		0.40 [0.03–5.43]		0.34 [0.03–4.13]		1.24 [0.18–16.87]		1.75 [0.21–14.37]
>=10 years		0.77 [0.20–3.01]		2.23 [0.37–13.38]		1.21 [0.19–7.62]		0.92 [0.21–4.09]		1.98 [0.56–14.22]		3.27 [0.48–22.23]

UOR= Unadjusted odds ratio, the 95% confidence interval, CI, is shown in the results section due to lack of space in table.

AOR = Adjusted odds ratio, its 95% CI is shown in this table.