Published in final edited form as:

Arch Environ Occup Health. 2016 November ; 71(6): 309–316. doi:10.1080/19338244.2015.1100104.

Musculoskeletal Pain, Depression and Stress among Latino Manual Laborers in North Carolina

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Abstract

The jobs of Latino manual laborers place their mental and physical health at risk. This study evaluates the associations among musculoskeletal pain, mental health, and work organization in Latino manual laborers. Farmworkers and non-farmworkers (n=189) in North Carolina were interviewed for self-reported musculoskeletal pain, depressive symptoms, stress, work safety climate, and precarious job status. More non-farmworkers than farmworkers had neck and shoulder pain, but they did not differ in other areas of musculoskeletal pain. Depressive symptoms had a significant association with neck and shoulder pain ($p<0.05$). Precariousness had a significant association with back pain ($p<0.05$). Farmworker participants had H-2A visas and were afforded some protection compared to non-farmworker manual workers. Research is needed to improve policy that relieves pain and improves mental health for all Latino manual workers.

Keywords

Occupational health; immigrant health; organization of work; minority health; health disparity; immigrant workers

INTRODUCTION

Migrant and immigrant workers constitute a vulnerable population in the United States (US).^{1,2,3} Latino workers are among the fastest growing segments of the US workforce, with an estimated population of 19.6 million Latino workers, 56% of whom are foreign born.^{3,4} Most Latino immigrant workers in the US have manual occupations in hazardous industries with high rates of work-related injuries,^{5,6} including agriculture,^{6,7} construction,^{8,9,10} manufacturing,¹¹ and services.^{12,13}

Musculoskeletal disorders are commonly reported among Latino manual workers across all industries.^{9,14,15} Manual workers' musculoskeletal pain is associated with poor work safety climate.^{9,14,16} Work safety climate refers to worker perceptions about how their employers prioritize workplace safety over production.^{14,16,17,18} Work safety climate is one component of work organization, which includes the work timeframe, the physical and psychological demands of work, the control that workers have, and the style of supervision and support workers experience.¹⁹

Work organization has also been associated with the mental health of Latino manual laborers, including farmworkers.^{8,20} Depressive symptoms are related to greater job demands at work, including heavy load and awkward posture,¹⁹ psychological job demand,^{19,21} and lower skill variety and job control.¹⁹ Greater support from supervisors and better work safety climate are associated with fewer depressive symptoms and appear to be protective of mental health.¹⁹

Existing studies suggest that musculoskeletal disorders and depressive symptoms should be associated among Latino manual workers, but little research has examined this association. Analyses have addressed these conditions in other occupational groups, such as nurses,^{22,23,24} office workers,²⁵ and industrial workers,^{26,27} finding musculoskeletal disorders to be associated with structural, psychosocial, and organizational factors.

Farmworkers occupy a particularly precarious position. About half of all farmworkers lack appropriate documents to work in the US.²⁸ Fears of deportation force Latino migrant farmworkers' acceptance of their unsafe work conditions.^{9,29} Most farmworkers have limited formal education, and about a quarter are indigenous people who speak Spanish as a second language.^{28,30} Farmworker housing is deficient.^{31,32} Not only is housing in disrepair, but workers are also physically and socially hidden from the larger community.^{31,33} Farmworkers also have limited social networks,¹⁶ leaving them socially isolated and susceptible to depressive symptoms.^{20,34,35}

This analysis uses data collected in North Carolina from Latino farmworkers and Latino manual workers employed in other industries. The goals of this analysis are to: (1) compare levels of musculoskeletal disorders reported by Latino farmworkers to levels reported by Latino manual workers employed in other industries; (2) compare mental health between Latino farmworkers and Latino manual workers; and (3) determine if differences in musculoskeletal disorders between Latino farmworkers and Latino manual workers are associated with indicators of mental health and work organization.

METHODS

This analysis uses data collected by the PACE4 project in 2013. PACE4 is a community-based participatory research partnership with Latino communities to examine the health consequences of occupational exposures, with a focus on the cognitive and neurological outcomes of pesticide exposure. Interview, cognitive function, biomarker, brain imaging, and balance data have been collected over the three year project to measure any factors that might be related to changes in cognitive and neurological outcomes. The larger PACE4 compares Latino farmworkers and Latino non-farmworkers using a longitudinal design in which participants completed a baseline interview and up to four follow-up contacts in 2012, up to four additional follow-up contacts in 2013, and one follow-up contact in 2014. The comparisons provide the opportunity to document whether farmworkers differ from other Latino manual workers. The primary community partners for the project are the North Carolina Farmworkers Project (Benson, NC), and El Buen Pastor Latino Community Services (Winston-Salem, NC). Wake Forest School of Medicine Institutional Review Board reviewed and approved PACE4. All participants provided signed informed consent.

Participants

Latino farmworkers were recruited from three eastern NC counties in the area immediately adjacent to Benson (Harnett, Johnston, and Sampson Counties). Benson is the location of the North Carolina Farmworkers Project. Latino non-farmworkers were recruited in Winston-Salem (Forsyth County), where El Buen Pastor Latino Community Services is located.

The PACE4 protocol restricted participants to men ranging in age from 30 to 70 years old who identified themselves as Latino or Hispanic. Most indicated Spanish to be their primary language. Farmworkers were currently employed in agriculture and had worked in agriculture for at least three years. Non-farmworkers were excluded if they had jobs in the last three years in which pesticides were used, including farm work, forestry, landscaping, grounds keeping, lawn maintenance, and pest control. Farmworkers or non-farmworkers were also excluded if their doctors said they had diabetes.

Community partners in each location assisted with recruiting participants. Farmworkers were approached at their camps through the outreach of the NC Farmworkers Project. The staff explained the PACE4 project to each camp's residents, including inclusion and exclusion criteria, time commitments and incentives. They asked for volunteers who were then screened to ensure they met the inclusion criteria. Staff located in Winston-Salem collaborated with El Buen Pastor Latino Community Services and other community organizations to identify participants. Project staff then contacted potential participants and explained the project, including the inclusion and exclusion criteria, time commitments and incentives. Following the explanation, the staff member asked if the individual wanted to volunteer. Volunteers were screened to ensure that they fulfill the inclusion criteria.

A total of 235 farmworkers and 212 non-farmworkers completed the baseline interviews in 2012. Groups of farmworkers were asked to volunteer, so only the number of individuals who agreed to volunteer is available. The total number of farmworkers asked (the denominator) is not known. Generally, all of the farmworkers in a camp who met the

inclusion criteria volunteered. Individuals who wished to avoid participation could have claimed to not meet the inclusion criteria or evaded contact with the project staff to escape delivering a direct refusal. Among the non-farmworker population, 101 individuals who were contacted did not meet the inclusion criteria. Of those who were contacted and met the inclusion criteria, 87 individuals refused to participate for a participation rate of 70.9% (212/(87+212)). Individual reasons for their refusal included the time commitment and length of study (51), blood draws (27), need to come to a clinic for data collection (31), and providing contact information (30) (individuals could give more than one reason for refusing).

Data Collection

Data for this analysis were collected in the baseline questionnaire (2012), and four follow-up contacts in 2013, which included 111 farmworkers and 78 non-farmworkers. The baseline questionnaire contained items used to construct the measures of depression, stress, and personal characteristics. Questionnaires for each of the four follow-up contacts in 2013 contained items to construct measures of depression and stress. The second follow-up contact in 2013 included items to construct measures of precariousness and work safety climate. The first and fourth contacts in 2013 included items to construct the measure of self-reported musculoskeletal pain. Each questionnaire was written in English and then translated into Spanish. When available, existing Spanish items and scales were utilized. Each item was verified for comparable meaning in English and Spanish, and wording of items was adjusted when necessary. The Spanish versions of the questionnaires were pre-tested with several native Spanish speakers, and final corrections were made. Study data were collected and organized through Research Electronic Data Capture (REDCap) electronic data capture tools hosted at the Wake Forest School of Medicine.³⁶ REDCap is a secure, web-based application designed to support data capture for research studies.

Measures

Measures included self-reported musculoskeletal pain, depressive symptoms, stress, precariousness, work safety climate, and participant personal characteristics. Musculoskeletal pain was adapted from the National Institute for Occupational Safety and Health Body Discomfort Interview Guide.^{16,37} Self-reported musculoskeletal pain was measured using 11 specific pain locations: neck, shoulder, elbow, wrists, hands, upper, mid, and lower back, upper and lower leg, and knees. The participants were asked about pain at each location they had experienced within the past 3 months. Then they were asked about the frequency and severity of any pain. Responses to frequency of pain were ranked on a 5-point scale ranging from 0 (none) to 4 (every day). If the response was greater than 0, then the interviewer asked about the pain's severity. Severity was ranked on a 4-point scale from 1 (mild) to 4 (unbearable).

Depressive symptoms were measured using the Center for Epidemiologic Studies Depression Scale Short Form (CES-D 10). Participants ranked experiences in the past week on a 4-point scale of 1 (rarely or none of the time) to 4 (most or all of the time). Caseness was determined to be a sum greater than or equal to 10 out of a possible score of 30. The translated Spanish version has previously been internally validated with Mexican-American

and migrant worker populations.^{38,39} The Cronbach's α was 0.71 for the first time point, and it was 0.77 for the second time point.

Stress was measured using a shortened scale derived from the Migrant Farmworker Stress Inventory.^{39,40,41,42} The 17-question self-reported measure assesses the exposure to and the severity of stress intrinsic to immigrants.³⁹ Questions targeted topics of family, social isolation, discrimination, and immigration. Responses were based on a 5-point scale (have not experienced to extremely stressful). Possible scores spanned 0 to 68, and scores greater than 30 met the criteria for having a high degree of stress. The Cronbach's α was 0.68 the first time point, and it was 0.72 for the second time point.

Precariousness was measured using five questions from the scale developed by Vives et al.^{43,44,45} Questions addressed concerns from the last year, such as fear of voicing concerns about job safety, fear of being fired, job discrimination, and being made to feel defenseless or replaceable. The responses ranged from 0 to 5, and were combined into the categories of none versus any precariousness. The Cronbach's α was 0.67.

Work safety climate was measured with the Perceived Safety Climate Scale.^{9,46} Nine questions were answered using the 4-point Likert format (strongly agree, agree, disagree, strongly disagree). The tenth question included three response categories. The questions covered topics such as importance of work practices to management, frequency of dangerous work practices, praise for safe conduct, explanation of safety when first hired, attendance to safety meetings, proper safety equipment, and the possibility of injury. Scores ranged from 10 to 39. The Cronbach's α was 0.76.

Participant characteristics included age (30 to 34, 35 to 44, 45 and older), employment (farmworker, construction, manufacturing, food preparation, maintenance/cleaning, mechanics, unemployed, other), education (0 to 6 years, 7 to 11 years, 12 years or more), country of birth (Mexico, US/Puerto Rico, Central America, other), and H2-A visa status. (An H2-A visa is a temporary work visa that allows foreign nationals to fill temporary agricultural jobs; <http://www.uscis.gov/working-united-states/temporary-workers/h-2a-agricultural-workers/h-2a-temporary-agricultural-workers>). Clinic has the values of 1st or 4th completed in 2013.

Analysis

Frequencies and percentages were used to describe the overall analytical sample and by farmworker status. Work organization characteristics (work safety climate and precariousness) were collected at the second follow-up contact. Therefore, the differences between farmworkers and non-farmworkers in safety climate and precariousness were compared using two-sample t-tests and chi-square tests, respectively. Self-reported musculoskeletal disorders and mental health were collected at the first and fourth follow-up contacts. The prevalence of each of these conditions was summarized across the two follow-up visits overall and by farmworker status. The differences between farmworkers and non-farmworkers in the prevalence of these conditions were compared using a generalized estimating equation (GEE) approach to account for the correlation between the two repeated measures on the same individual. Finally, logistic regression models with farmworker status,

age, depression, total stress score, work safety climate, precariousness, and clinic visit were fit to evaluate the association between mental health and each of the self-reported musculoskeletal disorder while adjusting for the longitudinal structure of the data using GEE approach. All analyses were performed using SAS 9.3 and a p-value of less than 0.05 was considered statistically significant.

RESULTS

Personal Characteristics

The number of farmworkers and non-farmworkers over the age of 45 was similar (27% farmworkers, 33% non-farmworkers) (Table 1). Among non-farmworkers, the two predominant industries of employment were construction (30.8%) and manufacturing (21.8%), with a small group of unemployed men (10.3%). Fewer farmworkers than non-farmworkers attended school for more than 12 years (8.1% farmworkers, 32.1% of non-farmworkers). All farmworkers and two-thirds of the non-farmworkers were from Mexico; another quarter of non-farmworkers were from Central America.

Bivariate Analysis

Fewer farmworkers than non-farmworkers reported musculoskeletal pain in each site, including neck-shoulder pain (7.3% of farmworkers vs. 17.1% of non-farmworkers), hand-wrist pain (9.2% vs. 15.7%), back pain (15.5% vs 22.1%) and upper or lower leg pain (11.7% vs. 15.7%), but only the difference in neck-shoulder pain was significant ($p=0.019$) (Table 2). Fewer farmworkers than non-farmworkers reported depression (9.2% vs. 15.7%, $p=0.1$) and work stress (2.9% vs. 10.0%, $p=0.018$). Farmworkers reported a lower average work safety climate score than non-farmworkers (25.2 ± 3.6 vs. 26.9 ± 5.7 , $p=0.024$). Farmworkers and non-farmworkers did not significantly differ in precariousness (38.8% vs. 35.2%).

Multivariate Model

Farmworkers had significantly lower odds of reporting neck-shoulder pain than non-farmworkers (Odds Ratio (OR) 0.37, 95% Confidence Interval (CI) 0.16,0.87) (Table 3). Farmworkers had lower odds of reporting pain at other sites, but these differences were not significant. Across all pain locations, the age differences were not significant. Caseness for depression was associated with significantly higher odds of reporting neck-shoulder pain (OR 3.30 CI 1.3500,8.07) or wrist/hand pain (OR 2.69, 95% CI 1.00,7.10). Stress and work safety climate were not associated with musculoskeletal disorders. Precariousness was significantly associated with back pain (OR 2.09, 95% CI 1.01,4.23). The clinic variable indicates that associations among measures were not affected by the clinic at which the data were collected.

DISCUSSION

This analysis found that more Latino non-farmworkers than Latino farmworkers had neck and shoulder pain, but they did not differ in other areas of musculoskeletal pain. Depressive symptoms had significant positive associations with neck/shoulder, and wrist/hand pain;

precariousness had a significant positive association with back. The prevalence of musculoskeletal pain among these Latino manual workers is similar to that reported for US workers across industries.⁴⁷

Immigrant manual workers experience musculoskeletal pain, whether employed in construction,^{10,48} manufacturing¹¹, food preparation,^{49,50,51} maintenance,^{51,52} transportation,⁵³ or agriculture.^{6,7} The PACE4 study, using clinical data, has shown Latino farmworkers to have a lower prevalence of specific musculoskeletal disorders (epicondylitis, rotator cuff syndrome, lower extremity pathology) than other manual workers.⁵⁴ Compared to Latino poultry processing workers,^{19,55} the PACE4 participants have comparable neck and shoulder pain prevalence (17.1% PACE4 vs 16.2%), comparable back pain prevalence (22.1% PACE4 vs 20.4%), lower hand and wrist pain prevalence (15.7% PACE4 vs 48.9%), and lower leg pain prevalence (15.7% vs 23.0%). The lower prevalence among PACE4 participants for hand and leg pain reflects the repetitive tugging and cutting motion, as well as the extensive standing, required of poultry processing workers.^{11,55,56}

Musculoskeletal disorders have been commonly associated with depressive symptoms.^{16,57} Magni et al.⁵⁷ reported that depressed patients had significantly higher odds of having chronic musculoskeletal pain, while the opposite association between musculoskeletal pain and depression was also substantiated. In the current study, Latino migrant farmworkers have fewer depressive symptoms than non-farmworkers. All of the farmworkers in the PACE4 study possessed H-2A guest worker visas, which provide them with legal documentation to migrate and work within US borders under increased protection.^{20,57–61} Farmworkers' depression varies throughout the season due to initial family separation or impending family reunions.¹⁶ Manual laborers who migrate to the US experience different levels of depression, and if separated from their families, they do not have the same opportunities of being reunited as do farmworkers with H-2A visas. Stress, another mental health indicator, was not significantly associated with musculoskeletal pain, but had a significantly lower prevalence among farmworkers compared to non-farmworkers (2.9% vs 10.0%, $p < 0.05$) (Table 2). Duke et al.²⁹ surveyed immigrant Latino day laborers and showed they experienced high rates of stress due to instability, relationships, communication, and alcohol or other drug use. The day laborers described by Duke and colleagues, like the non-farmworkers in this analysis, are largely undocumented immigrants. Almost all of the farmworkers who participated in this study had H-2A visas; while these temporary work visas may result in worker intimidation,⁶² as well as separation from family and community, they do afford these workers with some sense of protection.⁶³

Work safety climate and musculoskeletal pain were not significantly associated, but another measure of work organization, precariousness, was associated with greater odds of back pain. Migration places farmworkers in a precarious position,⁶⁴ and chronic back pain occurs while migrating.⁶⁵ The jobs of immigrant laborers, such as poultry processing workers, involve minimal decision-making and control, leaving them in precarious positions with their employers, coping with leg pain from long hours of standing.^{11,66,67} PACE4 farmworkers and non-farmworker manual laborers did not differ significantly in their levels of perceived precariousness.

The results of this research should be interpreted within its limitations. PACE4 recruited farmworkers and non-farmworkers in specific areas of one state, making generalizability limited. There is the possibility of regional variation among immigrant workers in the types of work performed.⁶⁸ The analysis does not provide evidence for causality. Not all measures were collected at the same time. Self-reported exposures and outcomes were not verified, and not all potential confounding variables were considered. There were a smaller number of participants used in analysis than were recruited, making non-response or self-selection bias possible. Though the farmworker sample size was small, the sample was representative of farmworkers in the southeastern United States.⁶⁹

Migrant farm work and immigrant labor jobs carry a high risk of occupational injury. Mental health and work organization are associated with the musculoskeletal disorders. Farmworkers, at least these with H-2A visas, are afforded protections compared to immigrant non-farmworker manual workers. The research goal was to obtain information about the possible association of depression, work stress, work safety climate, and precariousness with musculoskeletal pain for Latino farmworkers and non-farmworker manual laborers. The results showed that depression and precariousness are correlates of musculoskeletal disorders and pain. Research is needed that measures the details of work and migration to improve policy that relieves pain and improves mental health.

Acknowledgments

This research was supported by grant R01-ES008739 from the National Institute of Environmental Health Sciences.

References

1. McCauley LA. Immigrant workers in the United States: recent trends, vulnerable populations, and challenges for occupational health. *AAOHN J*. 2005; 53(7):313–319. [PubMed: 16097105]
2. Leong, FTL.; Eggerth, D.; Flynn, M., et al. Occupational health disparities among racial and ethnic minorities. In: Perrewe, PL.; Halbesleben, JLB.; Rosen, CC., editors. *The Role of the Economic Crisis on Occupational Stress and Well Being*. Bingley, UK: Emerald Group Publishing; 2012. p. 267-310.
3. Gany F, Novo P, Dobslaw R, Leng J. Urban occupational health in the Mexican and Latino/Latina immigrant population: a literature review. *J Immigr Minor Health*. 2014; 16(5):846–855. [PubMed: 23468371]
4. Cierpich H, Styles L, Harrison R, et al. Work related injury deaths among Hispanics-United States, 1992–2006. *Morb Mortal Wkly Rep*. 2008; 57(22):597–600.
5. Sears JM, Bowman SM, Silverstein BA. Trends in the disproportionate burden of work-related traumatic injuries sustained by Latinos. *J Occup Environ Med*. 2012; 54(10):1239–45. [PubMed: 22975666]
6. Orrenius PM, Zavodny M. Do immigrants work riskier jobs? *Demography*. 2009; 46(3):535–551. [PubMed: 19771943]
7. Xiao H, McCurdy SA, Stoecklin-Marois M, Li C-S, Schenker MB. Agricultural work and chronic musculoskeletal pain among Latino farm workers: the MICASA study. *Am J Ind Med*. 2013; 56(2): 216–225. [PubMed: 23023585]
8. Grzywacz JG, Arcury TA, Marin A, et al. The organization of work: implications for injury and illness among immigrant Latino poultry-processing workers. *Arch Environ Occup Health*. 2007; 62(1):19–26. [PubMed: 18171643]
9. Arcury TA, Mills T, Marin AJ, et al. Work safety climate and safety practices among immigrant Latino construction workers. *Am J Ind Med*. 2012; 55(8):736–45. [PubMed: 22544480]

10. Dong XS, Fujimoto A, Ringen K, Men Y. Fatal falls among Hispanic construction workers. *Accid Anal Prev.* 2009; 41(5):1047–1052. [PubMed: 19664444]
11. Quandt SA, Grzywacz JG, Marin A, et al. Illnesses and injuries reported by Latino poultry workers in western North Carolina. *Am J Ind Med.* 2006; 49(5):343–351. [PubMed: 16570254]
12. Panikkar B, Woodin MA, Brugge D, Hyatt R, Gute DM. Community Partners of the Somerville Community Immigrant Worker Project. Characterizing the low wage immigrant workforce: a comparative analysis of the health disparities among selected occupations in Somerville, Massachusetts. *Am J Ind Med.* 2014; 57(5):516–526. [PubMed: 23840014]
13. Hsieh Y-C, Apostolopoulos Y, Hatzudis K, Sonmez S. Occupational exposures and health outcomes among Latina hotel cleaners. *Hisp Health Care Int.* 2014; 12(1):6–15. [PubMed: 24865435]
14. Arcury TA, Grzywacz JG, Anderson AM, et al. Personal protective equipment and work safety climate among Latino poultry processing workers in Western North Carolina, USA. *Int J Occup Environ Health.* 2012; 18(4):320–328. [PubMed: 23433293]
15. Stewart SK, Rothmore PR, Doda DVD, Hiller JE, Mahmood MA, Pisaniello DL. Musculoskeletal pain and discomfort and associated work and organizational factors: a cross-sectional study. *Work.* 2014; 48(2):261–271. [PubMed: 23531584]
16. Arcury TA, O'Hara H, Grzywacz JG, Isom S, Chen H, Quandt S. Work safety climate, musculoskeletal discomfort, working while injured, and depression among migrant farmworkers in North Carolina. *Am J Public Health.* 2012; 102(S2):S272–S278. [PubMed: 22401520]
17. Zohar D. Safety climate in industrial organizations: theoretical and applied implications. *J Appl Psychol.* 1980; 65(1):96–102. [PubMed: 7364709]
18. Huang Y-H, Ho M, Smith GS, Chen PY. Safety climate and self-reported injury: assessing the mediating role of employee safety control. *Accid Anal Prev.* 2006; 38(3):425–433. [PubMed: 16442068]
19. Arcury TA, Grzywacz JG, Chen H, Mora D, Quandt SA. Work organization and health among immigrant women: Latina manual workers in North Carolina. *Am J Public Health.* 2014; 104(12):2445–2452. [PubMed: 24432938]
20. Grzywacz JG, Quandt SA, Chen H, et al. Depressive symptoms among Latino farmworkers across the agricultural season: structural and seasonal influences. *Cultur Divers Ethnic Minor Psychol.* 2010; 16(3):335–343. [PubMed: 20658876]
21. Smith PM, Bielecky A. The impact of changes in job strain and its components on the risk of depression. *Am J Public Health.* 2012; 102(2):352–358. [PubMed: 22390450]
22. Smedley J, Egger P, Cooper C, Coggon D. Manual handling activities and risk of low back pain in nurses. *Occup Environ Med.* 1995; 52(3):160–163. [PubMed: 7735387]
23. Niedhammer I, Lert F, Marne J. Back pain and associated factors in French nurses. *Int Arch Occup Environ Health.* 1994; 66(5):349–357. [PubMed: 7896421]
24. Reme SE, Shaw WS, Boden LI, et al. Worker assessments of organizational practices and psychosocial work environment are associated with musculoskeletal injuries in hospital patient care workers. *Am J Ind Med.* 2014; 57(7):810–818. [PubMed: 24737462]
25. Choobineh A, Motamedzade M, Kazemi M, et al. The impact of ergonomics intervention on psychosocial factors and musculoskeletal factors among office workers. *Int J Industrial Ergonomics.* 2011; 41(6):671–676.
26. Yu W, Yu ITS, Li Z, et al. Work-related injuries and musculoskeletal disorders among factory workers in a major city of China. *Accid Anal Prev.* 2012; 48:457–463. [PubMed: 22664712]
27. Morken T, Riise T, Moen B, et al. Low back pain and widespread pain predict sickness absence among industrial workers. *BMC Musculoskelet Disord.* 2003; 4(1):1–8. [PubMed: 12570876]
28. Carroll, DJ.; Samardick, R.; Gabbard, SB.; Hernandez, T. Research Report No. 9. Washington, DC: US Department of Labor, Office of the Assistant Secretary for Policy, Office of Programmatic Policy; 2005. Findings from the National Agricultural Workers Survey (NAWS) 2001–2002: a demographic and employment profile of United States farm workers; p. 1-50.
29. Duke MR, Bourdeau B, Hovey JD. Day laborers and occupational stress: testing the Migrant Stress Inventory with a Latino day laborer population. *Cultur Divers Ethnic Minor Psychol.* 2010; 16(2):116–122. [PubMed: 20438149]

30. Farquhar SA, Goff NM, Shadbeh N, et al. Occupational health and safety status of indigenous and Latino farmworkers in Oregon. *J Agric Saf Health*. 2009; 15(1):89–102. [PubMed: 19266886]
31. Arcury TA, Weir MM, Summers P, et al. Safety, security, hygiene and privacy in migrant farmworker housing. *New Solut*. 2012; 22(2):153–173. [PubMed: 22776578]
32. Sandberg JC, Talton JW, Quandt SA, et al. Association between housing quality and individual health characteristics on sleep quality among Latino farmworkers. *J Immigr Minor Health*. 2014; 16(2):265–272. [PubMed: 23161266]
33. Vallejos QM, Quandt SA, Grzywacz JG, et al. Migrant farmworkers' housing conditions across an agricultural season in North Carolina. *Am J Ind Med*. 2011; 54(7):533–544. [PubMed: 21360725]
34. Gares CE, Montz BE. Disaster vulnerability of migrant and seasonal farmworkers: a comparison of Texas and North Carolina. *Southeastern Geographer*. 2014; 54(1):36–54.
35. Grzywacz JG, Chatterjee AB, Quandt SA, et al. Depressive symptoms and sleepiness among Latino farmworkers in eastern North Carolina. *J Agromedicine*. 2011; 16(4):251–260. [PubMed: 21958399]
36. Harris PA, Taylor R, Thielke R, Payne J, Gonzalez N, Conde JG. Research electronic data capture (REDCap) – A metadata-driven methodology and workflow process for providing translational research informatics support. *J Biomed Inform*. 2009; 42(2):377–381. [PubMed: 18929686]
37. Wiehagen, WJ.; Turin, FC. Ergonomic assessment of musculoskeletal risk factors at four mine sites: underground coal, surface copper, surface phosphate, and underground limestone. U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health; 2004. DHHS (NIOSH) Publication No. 2004-159 Informational Circular 9475 Available at: <http://www.cdc.gov/niosh/mining/UserFiles/works/pdfs/2004-159.pdf> [Accessed April 3, 2015]
38. Grzywacz JG, Quandt SA, Early J, Tapia J, Graham CN, Arcury TA. Leaving family for work: ambivalence and mental health among Mexican migrant farmworker men. *J Immigr Minor Health*. 2006; 8(1):85–97. [PubMed: 19835002]
39. Hiott AE, Grzywacz JG, Davis SW, Quandt SA, Arcury TA. Migrant farmworker stress: mental health implications. *J Rural Health*. 2008; 24(1):32–39. [PubMed: 18257868]
40. Hovey JD, Magaña CG. Cognitive, affective, and physiological expressions of anxiety symptomatology among Mexican migrant farmworkers: Predictors and generational differences. *Community Ment Health J*. 2002; 38(3):223–237. [PubMed: 12046676]
41. Hovey JD, Magaña CG. Psychosocial predictors of anxiety among immigrant Mexican migrant farmworkers: Implications for prevention and treatment. *Cultur Divers Ethnic Minor Psychol*. 2002; 8(3):274–289. [PubMed: 12143104]
42. Hovey, JD.; Seligman, LD. The mental health of agricultural workers. In: Lessenger, JE., editor. *Agricultural Medicine: A Practical Guide*. New York, NY: Springer-Verlag; 2005. p. 282–299.
43. Vives A, Amable M, Ferrer M, et al. The Employment Precariousness Scale (EPRES): psychometric properties of a new tool for epidemiological studies among waged and salaried workers. *Occup Environ Med*. 2010; 67(8):548–555. [PubMed: 20576923]
44. Vives A, Vanroelen C, Amable M, Ferrer M, Moncada S, Llorens C, Muntaner C, Benavides FG, Benach J. Employment precariousness in Spain: prevalence, social distribution, and population-attributable risk percent of poor mental health. *Int J Health Serv*. 2011; 41(4):625–646. [PubMed: 22053526]
45. Arcury TA, Nguyen HT, Summers P, et al. Lifetime and current pesticide exposure among Latino farmworkers in comparison to other Latino immigrants. *Am J Ind Med*. 2014; 57(7):776–787. [PubMed: 24737498]
46. Gillen M, Baltz D, Gassel M, Kirsch L, Vaccaro D. Perceived safety climate, job demands, and coworker support among union and nonunion injured construction workers. *J Safety Res*. 2002; 33(1):33–51. [PubMed: 11979636]
47. Lee SJ, Tak S, Alterman T, Calvert GM. Prevalence of musculoskeletal symptoms among agricultural workers in the United States: an analysis of the National Health Interview Survey, 2004–2008. *J Agromedicine*. 2014; 19(3):268–80. [PubMed: 24959759]
48. Occupational Safety and Health Administration. Preventing musculoskeletal disorders in construction workers. *Electronic Library of Construction Occupational Safety & Health*. 1999

49. Tsai JH-C. Chinese immigrant restaurant workers' injury and illness experiences. *Arch Environ Occup Health*. 2009; 64(2):107–114. [PubMed: 19395341]
50. Dempsey PG, Filiaggi AJ. Cross-sectional investigation of task demands and musculoskeletal discomfort among restaurant wait staff. *Ergonomics*. 2006; 49(1):93–106. [PubMed: 16393806]
51. Pransky G, Moshenberg D, Benjamin K, Portillo S, Thackrey JL, Hill-Fotouhi C. Occupational risks and injuries in non-agricultural immigrant Latino workers. *Am J Ind Med*. 2002; 42(2):117–123. [PubMed: 12125087]
52. Scherzer T, Rugulies R, Krause N. Work-related pain and injury and barriers to workers' compensation among Las Vega hostel room cleaners. *Am J Public Health*. 2005; 95(3):483–488. [PubMed: 15727981]
53. Spielholz P, Cullen J, Smith C, Howard N, Silverstein B, Bonauto D. Assessment of perceived injury risks and priorities among truck drivers and trucking companies in Washington State. *J Safety Res*. 2008; 39(6):569–576. [PubMed: 19064041]
54. Mora DC, Miles CM, Chen H, Quandt SA, Summers P, Arcury TA. Prevalence of musculoskeletal disorders among immigrant Latino farmworkers and non-farmworkers in North Carolina. *Arch Environ Occup Health*. 2014 abstract.
55. Arcury TA, Cartwright MS, Chen H, et al. Musculoskeletal and neurological injuries associated with work organization among immigrant Latino women manual workers in North Carolina. *Am J Ind Med*. 2014; 57(4):468–475. [PubMed: 24436169]
56. Lundberg U. Stress responses in low-status jobs and their relationship to health risks: musculoskeletal disorders. *Ann N Y Acad Sci*. 1999; 896(1):162–172. [PubMed: 10681896]
57. Magni G, Moreschi C, Rigatti-Luchini S, Merskey H. Prospective study on the relationship between depressive symptoms and chronic musculoskeletal pain. *Pain*. 1994; 56(3):289–297. [PubMed: 8022622]
58. Bauer, M. Close to Slavery: Guestworker Programs in the United States. Vol. 2. Montgomery, AL: Southern Poverty Law Center; 2013. p. 1-46.<http://www.splcenter.org/sites/default/files/downloads/publication/SPLC-Close-to-Slavery-2013.pdf> [Date Accessed: 6 April 2015]
59. Hall ML. Defending the rights of H-2A farmworkers. *NC J Int Law and Commercial Regulation*. 2002; 27(3):521–538.
60. Whalley LE, Grzywacz JG, Quandt SA, et al. Migrant farmworker field and camp safety and sanitation in Eastern North Carolina. *J Agromedicine*. 2009; 14(4):421–436.
61. Robinson E, Nguyen HT, Isom S, et al. Wages, wage violations, and pesticide safety experienced by migrant farmworkers in North Carolina. *New Solut*. 2011; 21(2):251–268. [PubMed: 21733804]
62. Bauer, M. Close to Slavery: Guestworker Programs in the United States. Montgomery, AL: Southern Poverty Law Center; 2007.
63. Arcury TA, Summers P, Talton JW, Nguyen HT, Chen H, Quandt SA. Job characteristics and work safety climate among North Carolina farmworkers with H-2A visas. *J Agromedicine*. 2015; 20(1): 64–76. [PubMed: 25635744]
64. Bustamante JA. Extreme vulnerability of migrants: the cases of the United States and Mexico. *Geo Immigr L J*. 2010; 24(3–4):565–583.
65. Shipp EM, Cooper SP, del Junco DJ, et al. Chronic back pain and associated work and non-work variables among farmworkers from Starr County, Texas. *J Agromedicine*. 2009; 14(1):22–32. [PubMed: 19214853]
66. Arcury TA, Grzywacz JG, Anderson AM, et al. Employer, use of personal protective equipment, and work safety climate: Latino poultry processing workers. *Am J Ind Med*. 2013; 56(2):180–188. [PubMed: 22847579]
67. Grzywacz JG, Quandt SA, Arcury TA. Immigrant farmworkers' health-related quality of life: an application of the job demands-control model. *J Agric Saf Health*. 2008; 14(1):79–92. [PubMed: 18376537]
68. Arcury, TA.; Quandt, SA. The health and safety of farmworkers in the eastern United States: a need to focus on social justice. In: Arcury, TA.; Quandt, SA., editors. *Latino Farmworkers in the Eastern US: Health, Safety, and Justice*. New York: Springer; 2009. p. 1-14.

69. Arcury, TA.; Marin, AJ. Latino/Hispanic farmworkers and farm work in the Eastern United States: the context for health, safety, and justice. In: Arcury, TA.; Quandt, SA., editors. Latino Farmworkers in the Eastern US: Health, Safety, and Justice. New York: Springer; 2009. p. 15-36.

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Table 1

Participant Characteristics PACE4 Project, 2013, n=189

Participant Characteristics	Total (n=189)		Farmworker (n=111)		Non-Farmworker (n=78)	
	N	%	N	%	N	%
Age						
30 to 34 years	65	34.4	41	36.9	24	30.8
35 to 44 years	68	36.0	40	36.0	28	35.9
45 years and older	56	29.6	30	27.0	26	33.3
Occupation						
Construction	24	12.7	0	0.00	24	30.8
Manufacturing	17	9.0	0	0.00	17	21.8
Food preparation/restaurant	8	4.2	0	0.00	8	10.3
Maintenance/cleaning	8	4.2	0	0.00	8	10.3
Mechanic	5	2.7	0	0.00	5	6.4
Unemployed	8	4.2	0	0.00	8	10.3
Other	8	4.2	0	0.00	8	10.3
Education						
0 to 6 years	78	41.3	46	41.4	32	41.0
7 to 11 years	77	40.7	56	50.5	21	26.9
12 or more years	34	18.0	9	8.1	25	32.1
Country of Birth						
Mexico	163	86.2	111	100.0	52	66.7
U.S./Puerto Rico	2	1.1	0	0.00	2	2.6
Central America	19	10.1	0	0.00	19	24.4
Other	5	2.7	0	0.00	5	6.4
H-2A Visa Status						
H-2A visa			108	97.3		
No visa			3	2.7		

Table 2
Summary of Self-Reported Musculoskeletal Disorders, Mental Health, and Work Organization Variables.

Characteristic	Total (n=189)		Farmworker (n=111)		Non-Farmworker (N=78)		P-value
	N	%	N	%	N	%	
Pain Location							
Neck-Shoulder *	39	11.3	15	7.3	24	17.1	0.019
Hand-Wrist *	41	11.9	19	9.2	22	15.7	0.105
Back *	63	18.2	32	15.5	31	22.1	0.231
Leg *	46	13.3	24	11.7	22	15.7	0.451
Mental Health							
Depression (CES-D 10) *	41	11.9	19	9.2	22	15.7	0.100
Stress (Score>30) *	39	11.3	6	2.9	14	10.0	0.018
Work Organization							
Work Safety Climate	25.8 ± 4.5		25.2 ± 3.6		26.9 ± 5.7		0.024
Precariousness							
None	98	62.4	63	61.2	35	64.8	0.650
Any	59	37.6	40	38.8	19	35.2	

* Data were aggregated over two clinical visits. The p-values were adjusted for correlation between repeated measures.

Table 3

Multivariate Model: Association of MS Pain to Mental Health and Work Organization Measures

Predictor	Neck/Shoulder Odds Ratio (95% Confidence Interval)	Wrist/Hand Odds Ratio (95% Confidence Interval)	Back Odds Ratio (95% Confidence Interval)	Leg Odds Ratio (95% Confidence Interval)
Farmworker (versus Non-Farmworker)	0.37 (0.16,0.87) *	0.68 (0.29,1.59)	0.75 (0.36,1.58)	0.74 (0.32,1.71)
Age (in years)	1.02 (0.98,1.07)	1.05 (1.00,1.11) #	1.01 (0.97,1.05)	1.04 (0.99,1.08)
Depression (CES-D 10 versus <10)	3.30 (1.35,8.07) **	2.69 (1.00,7.10) *	2.24 (0.82,6.08)	1.91 (0.69,5.29)
Stress (score>30 versus 30) *	2.23 (0.71,7.06)	0.77 (0.17,3.53)	0.62 (0.17,2.23)	1.70 (0.42,6.85)
Work Safety Climate (score)	0.94 (0.86,1.02)	0.98 (0.88,1.08)	1.00 (0.92,1.09)	0.93 (0.84,1.02)
Precariousness (any versus none)	0.92 (0.36,7.06)	1.39 (0.58,3.37)	2.09 (1.01,4.23) *	0.55 (0.22,1.41)
Clinic (1 st versus 4 th)	0.92 (0.46,1.83)	0.80 (0.41,1.59)	0.69 (0.41,1.14)	0.69 (0.40,1.17)

**
p<0.01,*
p<0.05,#
p< 0.1