



Published in final edited form as:

*Am J Public Health*. 2012 May ; 102(Suppl 2): S272–S278. doi:10.2105/AJPH.2011.300597.

## Work Safety Climate, Musculoskeletal Discomfort, Working While Injured, and Depression Among Migrant Farmworkers in North Carolina

Thomas A. Arcury, PhD, Heather O'Hara, MD, MSPH, Joseph G. Grzywacz, PhD, Scott Isom, MS, Haiying Chen, MD, PhD, and Sara A. Quandt, PhD

Thomas A. Arcury and Joseph G. Grzywacz are with the Department of Family and Community Medicine, Wake Forest School of Medicine, Winston-Salem, NC. Heather O'Hara is with the Department of Family and Community Medicine, Meharry Medical College, Nashville, TN. Scott Isom and Haiying Chen are with the Department of Biostatistical Sciences, Division of Public Health Sciences, Wake Forest School of Medicine. Sara A. Quandt is with the Department of Epidemiology and Prevention, Division of Public Health Sciences, Wake Forest School of Medicine

### Abstract

**Objectives**—This analysis described Latino migrant farmworkers' work safety climate and its association with musculoskeletal discomfort, working while injured or ill, and depressive symptoms.

**Methods**—Data were from a cross-sectional survey of 300 farmworkers conducted in North Carolina in 2009. Generalized estimating equations models were used to investigate the association of work safety climate with health and safety outcomes.

**Result**—Farmworkers perceived their work safety climate to be poor. About 40% had elevated musculoskeletal discomfort, 5.0% had worked at least 1 day while injured or ill, and 27.9% had elevated depressive symptoms. The odds of elevated musculoskeletal discomfort were 12% lower and the odds of working while injured or ill were 15% lower with each 1-unit increase in the work safety climate. Work safety climate was not associated with depressive symptoms.

**Conclusions**—Work safety climate was important for agricultural workers. Poor work safety climate was associated with health outcomes (musculoskeletal discomfort) and safety (working while injured or ill). Interventions to improve work safety climate in agriculture are needed, with these interventions being directed to employers and workers.

---

Farmworkers experience poor occupational health. These workers are exposed to a variety of hazards in the workplace.<sup>1,2</sup> They experience high rates of occupational injury, illness, and death as a result of these exposures.<sup>3-5</sup> When they experience an occupational injury or

---

Correspondence should be sent to Thomas A. Arcury, PhD, Department of Family and Community Medicine, Wake Forest School of Medicine, Medical Center Boulevard, Winston-Salem, NC 27157 (tarcury@wake-health.edu).

Reprints can be ordered at <http://www.ajph.org> by clicking the "Reprints" link."

Contributors: T.A. Arcury, J. G. Grzywacz, H. Chen, and S.A. Quandt conceived and designed the overall study. T. A. Arcury supervised all aspects of the study's implementation. T. A. Arcury and H. O'Hara developed the aims for this specific analysis, and led the writing. H. Chen and S. Isom completed the statistical analysis. All authors helped to conceptualize ideas, interpret findings, and review drafts of the article.

The research was previously presented at the American Occupational Health Conference; March 2011, Washington, DC; and NORA Symposium 2011: Achieving Impact through Research and Partnership; July 2011; Cincinnati, OH.

Human Participant Protection: The Wake Forest School of Medicine institutional review board approved this study.

illness, farmworkers have limited access to health services.<sup>6</sup> An important factor that may influence the occupational health of farmworkers is the organization of work in agriculture,<sup>7</sup> particularly the work safety climate.<sup>8</sup> Work safety climate describes the shared perceptions of workers about how employers operationalize, support, and value safety in the workplace.<sup>9</sup> Associations of work safety climate with occupational safety and injury have been examined in many industries, including construction,<sup>10</sup> manufacturing,<sup>11</sup> and retail.<sup>12</sup> However, with 1 exception,<sup>13</sup> work safety climate has not considered in analyses of occupational safety and injury in agriculture.

Farmworkers are a vulnerable population. Over 80% of farmworkers in the United State; are Latino, with the majority coming from Mexico.<sup>14</sup> About half of all farmworkers lack appropriate documents to work in the United States,<sup>14</sup> and a growing number are in the United States with H-2A guest worker visas.<sup>15</sup> Most farmworkers are male, poor, and have limited formal education.<sup>14</sup> About a quarter of farmworkers are indigenous peoples who speak Spanish as a second language.<sup>16</sup> Many farmworkers are supporting families that remain in their communities of origin.<sup>17</sup>

Work safety climate may be especially important for farmworkers. Farmworkers feel little control over their work environments.<sup>18-20</sup> They seldom complain about unsafe work environments because of fear of losing their jobs, harassment from authorities, or deportation if they have an H-2A visa or if they lack appropriate documentation.<sup>15,21</sup> Therefore, faced with an unsafe work climate, farmworkers tend to ignore risk and appropriate safety behaviors to conform to the expectations of their employers.<sup>20</sup> The willingness of farmworkers to accept unsafe work conditions is bolstered by a belief system in which men are expected to accept danger, and they are expected to act as if they will not be harmed by exposure to hazards.<sup>18,22,23</sup>

Although the safety climate in which farmworkers work has not been examined, research has documented the risk tolerance of the farmers who employ these workers.<sup>21,24-26</sup> Farmers have acknowledged the occupational hazards inherent in farming, but their beliefs have limited their willingness to adhere to safety procedures, particularly when these procedures are perceived as affecting the economic viability of their enterprise.<sup>24-26</sup> The result is that many farmers have not instituted a culture of work safety, often believing that safety regulations imposed from outside agencies were unnecessary. Furthermore, farmers often believe that they experience far greater exposure to occupational hazards than do their employees, including farmworkers, and that they do not need to establish safety procedures for these employees.<sup>22,27</sup>

This analysis used data collected from migrant farmworkers in North Carolina to address 2 aspects of work safety climate in agriculture. First, this analysis described migrant farmworkers' work safety climate. Second, it examined the association of work safety climate with musculoskeletal discomfort, working while injured or ill, and depressive symptoms among migrant farmworkers.

## Methods

Data were from a cross-sectional survey of health and safety among migrant farmworkers conducted in eastern North Carolina from June through August 2009. This survey was one component of a long-term community-based participatory research program based on a collaboration of investigators at Wake Forest School of Medicine and the North Carolina Farmworkers Project.

## Participant Recruitment and Sample

Participants were selected using a 2-stage process. First, farmworker camps were chosen in 3 eastern North Carolina counties: Harnett, Johnston, and Sampson. Farmworker camps in eastern North Carolina are owned by specific employers, and all the residents of a camp have the same employer. Camp selection used an established strategy developed to deal with the broad geographic distribution of camps that are not occupied every year and for which no comprehensive official listing exists.<sup>28-30</sup> A list of camps in the region was created. Camps were visited in random order. Study personnel explained the study to camp residents, and asked the residents to participate in the study. If residents agreed to participate, a camp census was completed. For the second stage, farmworkers in each camp were recruited from the census list in random order, with up to 6 recruited per camp. Participation was limited to 6 farmworkers per camp to reduce the affects of clustering. Inclusion criteria were residence in the camp and employment doing farm work; there were no exclusion criteria.

Farmworkers at 62 camps were asked to participate in the study. At 8 camps, workers declined to participate; growers refused to allow study personnel to recruit at 2 camps. The 52 camps that agreed to participate in the study had a total of 1076 residents. Three hundred farmworkers from these camps agreed to participate in the study, and 157 individuals refused to participate, for a participation rate of 66% (300/457). The sample included 285 men and 15 women. At recruitment, the study was explained, and informed consent obtained from all participants. Workers received \$10 and protective glasses for completing the interview. All procedures were approved by the Wake Forest Health Sciences institutional review board.

## Data Collection

The data collection questionnaire was developed in English and translated into Spanish by a native Spanish speaker familiar with Mexican Spanish and farmworker vocabulary. Many of the items used in the questionnaire were taken from existing scales that were validated in Spanish or from instruments used in previous farmworker research. Five farmworkers were recruited to pretest the questionnaire to ensure that the language used was understandable, and that the meaning of each question was understood. Modifications to item wording were made based on their feedback.

All interviewers were native Spanish speakers who had experience in farmwork. Interviewers participated in a 1-day training, which included a review of camp and participation selection, recruitment procedures, and interview data collection procedures. All interviews were conducted in Spanish.

## Measures

The outcome measures for this analysis were musculoskeletal discomfort, working while injured or ill, and depressive symptoms. Although many specific occupational injuries and illnesses are relatively prevalent among farmworkers,<sup>2,3</sup> insufficient numbers of these specific injuries and illnesses would be observed in a small cross-sectional survey to analyze their associations with work safety climate. Therefore, 3 general indicators of farmworker health and safety were selected that would reflect farmworker experience with numerous hazards and inform occupational safety policy. Musculoskeletal discomfort is common among farmworkers; it reflects the bending, lifting, and carrying tasks that farmworkers perform, as well as the difficult living conditions that they experience.<sup>31-33</sup> Days working while injured or ill is an indicator of farmworker safety that takes into account the wide range of occupational injuries and illnesses that farmworkers experience, and their need to continue working even when injured.<sup>6</sup> Depressive symptoms are also common among farmworkers and indicate the mental health outcomes of their work environment.<sup>34-35</sup>

The measure of musculoskeletal discomfort was adapted from the National Institute for Occupational Safety and Health Body Discomfort Interview Guide.<sup>36</sup> Participants reported if they had experienced discomfort or pain as a result of their job in 8 distinct body parts (neck, shoulders, elbows, wrists, hands, lower back, knees, and ankles) during the current agricultural season. For each body part, the frequency of pain was recorded; 0 indicated no experience of work-related discomfort or pain, and 4 indicated daily discomfort or pain. A value of 1 indicated that participants reported they had experienced pain or discomfort at least once a month during the current season; the original version rated pain or discomfort within the past year. Those who reported work-related pain or discomfort in a particular body part were asked to rate the severity. The values in the questionnaire ranged from no pain (0) to unbearable (4). The original instrument did not indicate a value for “no pain,” but other levels of pain were identical to the version used in this study. The value of the frequency of pain (0–4) was multiplied by the value of the severity of pain (0–4) for each body part. Participants with frequent moderate or severe pain in 1 body part therefore had a higher pain scale value than did those who reported infrequent or mild musculoskeletal pain in many body parts. General discomfort was divided into tertiles; the highest tertile (0.375) was considered to be elevated musculoskeletal pain and the bottom 2 tertiles were considered low pain. No pain or discomfort in any area was reported by 111 (37.0%) of the participants.

Working while injured or ill was based on responses to the question: “How many days have you worked this season when you were injured or ill?” Participants who reported 1 or more days were coded as having worked while injured or ill.

Depressive symptoms were measured using the short form of the Center for Epidemiological Studies—Depressive Symptoms (CES-D), a 10-item form that demonstrated good predictive accuracy and appropriateness of use among Latino immigrants.<sup>37,38</sup> For each of the 10 items, participants were asked how often they felt or behaved in a particular way during the previous week: rarely or none of the time (0) to most or all of the time (3). The participants' responses were summed, and the maximum value for the CES-D 10 item index was 30. If any of the 10 items were missing, the CES-D value was set to missing. Participants with CES-D scores of 10 or higher were considered to have elevated levels of depressive symptoms.<sup>38</sup> The Cronbach's  $\alpha$  was 0.59.

Work safety climate was the primary independent measure. Participants were asked to evaluate their current farmwork employers with the 10-item Perceived Safety Climate Scale.<sup>10</sup> Nine of the items in this scale used a 4-point Likert format (strongly agree, agree, disagree, strongly disagree). The tenth item included 3 response categories. Items were summed. Values for the scale ranged from 10 to 39, with higher values indicating better work safety climate. The mean score in this study was 26.6, with an SD of 4.0, and a Cronbach's  $\alpha$  of 0.81.

Participant personal and work characteristics were used to describe the sample and in multivariate analysis. These included age (8–24, 25–29, 30–39, and 40 years); educational attainment (0–6 and 7 years); and years worked in US agriculture (1, 2–7, and 8). Dichotomous measures of work tasks in the past 7 days were planting or cultivating, topping tobacco (removing the flowers from the tobacco plant), harvesting, and loading or burning (loading and removing tobacco from the barns in which it is cured). These measures were selected because previous research showed that they were associated with health outcomes.<sup>2,3</sup>

## Analysis

Descriptive statistics were calculated for personal and work characteristics and outcomes using frequencies and means. The standardized Cronbach's  $\alpha$  was used to evaluate the consistency of items used to create the work safety climate scale and CES-D. Logistic regression models using generalized estimating equations methods were used to investigate the association of work safety climate with musculoskeletal discomfort, working while injured or ill, and depression. These models used a binomial distribution with a logit link, and they accounted for the clustering within a camp. Two different models were evaluated for each outcome. An unadjusted model was used, with only the predictor of interest, work safety climate, and a multivariate model with work safety climate, age, education, years worked in US agriculture, planting or cultivating, topping tobacco, harvesting, and loading or barning. The multivariate model was not used to evaluate the working while injured or ill outcome because of the low observed frequency of participants who reported working while injured or ill. Using these models, odds ratios and corresponding 95% confidence intervals were produced to show the association between work safety climate and health and safety outcomes. All data analyses were performed using SAS 9.2 (SAS Institute, Cary, NC).

## Results

This study included 300 participants (Table 1). More than two thirds (68.7%) were aged 30 years or older. Most (53.7%) had less than 7 years of formal education. Most (86.3%) had worked in agriculture for 2 or more years. During the 7 days before their interview, 7.7% of the participants worked planting or cultivating, 42.8% worked topping tobacco, 45.2% worked harvesting, and 7.7% worked loading or barning.

About 40% of participants had elevated musculoskeletal discomfort. Fifteen (5.0%) participants reported having worked at least 1 day in the current agricultural season while injured or ill. Although 13 of these participants had worked 1 to 8 days while injured or ill, 1 participant reported working 40 days and another reported working 45 days while injured or ill. Elevated depressive symptoms were reported by 27.9% of the participants.

Most of the participants reported that safe work practices were important to their grower (209; 70.1%), and that their grower informed them about dangerous work practices (177; 59.6%). However, most farmworkers reported that their growers did not often praise workers for working safely (161; 54.2%), that newly hired workers did not receive safety instructions (195; 65.2%), that workers did not attend regular safety meetings (245; 82.2%), and that proper safety equipment was not always available (253; 85.2%). Most (253; 85.5%) felt that farmworkers had control over their personal safety. Most (282, 94.9%) believed that taking risks was part of farmwork, and most (283, 95.0%) believed they would be injured within the year. Fewer than half (122; 40.7%) of the participants perceived that their grower did as much as possible about safety, with 33.0% (99) perceiving the grower could do more and 26.3% (79) perceiving the grower was most concerned about getting the work done quickly and cheaply.

Age was positively associated with musculoskeletal discomfort, working while injured or ill, and depressive symptoms, but not with work safety climate (Table 2). Those with 7 or more years of education reported a better work safety climate than those with 6 or fewer years of education. Harvesting was associated with a better work safety climate. Farmworkers topping tobacco less often reported working while injured or ill and a better work safety climate. Farmworkers loading and barning reported more elevated musculoskeletal discomfort, more days working while injured or ill, and lower work safety climate. Work safety climate was lower for those reporting elevated musculoskeletal discomfort, and for



those reporting having worked while injured or ill. Work safety climate was not associated with elevated depressive symptoms.

Work safety climate was associated with musculoskeletal discomfort and working while injured or ill, but not with depressive symptoms (Table 3). In both the unadjusted analysis and the analysis adjusted for age, education, years in US agriculture, and work activities, every 1-unit increase in work safety climate was associated with a 12% reduction in the odds of elevated musculoskeletal discomfort. In the unadjusted analysis, every 1-unit increase in work safety climate was associated with a 15% reduction in the odds of working while injured or ill. The small number of workers working while injured or ill precluded an adjusted analysis.

## Discussion

These results are important because they describe the level of work safety climate among farmworkers, a vulnerable worker population, and because they document that work safety climate is associated with health outcomes (musculoskeletal discomfort) and with dangerous work behaviors (working while injured or ill). These Latino farmworkers generally perceived their work safety climate to be poor. Although most reported that safety was important to their employers, they uniformly reported behaviors for their employers, such as not praising working safely and not providing proper safety equipment, which did not reflect a value for safety. Many farmworkers felt that their employers could do more for safety, and over one quarter felt that production was more important than safety for their employers. Almost all expected to be injured at work within a year. Although they used a different version of the worker safety climate scale developed by Gillen et al.,<sup>10</sup> Whalley et al. reported similar levels of work safety climate among Latino farmworkers in the same area of North Carolina, and Quandt et al.<sup>39</sup> and Grzywacz et al.<sup>40</sup> reported similar levels of work safety climate among Latino poultry processing workers in western North Carolina. Using a different scale to measure safety climate,<sup>41</sup> Sokas et al.<sup>42</sup> reported somewhat higher safety climate among union Latino construction workers who participated in a safety training program.

Work safety climate is important to the occupational health of Latino farmworkers. Those who perceived a less safe climate were at increased risk of experiencing musculoskeletal discomfort. They were also at greater risk of working when injured or ill. Whalley et al.<sup>13</sup> found that North Carolina farmworkers with a greater work safety climate practiced a greater number of pesticide safety behaviors. Grzywacz et al.<sup>40</sup> presented the only results examining the association of work safety climate with a health outcome among Latino poultry processing workers. They reported that lower perceived safety commitment among Latino poultry processing workers was associated with recent respiratory problems. In other worker populations, the importance of work safety climate for improving safety behavior and decreasing work injury was widely advocated.<sup>11</sup>

These results are important for improving the occupational health of migrant and seasonal farmworkers, as well as to improve occupational safety across agriculture. Knowledge of work safety climate in agriculture is nascent. Analyses of farmer attitudes indicated that many accepted risk, assumed that safety regulations and procedures were an unnecessary burden, were willing to overlook safety when they believed that production and the economic survival of the enterprise were in jeopardy, and believed that farmworker employees were at little risk for occupational injury.<sup>24-27</sup> At the same time, agriculture has one of the highest rates of occupational injury and mortality of all industries in the United States,<sup>43</sup> and farmworkers experience exceedingly high rates of occupational injury and illness.<sup>3-5</sup>

Addressing work safety climate is considered important for improving occupational safety and reducing occupational injury across industries.<sup>8,11,44</sup> This analysis builds on this larger research literature to indicate the importance of work safety climate for occupational safety in agriculture, particularly as related to migrant and seasonal farmworkers. Relatively few safety regulations are available to protect agricultural workers because of “agricultural exceptionalism,” the historic practice of excluding farmworkers and other agricultural workers from legal protections benefiting other workers.<sup>45</sup> Together with the acceptance of risk among agricultural employers and the perceptions of farmworkers that they must accept unsafe work conditions, the lack of safety regulations in agriculture results in a great concern for farmworker safety.<sup>1</sup>

Little occupational safety training is required for farmworkers or their employers<sup>23</sup>; safety training is 1 component of a safe work climate. For example, the only national occupational safety training required for agricultural workers is for pesticide safety based on the US Environmental Protection Agency Worker Protection Standard.<sup>46</sup> Washington and Oregon also require safety training for heat-related illness.<sup>47</sup> Because agriculture is a very hazardous industry, additional safety training should be required for workers and for their employers in an effort to improve the work safety climate in agriculture. Such training could be offered through existing agencies, such as county cooperative extension offices or county health departments. Larger corporate agricultural producers often provide this additional safety training, but they employ the minority of farmworkers. However, some large, corporate agricultural producers are also known to ignore safety and other regulations.<sup>48</sup> Additional requirements for training should recognize the burdens that might be placed on small agricultural producers and help these small producers comply with these requirements.

The results of this research should be interpreted within its limitations. The study was based on data collected from a small number of farmworkers in 1 area of 1 state; therefore, its generalizability might be limited. The data were cross sectional, and causality could not be established. The interpretation of the results would need to be modified if participants changed employers during the current agricultural seasons. However, although a small sample of farmworkers was recruited for this study, the sample was representative of farmworkers in the southeastern United States.<sup>21</sup> This study considered an important occupational health concern, work safety climate, in a population of workers at substantial risk and for which only limited information was available.

Work safety climate is important for the health and safety of workers in general; this analysis showed that it might also be important for workers in agriculture. Additional research on the importance of work safety climate in agriculture is needed in an effort to understand better how the organization of work affects occupational health in agriculture.<sup>19</sup> Interventions to improve the work safety climate in agriculture are also needed; although these interventions should be directed to agricultural workers, more importantly, they need to address the attitudes and behaviors of agricultural employers. Finally, existing occupational health and safety regulations for agriculture are extremely limited, they are often ignored, and they do not support a climate of work safety. Review and revision of health and safety policy in agriculture is needed to sustain a climate of work safety.

## Acknowledgments

This publication was supported by the Northeast Center for Agricultural and Occupational Health, with support from the National Institute for Occupational Safety and Health (grant Number U50 OH007542), and by the National Institute of Environmental Health Sciences (grant RO1 ES008739).

## References

1. Arcury, TA.; Marín, 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 United States: Health, Safety, and Justice*. New York: Springer; 2009. p. 15-36.
2. May, JJ. Occupational injuries and illness in farmworkers in the eastern United States. In: Arcury, TA.; Quandt, SA., editors. *Latino Farmworkers in the Eastern United States: Health, Safety, and Justice*. New York: Springer; 2009. p. 71-101.
3. Villarejo D. The health of U.S. hired farm workers. *Annu Rev Public Health*. 2003; 24:175–193. [PubMed: 12359914]
4. Villarejo D, McCurdy SA, Bade B, Samuels S, Lighthall D, Williams D III. The health of California's immigrant hired farmworkers. *Am J Ind Med*. 2010; 53(4):387–397. [PubMed: 20191600]
5. Steege, AL.; Baron, S.; Chen, X. [Accessed June 3, 2011] Occupational health of hired farmworkers in the United States: National Agricultural Workers Survey Occupational Health Supplement. DHSS (NIOSH) Publication No 2009-19. 1999. Available at <http://www.cdc.gov/niosh/docs/2009-119/default.html>
6. Arcury TA, Quandt SA. Delivery of health services to migrant and seasonal farmworkers. *Annu Rev Public Health*. 2007; 28:345–363. [PubMed: 17291182]
7. Sauter, SL.; Brightwell, WS.; Colligan, MJ., et al. Report No DHHS (NIOSH) No 2002-116. Cincinnati, OH: Department of Health and Human Services; 2002. *The Changing Organization of Work and the Safety and Health of Working People*.
8. Zohar D. Thirty years of safety climate research: reflections and future directions. *Accid Anal Prev*. 2010; 42:1517–1522. [PubMed: 20538108]
9. Zohar D. Safety climate in industrial organizations: theoretical and applied implications. *J Appl Psychol*. 1980; 65:96–102. [PubMed: 7364709]
10. 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]
11. Johnson SE. The predictive value of safety climate. *J Safety Res*. 2007; 38:511–521. [PubMed: 18023636]
12. DeJoy DM, Schaffer BS, Wilson MG, Vandenberg RJ, Butts MM. Creating safer workplaces: assessing the determinants and role of safety climate. *J Safety Res*. 2004; 35:81–90. [PubMed: 14992849]
13. Whalley LE, Grzywacz JG, Quandt SA, et al. Migrant farmworker field and camp safety and sanitation in eastern North Carolina. *J Agromedicine*. 2009; 14:421–436. [PubMed: 19894164]
14. Carroll, DJ.; Samardick, R.; Gabbard, SB.; Hernandez, T. Findings From the National Agricultural Workers Survey (NAWS) 2001–2002: A Demographic and Employment Profile of United States Farm Workers. Washington, DC: US Department of Labor, Office of the Assistant Secretary for Policy, Office of Programmatic Policy; p. 2005Research Report No 9
15. Bauer, M. *Close to Slavery: Guestworker Programs in the United States*. Montgomery, AL: Southern Poverty Law Center; p. 2007
16. 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]
17. 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; 8:85–97. [PubMed: 19835002]
18. Grieshop JI, Stiles MC, Villanueva N. Prevention and resiliency: a cross cultural view of farmworkers' and farmers' beliefs about work safety. *Hum Organ*. 1996; 55:25–32.
19. 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; 14:79–92. [PubMed: 18376537]



20. Keifer M, Salazar MK, Connon C. An exploration of Hispanic workers' perspectives about risks and hazards associated with orchard work. *Fam Community Health*. 2009; 32:34–47. [PubMed: 19092433]
21. Arcury TA, Estrada JM, Quandt SA. Overcoming language and literacy barriers in safety and health training of agricultural workers. *J Agromedicine*. 2010; 15:236–248.
22. Quandt SA, Arcury TA, Austin CK, Saavedra RM. Farmworker and farmer perceptions of farmworker agricultural chemical exposure in North Carolina. *Hum Organ*. 1998; 57:359–368.
23. Hunt, LM.; Tinoco-Ojanguren, R.; Schwartz, N.; Halperin, D. Balancing risks and resources: applying pesticides without using protective equipment in southern Mexico. In: Hahn, RA., editor. *Anthropology in Public Health: Bridging Differences in Culture and Society*. New York: Oxford University Press; 1999. p. 235-254.
24. Perry MJ, Marbella A, Layde PM. Association of pesticide safety beliefs and intentions with behaviors among farm pesticide applicators. *Am J Health Promot*. 1999; 14:18–21. [PubMed: 10621520]
25. Neufeld S, Wright SM, Gaut J. Not raising a “bubble kid”: farm parents' attitudes and practices regarding the employment, training and supervision of their children. *J Rural Health*. 2002; 18:57–66. [PubMed: 12043756]
26. Sorensen JA, May JJ, Paap K, Purschwitz MA, Emmelin M. Encouraging farmers to retrofit tractors: a qualitative analysis of risk perceptions among a group of high-risk farmers in New York. *J Agric Saf Health*. 2008; 14:105–117. [PubMed: 18376539]
27. Rao P, Arcury TA, Quandt SA, Doran A. North Carolina growers' and extension agents' perceptions of Latino farmworker pesticide exposure. *Hum Organ*. 2004; 63:151–161.
28. Verma A, Schulz MR, Quandt SA, et al. Eye health and safety among Latino farmworkers. *J Agromedicine*. 2011; 16:143–152.
29. Arcury TA, Quandt SA, Preisser JS. Predictors of incidence and prevalence of green tobacco sickness among Latino farmworkers in North Carolina, USA. *J Epidemiol Community Health*. 2001; 55:818–824. [PubMed: 11604438]
30. Arcury TA, Feldman SR, Schulz MR, et al. Diagnosed skin diseases among migrant farmworkers in North Carolina: prevalence and risk factors. *J Agric Saf Health*. 2007; 13:407–418. [PubMed: 18075016]
31. 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 Agro-medicine*. 2009; 14:22–32.
32. Brumitt J, Reisch R, Krasnoselsky K, et al. Self-reported musculoskeletal pain in Latino vineyard workers. *J Agromedicine*. 2011; 16:72–80. [PubMed: 21213166]
33. Walker-Bone K, Palmer KT. Musculoskeletal disorders in farmers and farm workers. *Occup Med (Lond)*. 2002; 52:441–450. [PubMed: 12488514]
34. Grzywacz JG, Quandt SA, Chen H, et al. Depressive symptoms among Latino farmworkers across the agricultural season: individual and contextual influences. *Cultur Divers Ethnic Minor Psychol*. 2010; 16:335–343. [PubMed: 20658876]
35. Hiott A, Grzywacz JG, Arcury TA, Quandt SA. Gender differences in anxiety and depression among immigrant Latinos. *Fam Syst Health*. 2006; 24:137–146.
36. 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, DHHS (NIOSH) Publication No. 2004-159 Informational Circular 9475; 2004. Available at: <http://www.cdc.gov/niosh/mining/pubs/pubreference/outputid82.htm>
37. Kohout FJ, Berkman LF, Evans DA, Cornoni-Huntley J. Two shorter forms of the CES-D depression symptoms index. *J Aging Health*. 1993; 5(2):179–193. [PubMed: 10125443]
38. Grzywacz JG, Hovey JD, Seligman LD, Arcury TA, Quandt SA. Evaluating short-form versions of the CES-D for measuring depressive symptoms among immigrants from Mexico. *Hisp J Behav Sci*. 2006; 28(3):404–424.
39. Quandt SA, Grzywacz JG, Marín A, et al. Illnesses and injuries reported by Latino poultry workers in western North Carolina. *Am J Ind Med*. 2006; 49:343–351. [PubMed: 16570254]

40. Grzywacz JG, Arcury TA, Marín A, et al. The organization of work: implications for injury and illness among immigrant Latinos in poultry processing. *Arch Environ Occup Health*. 2007; 62:19–26. [PubMed: 18171643]
41. Jorgensen E, Sokas RK, Nickels L, Gao W, Gittleman JL. An English/Spanish safety climate scale for construction workers. *Am J Ind Med*. 2007; 50(6):438–442. [PubMed: 17492632]
42. Sokas RK, Emile J, Nickels L, Gao W, Gittleman JL. An intervention effectiveness study of hazard awareness training in the construction building trades. *Public Health Rep*. 2009; 124(suppl 1):160–168. [PubMed: 19618818]
43. Bureau of Labor Statistics. National census of fatal occupational injuries in 2000. Washington, DC: Bureau of Labor Statistics, United States Department of Labor; Available at: <http://www.bls.gov/iif/oshwc/cfoi/cfnr0007.pdf>
44. Smith GS, Huang YH, Ho M, Chen PY. The relationship between safety climate and injury rates across industries: the need to adjust for injury hazards. *Accid Anal Prev*. 2006; 38:556–562. [PubMed: 16430845]
45. Wiggins, M. Farm labor and the struggle for justice in the Eastern United States fields. In: Arcury, TA.; Quandt, SA., editors. *Latino Farmworkers in the Eastern United States: Health, Safety, and Justice*. New York: Springer; 2009. p. 201-220.
46. US Environmental Protection Agency. The Worker Protection Standard for Agricultural Pesticides – How To Comply/What Employers Need To Know. Washington, DC: Office of Prevention, Pesticides and Toxic Substances (H7506C). EPA 735-B-93–001; 1993.
47. Jackson LL, Rosenberg HR. Preventing heat-related illness among agricultural workers. *J Agromedicine*. 2010; 15(3):200–215. [PubMed: 20665306]
48. Calvert GM, Alarcon WA, Chelminski A, et al. Case report: three farmworkers who gave birth to infants with birth defects closely grouped in time and place-Florida and North Carolina, 2004-2005. *Environ Health Perspect*. 2007; 115(5):787–791. [PubMed: 17520069]

**Table 1**  
**Participant Personal Characteristics: Farmworkers, Eastern North Carolina, 2009**

Personal Characteristics	Total Sample (n = 300), No. (%)
Age, y	
18–24	59 (19.6)
25–29	35 (11.7)
30–39	110 (36.7)
40	96 (32.0)
Education, y	
0–6	161 (53.7)
7	139 (46.3)
Years in US agriculture	
1	41 (13.7)
2–7	141 (47.0)
8	118 (39.3)
Work tasks in the past 7 d <sup>a</sup>	
Planting or cultivating	23 (7.7)
Topping tobacco	128 (42.8)
Harvesting	135 (45.2)
Loading or barning	23 (7.7)
Elevated musculoskeletal discomfort	118 (39.3)
Worked while injured or ill	15 (5.0)
Elevated depressive symptoms <sup>b</sup>	82 (27.9)

<sup>a</sup>Adds to more than 100% because some workers were engaged in > 1 task in a 7-day period.

<sup>b</sup>Six missing.



Personal Characteristics	Elevated Musculoskeletal Discomfort		Working While Sick		Elevated Depressive Symptoms		Work Safety Climate	
	Absent, No. (%) or Mean $\pm$ SD	Present, No. (%) or Mean $\pm$ SD	No, No. (%) or Mean $\pm$ SD	Yes, No. (%) or Mean $\pm$ SD	No, No. (%) or Mean $\pm$ SD	Yes, No. (%) or Mean $\pm$ SD	No. (Mean $\pm$ SD)	
Safety climate	23.2 $\pm$ 63.7	21.3 $\pm$ 64.3***	22.6 $\pm$ 63.95	19.4 $\pm$ 64.6***	22.3 $\pm$ 64.1	23.0 $\pm$ 63.9		

Note. *P* values for frequencies are results from  $\chi^2$  tests. *P* values for means are results from *t*-tests. All values (means, SDs, frequencies, and *P* values) are raw values (no adjustment for camp clustering).

\* *P* < .10.

\*\* *P* < .05;

\*\*\* *P* < .01.



**Table 3**  
**Multivariate Analyses of Associations of Work Safety Climate With Musculoskeletal Pain, Working While Injured or Sick, and Elevated Depressive Symptoms: Farmworkers, Eastern North Carolina, 2009**

Outcome	Unadjusted <sup>a</sup>		Adjusted <sup>b</sup>	
	OR (95% CI)	P	OR (95% CI)	P
Elevated musculoskeletal discomfort	0.88 (0.83, 0.94)	< .001	0.88 (0.82, 0.94)	< .001
Worked while injured or ill	0.85 (0.75, 0.96)	.009	–	–
Elevated depressive symptoms	1.04 (0.97, 1.10)	.301	1.05 (0.98, 1.13)	.147

Note. CI = confidence interval; OR = odds ratio. ORs and CIs compare the odds of a 1-unit increase in the safety climate score (continuous measure). A dash indicates that the analysis was not performed.

<sup>a</sup>Unadjusted results account for camp clustering.

<sup>b</sup>Adjusted results account for camp clustering and adjust for age (continuous), education (0–6 years, 7 years), years in US agriculture (1, 2–7, 8), and engaging in the work tasks planting or cultivating, topping tobacco, harvesting, and loading or burning in the past 7 days.