Published in final edited form as:
New Solut. 2011 ; 21(2): 251–268. doi:10.2190/NS.21.2.h.

WAGES, WAGE VIOLATIONS, AND PESTICIDE SAFETY EXPERIENCED BY MIGRANT FARMWORKERS IN NORTH CAROLINA*

ERIN ROBINSON[1], **HA T. NGUYEN**[1], **SCOTT ISOM**[2], **SARA A. QUANDT**[3], **JOSEPH G. GRZYWACZ**[1], **HAIYING CHEN**[2], and **THOMAS A. ARCURY**[1]

[1]Department of Family and Community Medicine, Wake Forest University School of Medicine

[2]Department of Biostatistical Sciences, Division of Public Health Sciences, Wake Forest University School of Medicine

[3]Department of Epidemiology and Prevention, Division of Public Health Sciences, Wake Forest University School of Medicine

Abstract

Farmworkers have the potential to receive wages that fail to meet minimum wage standards. This analysis describes wages and minimum wage violations among farmworkers, and it determines associations of wage violations with personal characteristics and pesticide safety regulation violations. Data are from a cross-sectional survey of 300 eastern North Carolina farmworkers conducted in June through August, 2009. Most farmworkers (90.0%) were paid by the hour, but 11.7 percent received piece-rate pay. Wage violations were prevalent among farmworkers: 18.3 percent of all farmworkers, 45.3 percent of farmworkers without H-2A visas, and 3.6 percent of farmworkers with H-2A visas experienced wage violations. Most farmworkers experienced numerous pesticide safety violations. Personal characteristics were not associated with wage violations among farmworkers without H-2A visas, but some pesticide safety violations were associated with wage violations. The association of violations indicates that some growers generally violate regulations. Greater enforcement of all regulations is needed.

Keywords

Occupational health; wage theft; minority health; health disparities

Migrant farmworkers experience a myriad of problems. These problems include occupational hazards, including pesticide exposure, that are exacerbated by the limited set of regulations and limited enforcement of these regulations [1–3], a lack of access to health care and social services [4], and poverty and food insecurity [5]. Another potential problem farmworkers face is not receiving the wages they have earned [6–8].

Migrant farmworkers in the United States number in the hundreds of thousands, although their exact number is not known [9]. These farmworkers are overwhelmingly Latino immigrants from Mexico [10]. Most are unaccompanied young men with limited formal education [9, 10]. Migrant farmworkers face an extraordinary set of occupational (e.g., pesticides exposure, machinery and equipment), environmental (e.g., poor housing), and lifestyle (e.g., separation from family) exposures that affect their health [1, 11–14]. At the

Direct reprint requests to: Thomas A. Arcury, Department of Family and Community Medicine, Wake Forest University School of Medicine, Winston-Salem, NC 27175, tarcury@wfubmc.edu.

same time, farmworkers have limited access to health services [4] and to culturally appropriate occupational safety training [15].

BACKGROUND

Few safety regulations are available to protect migrant farmworkers [3]. Due to what is often referred to as "agricultural exceptionalism," many current occupational safety regulations do not apply to the small agricultural employers of most migrant farmworkers. Current policy efforts include the Agricultural Job Opportunities, Benefits and Security Act [16], a bipartisan effort that would provide the opportunity for "earned legalization," enabling many undocumented farmworkers and farmworkers with temporary H-2A work visas to earn a "blue card" (temporary immigration status with the possibility of becoming permanent residents by continuing to work in agriculture and by meeting additional requirements), and would revise the existing H-2A temporary foreign agricultural worker visa program. The only current agricultural guest-worker program, the H-2A visa program, has been criticized for the potential for worker intimidation, limitations on freedom of association, and limitations on other labor rights [17].

Farmworker Pesticide Exposure and Safety Regulations

Pesticide exposure is a major occupational health risk for migrant farmworkers. Pesticide exposure has immediate health effects, such as rashes, dizziness, burning eyes, and vomiting; immediate health effects in severe cases of pesticide exposure include coma and death [18]. Pesticide exposure can also have long-term health effects, including increased risk for cancer, neurological decline, and problems with reproduction. Farmworkers are exposed to a variety of pesticides across the agricultural season [15, 19, 20].

The major regulation to protect farmworkers from pesticide exposure is the U.S. Environmental Protection Agency's Worker Protection Standard (WPS) [21]. The WPS requires that those employed in agriculture receive pesticide safety training before they accumulate five days of work in fields to which restricted-use pesticides had been applied in the previous 30 days. The WPS also requires that a set of safety procedures be in place. These safety procedures include notifying farmworkers where pesticides have been applied, observing the restricted entry intervals after pesticides have been applied, and providing appropriate personal protective equipment to farmworkers when they work with pesticides. However, training and safety procedures required by the WPS often are not provided [2, 22–27].

Farmworker Wage Regulations and Wage Violations

Minimum wage violations are a problem faced by many low-wage workers in the United States, regardless of geographical location, industry, or nationality. In 2008, 26 percent of low-wage workers in the three largest U.S. cities were paid less than the federally mandated minimum wage [28]. Farmworkers have a very low national average annual income of approximately $11,000 [10]. Farmworkers in the eastern United States earn about 35 percent less annually than do farmworkers in other regions [29]. The total average annual income in 2005 for farmworkers in the eastern United States was $7,150. This annual income is based on an average of 34.5 weeks of labor with 42 hours of labor per week. This is equivalent to an average hourly wage of $4.93 [10]. However, aside from the National Agricultural Workers Survey [10], systematic information on underpayment and wage theft for farmworkers is not available.

Minimum wage regulations for farmworkers are contingent on their visa status. Seasonal farmworkers and immigrant farmworkers without H-2A visas cannot be paid less than the

higher of the applicable state minimum wage or the federal minimum wage established by the Fair Labor Standards Act (FLSA). Immigrant farmworkers with H-2A visas must be paid the highest of 1) the Adverse Effect Wage Rate (AEWR) for the county in which they work; 2) the "prevailing rate" for a given crop, task, and area; or 3) the federal or applicable state minimum wage [30]. The Adverse Effect Wage Rate is a separate minimum wage set by the Department of Labor that will not have adverse effects on employment opportunities of United States workers [31]. The prevailing rate is established by the Department of Labor and reflects the hourly wage paid to the majority of workers in the largest city in each county [32].

Aims

This analysis uses survey data collected from migrant farmworkers in eastern North Carolina to address three aims. First, it describes the wages and the presence of minimum wage violations among farmworkers. Second, it determines whether minimum wage violations are associated with personal characteristics of farmworkers. Finally, it determines whether minimum wage violations are related to violations of pesticide safety regulations.

METHODS

This research is based on a community-based participatory research program that began in 1996. The primary partners for this collaboration are the North Carolina Farmworkers Project, a nonprofit service and advocacy organization located in Benson, North Carolina, and Wake Forest University School of Medicine. Data for this analysis are from a cross-sectional survey of migrant farmworkers completed from June through August, 2009. The Wake Forest University Health Sciences Institutional Review Board reviewed and approved the study protocol.

Locale

This study includes migrant farmworkers in three eastern North Carolina counties: Harnett, Johnston, and Sampson. Migrant farmworkers in these counties include those who are documented permanent residents of the United States, those who have temporary H-2A work visas, and those who are undocumented. These farmworkers are overwhelmingly from Mexico. The levels of pesticide exposure experienced by farmworkers in these counties have been documented in previous studies [15, 19, 20]. These studies show that farmworkers in North Carolina are exposed to a variety of pesticides, including several organophosphorous and pyrethroid insecticides, carbamate fungicides, and numerous herbicides. These farmworkers are repeatedly exposed to these pesticides across the agricultural season. Many of these farmworkers are not provided with the training and field sanitation resources required by regulation to protect them from pesticide exposure [2]. Migrant farmworkers in these counties, including documented United States permanent residents, those with H-2A visas, and those who are undocumented, generally live in grower-provided housing, referred to as camps. Substandard conditions are common in North Carolina migrant farmworker camps. Based on repeated measures data, Vallejos and colleagues [33] report that at any point in the 2007 agricultural season, between 11 percent and 44 percent of camps had inadequate bathing, laundry, or storage facilities. When housing was assessed in 2008, 89 percent of camps had more than one condition that violated the Migrant Housing Act standards.

Farmworkers in this region commonly experience several additional health problems. Some of these health problems, such as green tobacco sickness [34], skin disease [35], and eye symptoms [36], result from occupational exposures. Other health problems, such as food insecurity [37], human immunodeficiency virus (HIV) and other sexually transmitted

infections [38], and psychological problems [39] are related to poverty and migratory lifeways.

Participant Recruitment

Participant recruitment and selection involved two steps: 1) identifying and selecting camps; and 2) identifying and selecting workers within camps. As camps are widely distributed and not occupied every year, an approach similar to that described by Arcury and colleagues [35, 40] was used. The North Carolina Farmworkers Project serves the camps in the study counties. They provided their list of camps to the study team. Camps from the list were selected and visited in random order. If a randomly selected camp was not being used, interviewers went to the next camp on the randomized list. Access and participation of farmworkers in these camps was facilitated by the long-term relationship and trust between the North Carolina Farmworkers Project staff members and farmworkers in these counties. Following the standard procedures of this research program, growers were not consulted before camps were approached for participation. According to North Carolina law, farmworkers are considered *de facto* renters and they have the right to have any visitors whom they choose, including occupational health researchers. However, if a grower is present at a camp and asks the researchers to leave, they comply so as not to endanger themselves or the farmworkers.

A census was completed at the selected camps in which farmworkers gave preliminary consent to participate. Farmworkers at each camp were recruited from the census list; up to six participants were recruited at each camp. The overall sample size included 300 farmworkers recruited from 52 camps. Farmworkers at 62 camps were asked to participate in the study; workers at eight camps declined to participate, and growers refused to allow study personnel to recruit at two camps. At the 52 camps included in the sample, 157 individuals refused to participate, for a participation rate of 66 percent (300/457). Reasons for the refusals by camps and individuals were not recorded.

Data Collection

Data collection included an interviewer-administered questionnaire. Questionnaire items addressed participant demographic and background conditions, hours worked, method of determining payment, and pesticide safety and safety training. The questionnaire was developed in English and translated into Spanish by a native Spanish speaker familiar with Mexican Spanish and farmworker vocabulary. Five farmworkers were recruited to pretest the questionnaire. Modifications to the questionnaire were made based on farmworker feedback. This approach to questionnaire development has been consistently used in this community-based participatory research program, and it has provided reliable and valid information.

The Spanish-speaking interviewers were former farmworkers who have had a long-term association with the North Carolina Farmworkers Project. Their backgrounds and their association with the North Carolina Farmworkers Project were helpful in establishing trust with the farmworkers participating in this study. The interviewers completed a one-day program conducted by investigators and project coordinators. The program included a thorough review of camp and participant selection, recruitment procedures, and interview data collection procedures. All participants provided signed informed consent before data collection began. Participants received an incentive of $20 for participating in the study.

Measures

Analysis is based on three sets of measures derived from the questionnaire data: 1) participant wages and earnings in the current agricultural season; 2) personal characteristics;

and 3) adherence to pesticide safety and training regulations. Measures of actual wages that participants received and whether a minimum wage rate violation occurred were determined by a series of questions on hours worked, total earnings, and whether earnings were based on an hourly rate, a daily rate, or a piece rate (e.g., paid by the bucket or by the barn). If a participant was paid hourly and reported an hourly rate that was below the current federal minimum wage, a minimum wage violation was recorded. If a participant was paid on a piece rate, effective hourly earnings were derived by dividing amount paid per unit (e.g., bucket or barn) by the total number of hours it takes to complete that unit. If the effective hourly earnings did not meet the current minimum wage, a minimum wage violation was recorded. Wage measures are based only on federal minimum wage regulations, not on AEWR or prevailing rate.

Participant personal characteristics included gender; age in the categories 18 to 24 years, 25 to 29 years, 30 to 39 years, and 40 years and older; educational attainment in the categories zero to six years, and seven or more years; and years in U.S. agriculture in the categories less than one year, two to seven years, and eight or more years. Participants indicated whether they could speak Spanish, English, and an indigenous language. Finally, participants reported whether they had an H-2A visa.

Measures of adherence to pesticide safety and safety training regulations were based on the U.S. Environmental Protection Agency's Worker Protection Standard [21]. These dichotomous measures indicate whether the participants reported that 1) supervisors (growers or contractors) gave farmworkers instructions on safety when they were hired; 2) proper safety equipment was provided by supervisors; 3) they were told when pesticides were applied; 4) they were told when the no-reentry interval had ended in fields in which they were asked to work; 5) they were told to enter a field to which pesticides had been applied before the reentry interval had ended; 6) they worked in a field while pesticides were being applied; 7) they worked in a field adjacent to one in which pesticides were being applied; 8) water for washing hands was always available in the fields; and 9) soap for washing hands was always available in the fields. A final measure was the total number of pesticide safety violations based on the nine individual items.

Analysis

Descriptive statistics were calculated to describe the baseline characteristics of workers both with and without H-2A visas. All tests of significance and means take into account the clustering within camps. For the tests of categorical variables, a camp variable was added as a cluster in the surveyfreq procedure and the resulting Rao-Scott chi-square tests are presented. The association between wage violation and compliance with safety regulations was measured using a mixed model with a camp variable as a random effect. The resulting lsmeans, standard errors, and *p*-value are presented. All analyses were performed using SAS 9.2 (SAS Institute, Cary, NC).

RESULTS

Participant Characteristics

One-third of the participants did not have an H-2A visa (Table 1). Participants were largely (95.0%) male. About one-third were under 30 years of age, while about one-third were aged 30 to 39 years, and about one-third aged 40 years and older. More than half (53.7%) had less than seven years of education. Most (47.0%) had worked in U.S. agriculture for two to seven years. Almost all spoke Spanish (99.7%), with 11.7 percent speaking English and 20.0 percent speaking an indigenous language.

A greater percentage of those without an H-2A visa than with an H-2A visa were female (12.3% versus 1.0%). A greater percent of those without an H-2A visa were under 25 years of age (28.3% versus 14.9%), and had less than seven years of education (68.9% versus 45.4%). Those without an H-2A visa had less experience in U.S. agriculture; 23.6 percent of those without an H-2A visa were in their first year compared to 8.2 percent of those with an H-2A visa. More of those without an H-2A visa spoke English (17.9% versus 8.2%), and spoke an indigenous language (29.2% versus 14.9%).

Farmworker Wages

Most farmworkers (90.0%) were paid hourly; two (0.7%) were paid daily; 23 (7.7%) were paid by the bucket; and 12 (4.0%) were paid by the barn (Table 2). A smaller percentage of participants without H-2A visas were paid hourly than were participants with H-2A visas (84.9% vs. 92.8%). A greater percentage of workers without H-2A visas were paid by the bucket than were participants with H-2A visas (17.0% versus 2.6%). A smaller percentage of participants without H-2A visas were paid by the barn than were participants with H-2A visas (none vs. 6.2%).

Five participants (1.7%) reported having difficulty in obtaining their pay from their supervisors; two (1.9%) were workers without H-2A visas and three (1.5%) were workers with H-2A visas. Fifty-five (18.3%) of the farmworkers reported wages that fell below the federally mandated minimum wage. Forty-eight (45.3%) of the workers without H-2A visas reported wages that fell below minimum wage. Seven (3.6%) of the workers with H-2A visas reported wages that fell below the minimum wage.

Personal Characteristics and Wage Violations

Almost all farmworkers with H-2A visas reported receiving correct wages. Therefore, all remaining analyses of minimum wage violations were limited to workers without H-2A visas. Among farmworkers without H-2A visas, no associations between worker personal characteristics and wage violations were statistically significant (Table 3).

Farmworker Pesticide Safety and Training

Many of the farmworkers reported a lack of adherence to pesticide safety regulations where they worked (Table 4). Only a third (34.8%) reported being provided pesticide safety instruction by their supervisor, and 14.8 percent were provided with pesticide safety equipment. About half were told when pesticides were applied (51.0%) and when the no-reentry interval had ended (51.3%). About one-quarter (25.2%) were asked to enter fields before the no-reentry interval had ended, 16.0 percent worked in fields when pesticides were being applied, and 28.0 percent worked in areas adjacent to fields in which pesticides were being applied. Most (75.3%) had water available in the fields for hand washing, but only 44.3 percent had soap.

The work environments of farmworkers without H-2A visas differed in many aspects of pesticide safety from the work environments of farmworkers with H-2A visas. Farmworkers without H-2A visas were less likely to be provided with pesticide safety equipment (1.4% versus 18.2%), to be told when pesticides were applied (34.9% versus 59.8%), and to be told when the no reentry interval had ended (33.0% versus 61.3%). Fewer of those without H-2A visas reported being asked to enter fields before the no-reentry interval had ended (17.1% versus 29.5%). However, those without H-2A visas more often reported working in fields when pesticides were being applied (21.7% versus 12.9%), and working in areas adjacent to fields in which pesticides were being applied (41.5% versus 20.6%).

Farmworker Wages Associated with Safety and Training Conditions

Farmworkers without H-2A visas who reported wages that fell below the minimum wage were also less likely to report being told when pesticides were applied (22.9% versus 44.8% of those who reported wages that met the minimum wage), and to report being told when the no-reentry interval had ended (20.8% versus 43.1%) (Table 5). Other associations of minimum wage violations and adherence to pesticide safety regulations for workers without H-2A visas were not statistically significant; however, workers experiencing wage violations also tended to experience improper pesticide safety and training conditions. For example, workers with minimum wage violations were less likely to receive safety instructions than those with legally adequate wages (29.2% versus 37.9%). These workers were also more likely to work in a field while pesticides were being applied to that field than those without minimum wage violations (29.2% versus 15.5%). The mean total number of pesticide safety violations among those with minimum wage violations was 4.9, while the mean number of pesticide safety violations among pesticide safety violations among those without minimum without wage violations was 4.1.

DISCUSSION

Wage violations are prevalent among migrant farmworkers in eastern North Carolina. About one in five of all farmworkers and 45 percent of farmworkers without H-2A visas were found to experience minimum wage violations. Farmworkers lack control over their work environment [41] and often fear retaliation for reporting any type of violation [42]. Combining these occupational characteristics with limited staff in government agencies responsible for monitoring farmworker wages may result in minimum wage violations going unchecked.

Far fewer workers with H-2A visas (3.6%) than those without H-2A visas (45%) receive wages below the federally mandated minimum. The wages paid to workers in North Carolina with H-2A visas are closely monitored by the federal H-2A visa program as well as by the Farm Labor Organizing Committee, the union representing many North Carolina farmworkers with H-2A visas. Among workers without H-2A visas, the percent of workers experiencing minimum wage violations does not differ by age, gender, education, speaking an indigenous language, or years in agriculture. Therefore, it is not likely that wage violations are due to supervisors targeting or exploiting specific groups of people. The lack of targeting individuals with specific characteristics is similar to findings of previous studies regarding more general labor markets and wage violations [28].

The proportions of study participants reporting violations of pesticide safety regulations are similar to those reported in other studies conducted in North Carolina [2, 23, 26] and elsewhere [22, 25, 27]. Also similar to other studies in North Carolina, fewer farmworkers with H-2A visas than farmworkers without H-2A visas report violations of pesticide safety regulations [23]. However, a substantial percentage of farmworkers in this study with H-2A visas still report violations of pesticide safety regulations.

The H-2A visa program has been criticized because the control and intimidation exerted over these workers by their employers limits the workers' ability to voice concerns over unsafe working conditions [17]. Although the H-2A program raises serious human rights concerns, and the enforcement of program regulations is not adequate, the few empirically based, peer-reviewed papers in which the occupational safety and living conditions of migrant farmworkers with H-2A visas are compared with those of migrant farmworkers without H-2A consistently report that work and living conditions are better for farmworkers with H-2A visas. Compared to workers without H-2A visas, workers with an H-2A visa are more likely to receive pesticide safety training, and they are more likely to work for

employers who follow the pesticide safety regulations [2, 23]. Workers with H2-A visas are likely to live in housing with fewer violations [33].

Although regulatory scrutiny is far from adequate, the employers of farmworkers with H-2A visas are under far greater scrutiny than are other migrant farmworkers' employers. The greater compliance available to migrant farmworkers with H-2A visas for wages and pesticide safety, as well as housing regulations, indicates that we could expect higher compliance for all farmworkers with more regulations and with greater monitoring and review of these regulations.

Limitations of this study need to be noted when considering the results. First, we could not fully assess H-2A wages because no information was collected to determine the exact crop in which the farmworkers were working or the exact task being completed by workers. This may have affected determining the number of workers with H-2A visas experiencing wage violations. Secondly, farmworkers did not report their paycheck amount, only hours worked and wage rate. Finally, a community partner identified the camps included in this study; camps not known to the community partner could not be included. The study was also limited to the farmworkers present at the time of recruitment. However, the camp list compiled by the community partner was very extensive and was randomized before beginning data collection. A strength of this study is its high participation rate (65.6%).

Implications that arise from this research are the obvious need for designated regulatory staff to oversee farmworker wages. Also, due to the relationship between pesticide safety violations and wage violations, inspectors should investigate for wage violations when pesticide safety violations are found. This could greatly benefit the lives of all farmworkers as well as streamline the process of investigation for inspectors. These results argue for greater regulation and greater enforcement of regulation resulting in safer work and living conditions for all farmworkers.

Acknowledgments

This research was funded by the National Institutes of Health, National Institute of Environmental Health Sciences (Grant Number R01ES008739) and the Northeast Center for Agricultural and Occupational Health, with support from the National Institute for Occupational Safety and Health (Grant Number U50OH007542-09).

NOTES

1. Villarejo D. The Health of U.S. Hired Farm Workers. Annual Review of Public Health. 2003; 24:175–193.10.1146/annurev.publhealth.24.100901.140901
2. Whalley LE, et al. Migrant Farmworker Field and Camp Safety and Sanitation in Eastern North Carolina. Journal of Agromedicine. 2009; 14(4):421–436.10.1080/10599240903389508 [PubMed: 19894164]
3. Wiggins, Melinda. Farm Labor and the Struggle for Justice in the Eastern United States Fields. In: Arcury, Thomas A.; Quandt, Sara A., editors. Latino Farmworkers in the Eastern United States: Health, Safety, and Justice. New York: Springer; 2009. p. 201-220.
4. Arcury TA, Quandt SA. Delivery of Health Services to Migrant and Seasonal Farmworkers. Annual Review of Public Health. 2007; 28:345–363.10.1146/annurev.publhealth.27.021405.102106
5. Quandt SA, et al. Experiences of Latino Immigrant Families in North Carolina Help Explain Elevated Levels of Food Insecurity and Hunger. Journal of Nutrition. 2006; 136(10):2638–2644. [PubMed: 16988139]
6. Mountain Area Information Network. [accessed August 3, 2010] Farmworkers Bring Tales of Modern-Day Slavery to Asheville. October 14. 2008 http://main.nc.us/features/news/farmworkers-bring-tales-of-modern-day-slavery-to-asheville/

7. South Florida Interfaith Worker Justice. [accessed August 3, 2010] Farm Workers Win Dispute over Pay. March 5. 2009 http://sites.google.com/site/stopwagetheft/farm-workers-win-dispute-over-pay
8. New America Media Immigration. [accessed August 3, 2010] Farm Workers Flock to Illinois for Growing Season. May 15. 2010 http://newamericamedia.org/2010/05/farm-workers-flock-to-illinois-for-growing-season.php
9. Kandel, W. Economic Research Service (Report No. 60). U.S. Department of Agriculture; 2008. Profile of Hired Farmworkers: A 2008 Update.
10. Carroll, D., et al. Findings from the National Agricultural Workers Survey (NAWS) 2001–2002: A Demographic and Employment Profile of United States Farm Workers (Report No. 9). 2005.
11. Bradman A, et al. Association of Housing Disrepair Indicators with Cockroach and Rodent Infestations in a Cohort of Pregnant Latina Women and their Children. Environmental Health Perspectives. 2005; 113(12):1795–1801.10.1289/ehp.7588 [PubMed: 16330367]
12. Bradman A, et al. Pesticides and their Metabolites in the Homes and Urine of Farmworker Children Living in the Salinas Valley, CA. Journal of Exposure Science & Environmental Epidemiology. 2007; 17(4):331–49.10.1038/sj.jes.7500507 [PubMed: 16736054]
13. Alderete E, et al. Lifetime Prevalence of and Risk Factors for Psychiatric Disorders among Mexican Migrant Farmworkers in California. American Journal of Public Health. 2000; 90:608–614.10.2105/ajph.90.4.608 [PubMed: 10754977]
14. Hovey JD, Magaña CG. Exploring the Mental Health of Mexican Migrant Farm Workers in the Midwest: Psychosocial Predictors of Psychological Distress and Suggestions for Prevention and Treatment. The Journal of Psychology. 2002; 136(5):493–513.10.1080/00223980209605546 [PubMed: 12431034]
15. Arcury TA, et al. Repeated pesticide exposure among North Carolina migrant and seasonal farmworkers. American Journal of Industrial Medicine. 2010; 53:802–813.10.1002/ajim.20856 [PubMed: 20623661]
16. Farmworker Justice, Inc. [accessed February 10, 2011] AgJOBS: The Agricultural Job Opportunities, Benefits and Security Act. September. 2010 http://www.fwjustice.org/what-is-agjobs
17. Bauer, M. Close to Slavery: Guestworker Programs in the United States. Montgomery, AL: Southern Poverty Law Center; 2007.
18. Reigart, JR.; Roberts, JR. Recognition and Management of Pesticide Poisonings. 5. Washington, DC: U.S. Environmental Protection Agency; 1999.
19. Arcury TA, et al. Variation across the Agricultural Season in Organophosphorus Pesticide Urinary Metabolite Levels for Latino Farmworkers in Eastern North Carolina: Project Design and Descriptive Results. American Journal of Industrial Medicine. 2009; 52(7):539–550.10.1002/ajim.20703 [PubMed: 19517490]
20. Arcury TA, et al. Seasonal Variation in the Measurement of Urinary Pesticide Metabolites among Latino Farmworkers in Eastern North Carolina. International Journal of Occupational and Environmental Health. 2009; 15(4):339–350. [PubMed: 19886344]
21. U.S. Environmental Protection Agency. [accessed January 6, 2009] Pesticides: Health and safety. Part 170 - Worker protection standard. 1992. http://www.epa.gov/oppfead1/safety/workers/PART170.htm
22. General Accounting Office. [accessed March 31 2009] Pesticides: Improvements Needed to Ensure the Safety of Farmworkers and their Children (Gao/Rced-00-4). 2000. http://www.gao.gov/archive/2000/rc00040.pdf
23. Arcury TA, et al. Implementation of EPA's Worker Protection Standard Training for Agricultural Laborers: An Evaluation Using North Carolina Data. Public Health Reports. 1999; 114(5):459–468. [PubMed: 10590768]
24. Arcury T, Quandt S, Preisser J. Predictors of Incidence and Prevalence of Green Tobacco Sickness among Latino Farmworkers in North Carolina, U.S.A. Journal of Epidemiology and Community Health. 2001; 55(11):818–824.10.1136/jech.55.11.818 [PubMed: 11604438]
25. Shipp EM, et al. Pesticide Safety Training and Access to Field Sanitation among Migrant Farmworker Mothers from Starr County, Texas. Journal of Agricultural Safety and Health. 2005; 11(1):51–60.10.1080/10599240903389508 [PubMed: 15782888]

26. Buhler WG, et al. Violations of Pesticide Use and Worker Safety Regulations in North Carolina. Journal of Agricultural Safety and Health. 2007; 13(2):189–203. [PubMed: 17555207]
27. Farquhar S, et al. Promoting the Occupational Health of Indigenous Farmworkers. Journal of Immigrant and Minor Health. 2008; 10(3):269–280.10.1007/s10903-007-9075-5
28. Bernhardt, A., et al. [accessed May 6, 2010] Broken Laws, Unprotected Workers: Violations of Employment and Labor Laws in America's Cities. 2009. http://www.unprotectedworkers.org/index.php/broken_laws/index
29. Ward, L. East Coast Migrants' Health and Policy: An Analysis of the National Agricultural Workers Survey. Annual Meeting, East Coast Migrant Stream Forum; Tarrytown NY. October 23–25, 2003;
30. U.S. Department of Labor. [accessed January 7, 2010] Wages in Agriculture. http://www.dol.gov/compliance/topics/wages-agricultural.htm
31. Womach, J. [accessed August 20, 2010] Agriculture: A Glossary of Terms, Programs, and Laws. CRS Report for Congress. 20052005. http://ncseonline.org/NLE/CRSreports/05jun/97-905.pdf
32. Washington State Department of Labor and Industries. [accessed February 8, 2011] Prevailing Rate: What You Need to Know. http://www.lni.wa.gov/tradeslicensing/prevwage/basics/
33. Vallejos QM, et al. Migrant Farmworkers' Housing Conditions across an Agricultural Season in North Carolina. American Journal of Industrial Medicine. in press. 10.1002/ajim.20945
34. Arcury TA, et al. High Levels of Transdermal Nicotine Exposure Produce Green Tobacco Sickness in Latino Farmworkers. Nicotine & Tobacco Research. 2003; 5:315–312.10.1080/1462220031000094132 [PubMed: 12791526]
35. Arcury TA, et al. Diagnosed Skin Diseases among Migrant Farmworkers in North Carolina: Prevalence and Risk Factors. Journal of Agricultural Safety and Health. 2007; 13(4):407–418. [PubMed: 18075016]
36. Quandt SA, et al. Eye Symptoms and Use of Eye Protection among Seasonal and Migrant Farmworkers. Southern Medical Journal. 2001; 94(6):603–607. [PubMed: 11440328]
37. Quandt SA, et al. Household Food Security among Migrant and Seasonal Latino Farmworkers in North Carolina. Public Health Reports. 2004; 119(6):568–576. [PubMed: 15504448]
38. Rhodes SD, et al. HIV and Sexually Transmitted Disease Risk among Male Hispanic/Latino Migrant Farmworkers in the Southeast: Findings from a Pilot CBPR Study. American Journal of Industrial Medicine. 2010; 53(10):976–983.10.1002/ajim.20807 [PubMed: 20632316]
39. Grzywacz JG, et al. Leaving Family for Work: Ambivalence and Mental Health among Mexican Migrant Farmworker Men. Journal of Immigrant and Minority Health. 2006; 8(1):85–97.10.1007/s10903-006-6344-7 [PubMed: 19835002]
40. Arcury TA, et al. Farmworker Reports of Pesticide Safety and Sanitation in the Work Environment. American Journal of Industrial Medicine. 2001; 39(5):487–498.10.1002/ajim.1042 [PubMed: 11333410]
41. Austin C, et al. Training Farmworkers about Pesticide Safety: Issues of Control. Journal of Health Care for the Poor and Underserved. 2001; 12:236–249. [PubMed: 11370190]
42. Vela-Acosta MS, Bigelow P, Buchan R. Assessment of Occupational Health and Safety Risks of Farmworkers in Colorado. American Journal of Industrial Medicine. 2002; (Suppl 2):19–27.10.1002/ajim.10064 [PubMed: 12210678]

Table 1

Participant Characteristics: Farmworkers, Eastern North Carolina, 2009

Personal characteristics	Total sample *N* = 300		Participants without H-2A visas *N* = 106 (35.3%)		Participants with H-2A visas *N* = 194 (64.7%)		*p*-value
	N	%	*N*	%	*N*	%	
Gender							<0.0001
Male	285	95.0	93	87.7	192	99.0	
Female	15	5.0	13	12.3	2	1.0	
Age							0.0023
18 to 24 years	59	19.6	30	28.3	29	14.9	
25 to 29 years	35	11.7	12	11.3	23	11.9	
30 to 39 years	110	36.7	25	23.6	85	43.8	
40 years and older	96	32.0	39	36.8	57	29.4	
Educational attainment							0.0005
0 to 6 years	161	53.7	73	68.9	88	45.4	
7 or more years	139	46.3	33	31.1	106	54.6	
Years in agriculture in the United States							0.0030
1 year or less	41	13.7	25	23.6	16	8.2	
2 to 7 years	141	47.0	53	50.0	88	45.4	
8 or more years	118	39.3	28	26.4	90	46.4	
Language spoken							
Spanish	299	99.7	105	99.1	194	100.0	NA
English	35	11.7	19	17.9	16	8.2	0.0247
Indigenous	60	20.0	31	29.2	29	14.9	0.0387

*Data missing for one participant.

Table 2

Wage Characteristics for Farmworkers, Eastern North Carolina, 2009

Wage characteristics	Total sample *N* = 300[a]		Participants without H-2A visas *N* = 106		Participants with H-2A visas *N* = 194		*p*-value
	N	%	*N*	%	*N*	%	
Basis of sage							
Paid by the hour	270	90.0	90	84.9	180	92.8	0.2638
Paid by the day	2	0.7	2	1.9	0	--	NA
Paid by the bucket	23	7.7	18	17.0	5	2.6	0.0125
Paid by the barn	12	4.0	0	--	12	6.2	NA
Experience difficulty getting pay	5	1.7	2	1.9	3	1.5	0.8398
Wages below minimum wage	55	18.3	48	45.3	7	3.6	<0.0001

[a]Data missing for one participant.

New Solut. Author manuscript; available in PMC 2012 March 1.

Table 3

Association of Personal Characteristics and Minimum Wage Violations for Farmworkers without H-2A Visas, Eastern North Carolina, 2009 (N =106)

Personal characteristics	Minimum wage violation		Minimum wage adherence		p-value[a]
	N	%	*N*	%	
Participants without H-2A visas	48	45.3	58	54.7	
Age					0.2298
18 to 24 years	13	27.1	17	29.3	
25 to 29 years	5	10.4	7	12.1	
30 to 39 years	12	25.0	13	22.4	
40 years and older	10	37.5	21	36.2	
Gender					0.9810
Male	40	83.3	53	91.4	
Female	8	16.7	5	8.6	
Educational attainment					0.4973
0 to 6 years	35	72.9	38	65.5	
7 or more years	13	27.1	20	34.5	
Seasons in U.S. agriculture					0.3162
1 year or less	12	25.0	13	22.4	
2 to 7 years	27	56.3	26	44.8	
8 or more years	9	18.8	19	32.8	
Indigenous language					0.2116
No	37	77.1	38	65.5	
Yes	11	22.9	20	34.5	

[a] p-value accounts for camp clusters.

Table 4

Adherence to Pesticide Safety Regulations for Farmworkers, Eastern North Carolina, 2009 (N = 300)

Pesticide safety and training regulations	Total sample N = 300		Participants without H-2A visas N = 106		Participants with H-2A visas N =194		p-value[a]
	N	%	N	%	N	%	
Safety instructions given by supervisor	104[b]	34.8	36	34.0	68[b]	35.2	0.8874
Safety equipment provided by supervisor	45[‡]	14.8	9[c]	1.4	36[b]	18.2	0.1912
Told by supervisor when pesticides applied	153	51.0	37	34.9	116	59.8	0.0074
Told by supervisor when no reentry interval has ended	154	51.3	35	33.0	119	61.3	0.0038
Asked by supervisor to enter field before no reentry interval ended	75[c]	25.2	18[b]	17.1	57[b]	29.5	0.0411
Worked in field while pesticides were being applied	48	16.0	23	21.7	25	12.9	0.0943
Worked in field adjacent to where pesticides applied	84	28.0	44	41.5	40	20.6	0.0056
Water for hand washing always available in the field	226	75.3	85	80.2	141	72.7	0.3642
Soap for hand washing always available in the field	133	44.3	45	42.4	88	45.4	0.7775

[a] p-value accounts for camp clusters.

[b] 1 missing.

[c] 2 missing.

[d] 3 missing.

Table 5

Association of Adherence to Pesticide Safety Regulations and Minimum Wage Violations for Farmworkers without H-2A Visas, Eastern North Carolina, 2009 (N = 106)

Pesticide safety and training regulations	Minimum wage violation N = 48		Minimum wage adherence N = 58		p-value[a]
	N	%	N	%	
Safety instructions given by supervisor	14	29.2	22	37.9	0.4621
Safety equipment provided by supervisor	4	8.5	5	8.6	0.9843
Told by supervisor when pesticides applied	11	22.9	26	44.8	0.0077
Told by supervisor when no reentry interval has ended	10	20.8	25	43.1	0.0350
Asked by supervisor to enter field before no reentry interval ended	8	17.0	10	17.2	0.9774
Worked in field when pesticides applied	14	29.2	9	15.5	0.1183
Worked in field adjacent to where pesticides applied	22	45.8	22	37.9	0.5299
Water for hand washing always available in the field	39	81.3	46	79.3	0.8622
Soap for hand washing always available in the field	19	39.6	26	44.8	0.6749
Compliance with regulations – mean (standard deviation)	46[b]	4.9 (1.9)	58	4.1 (1.9)	0.1399

[a] p-value accounts for camp clusters.

[b] Cell size differs from sample size due to missing data