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Migrant Farmworker Field and Camp Safety and Sanitation in Eastern North Carolina

Lara E. Whalley, BA¹, Joseph G. Grzywacz, PhD¹, Sara A. Quandt, PhD², Quirina M. Vallejos, MPH¹, Michael Walkup, MS³, Haiying Chen, PhD³, Leonardo Galvan⁴, and Thomas A. Arcury, PhD¹

¹ Department of Family and Community Medicine, Wake Forest University School of Medicine, Winston-Salem, NC

² Department of Epidemiology and Prevention, Division of Public Health Sciences, Wake Forest University School of Medicine, Winston-Salem, NC

³ Department of Biostatistical Sciences, Division of Public Health Sciences, Wake Forest University School of Medicine, Winston-Salem, NC

⁴ North Carolina Farmworkers Project, Benson, NC

Abstract

Migrant farmworkers are exposed to numerous workplace hazards, with pesticides being a ubiquitous occupational exposure. This analysis describes farmworker experiences of field and camp safety conditions and their safety behaviors, and delineates farmworker characteristics associated with safety conditions and behaviors. Data were collected from 255 migrant farmworkers up to four times at monthly intervals during the 2007 agricultural season in eastern North Carolina. Measures assess field safety conditions and camp sanitation required by federal and state regulations. Most of the farmworkers were Latino men from Mexico. About 20% had not received pesticide safety training across the season; many of those who received such training did not understand it. Water for washing was not available for about one-third of the workers; soap and towels were not available for over half. About 20% lived in camps with more than eight workers per showerhead and about 20% lived in camps that failed to meet the standard of 30 or fewer workers per washtub/washing machine. Important predictors of variation included H2A visa status and years of experience. Four themes emerged from the analysis: (1) safety regulations are not consistently met; (2) farmworkers do not always practice safety behaviors; (3) camps become more crowded and less compliant during the middle of the agricultural season; and (4) workers with H2A visas experience better conditions and practice more safety behaviors than do workers who do not have H2A visas. Further research needs to account for social and cultural factors. Regulations should be compared with pesticide metabolite levels to measure their effectiveness. More effort is needed to enforce existing regulations.

Keywords

Migrant farmworkers; safety regulations; policy; agriculture; occupational health; minority health; rural health; health disparities

Introduction

This analysis describes farmworker experiences of field safety and sanitation conditions and farmworker occupational safety behaviors, and it delineates how farmworker characteristics are associated with these safety conditions and safety behaviors. Agriculture is one of the most dangerous industries in the United States.¹ This is particularly true for migrant and seasonal farmworkers.² Nationally, farmworkers are overwhelmingly Latino, with most coming from Mexico.³ Farmworkers confront multiple hazards. They work with sharp tools, and they work around machinery and toxic chemicals. They carry heavy loads, work in awkward positions, and work in the elements. Farmworkers also commonly live in substandard housing where poor conditions increase the risk of health problems.⁴ Exposure to these hazards often results in high rates of occupational injuries and illnesses that include severe lacerations, musculoskeletal injuries, skin disease, dehydration and heat stress, respiratory disease, infectious disease, and pesticide poisoning.^{3,5} Farmworkers have limited access to health care despite confronting numerous hazards.⁶ Barriers to care include language (speaking Spanish or an indigenous language), limited transportation, improper immigration and work documents, and the small number of migrant and community clinics designed to provide care.

Pesticides are a ubiquitous occupational exposure for farmworkers.⁷ In the fields, farmworkers are exposed to pesticides when handling and applying pesticides and while working in fields to which pesticides have been applied, even after the re-entry interval has expired.^{8,9} They are also exposed in their homes.¹⁰⁻¹³ Workers can expose their family and other household members by bringing pesticides into their homes on clothing, boots, and other materials.¹⁴

Farmworker Protections

Two sets of regulations exist to protect farmworkers from pesticide exposure. The Worker Protection Standard (WPS) was implemented by the US Environmental Protection Agency in 1984 and revised in 1992.¹⁵ The Occupational Safety and Health Administration (OSHA) sets standards for field sanitation and migrant housing regulations.¹⁶ For North Carolina, the WPS is administered by the North Carolina Department of Agriculture and Consumer Services, and the OSHA field sanitation and housing regulations are administered by the North Carolina Department of Labor.

The WPS requires that farmworkers receive pesticide safety training if they have accumulated five or more days of agricultural work, across their lifetime, in fields that were treated with pesticides up to 30 days before entry. The goal of the pesticide safety training is to educate farmworkers about what pesticides are and how to prevent or reduce pesticide exposure. The WPS lists 11 topics that must be covered in the trainings. Recommended behaviors included in WPS training to reduce exposure include washing their hands before eating or going to the bathroom, showering immediately when getting home from work, and washing work clothes separately from non-work clothes.¹⁵ The WPS requires that workers be trained in a language they understand. Other WPS requirements are that workers be told about the application of pesticides where they are working, and that warnings be posted in a central locale at the worksite or at the entrance of fields indicating where pesticides that have been applied and when workers may enter the fields (the re-entry interval) without wearing personal protective equipment (PPE).

Field sanitation and migrant housing standards established by OSHA detail what agricultural employers should provide to help protect workers from pesticide exposure. In the fields, they must provide cool, potable drinking water with individual cups (or a drinking fountain) for their employees. A toilet and an adjacent hand washing facility must be provided within a quarter mile of the field for every 20 workers. Housing regulations include having a working shower head for every ten people, a laundry tub or tray for every 30 people, facilities for drying

clothes, and an adequate supply of running hot and cold water for bathing and laundry. Other regulations cover the exterior and interior conditions of the housing, water supply, toilet facilities, and kitchen facilities.¹⁶

The WPS and OSHA regulations are designed to decrease pesticide exposure through two main mechanisms. First, pesticide safety trainings and regulations minimize farmworkers contact with pesticides used on crops.^{18,14} Following re-entry intervals and using appropriate personal protective equipment (PPE) as recommended by the WPS reduces the likelihood of being exposed to pesticides. Second, advocated behaviors such as showering immediately after work or washing contaminated clothes separately, which are supported by field sanitation and housing codes, reduce the amount of pesticides absorbed into the body. However, regulations are not always followed. Farmworkers do not always receive the required pesticide safety training.¹⁷⁻¹⁹ It is also unknown if all required information is covered at training sessions. Some workers who reported being trained still did not know how they could be exposed to pesticides.²⁰ Workers who speak an indigenous language or have low education attainment might not fully understand information on preventing pesticide exposure.²¹

Regulations that are not met increase the risk of pesticide exposure and health problems for farmers and farmworkers.^{17,20,22-24} Violations of the WPS and OSHA regulations can be reported. However, farmworkers often report that their housing conditions are better than they actually are, as they are afraid they may lose their jobs if they report violations.²⁵ Inspection of farmworker camps is limited due to the lack of resources. For example, in North Carolina during 2004, only five full-time OSHA agricultural inspectors were available to cover 88 of North Carolina's 100 counties.²² Although two more inspectors were added in 2007, for a total of seven, inspections remain limited. The WPS is enforced by only 10 inspectors for North Carolina. Violations might be underestimated because complaints and referrals are the main ways violations are discovered.²²

Employers play an important role in pesticide safety. They are responsible for training and for providing workers with appropriate PPE, such as masks, protective suits, and gloves, as well as maintaining facilities that help minimize contact with pesticides such as bathrooms and showers. Farmers who do not believe their workers are exposed to pesticides may not supply or maintain drinking, toilet, or laundry facilities because they do not believe it is a legitimate threat to the workers on their property.^{17,26,27}

Work environments may not encourage or allow workers to practice safety behaviors. An atmosphere that promotes safety (safety climate) and is organized in a way in which workers are able to exert their own judgment over tasks (job control) is more likely to have workers who implement pesticide safety behaviors. Job characteristics such as control and safety climate can influence a workers' use of precautions and their risk of injury or illness.²⁸⁻³⁰ Workers who perceive a lack of control over their job are less likely to take precautions.^{31,32} Positive safety climates increase safety practices.^{33,34} Workers who know how to protect themselves from exposure might not utilize their knowledge if they perceive they have no say in how they accomplish work tasks or if their work environment does not support safety behaviors.

Study Goal and Aims

The goal of this study is to evaluate compliance with federal and state regulations and farmworker behavior intended to minimize pesticide exposure. Research describing the effectiveness of WPS and OSHA regulations is limited. Most evaluation studies are cross-sectional; however, the agricultural season lasts several months with the number of workers employed dependent on changes in tasks (e.g., a greater number of workers when crops are being harvested). Safety and sanitation conditions could decline during the season due to an

influx of workers and more pesticide exposure could occur at this seasonal peak. Little is understood about what affects safety behaviors. Behaviors are affected by interactions between social, physical, and environmental factors.³⁵ Understanding how personal, occupational, sanitation, and safety characteristics affect safety practices in farming could help further protect growers and farmworkers from pesticide exposure. To achieve our goal, we use longitudinal data collected from 255 Latino migrant farmworkers working in North Carolina during the 2007 agricultural season to: (1) describe farmworker experiences of safety and sanitation conditions; (2) describe farmworker occupational safety and hygiene behaviors; and (3) delineate the associations of farmworkers personal and job characteristics with their safety and sanitation conditions and their safety and hygiene behaviors.

Methods

The data used in this analysis were collected in 2007 as part of a community-based participatory research project conducted in east central North Carolina. Community partners for this project included North Carolina Farmworkers Project (Benson, NC), Greene County Health Care, Inc. (Snow Hill, NC), and Columbus County Community Health Center (Whiteville, NC). This research study used a longitudinal design in which data were collected from participants up to four times at monthly intervals.

Locale

Data collection was completed in 11 counties with large farmworker populations, including Brunswick, Columbus, Cumberland, Greene, Harnett, Johnston, Lenoir, Pitt, Sampson, Wayne, and Wilson Counties. For these counties in 2007, estimates by the North Carolina Employment Security Commission put the number of migrant farmworkers without H2A visas at 13,675, which is 36.2% of all migrant farmworkers without H2A visas in North Carolina. The number of migrant farmworkers with H2A visas in the study counties is 2,995 (34.3% of all migrant farmworkers with H2A visas in North Carolina), and the number of seasonal farmworkers is 5,800 (22.8% of all seasonal farmworkers in North Carolina). The agricultural production in these counties varies, but the major hand-cultivated and hand-harvested crops include tobacco, sweet potatoes, and cucumbers.

Sample

A two-stage procedure was used to select farmworkers to participate in this research study. First, the three partnering agencies prepared lists of farmworker camps for the counties that they served. Camps were randomly selected and then approached in order until each agency recruited a minimum number of camps and a specified number of participants. All camps that were approached agreed to participate. Residents in each camp were recruited. In camps with seven or fewer residents, all farmworkers were invited to participate. In camps with more than seven residents, eight to ten farmworkers were recruited. For the overall study, 287 farmworkers were recruited at 44 camps with a participation rate was 95.7%. Participants included 32 seasonal farmworkers who are excluded in this analysis for a sample of 255 migrant farmworkers. At the first round of interviews, 233 migrant farmworkers were recruited to participate. At the second round of interviews, an additional 22 migrant farmworkers were recruited to replace farmworkers who were lost to follow-up. No new participants were recruited at the third or fourth rounds of data collection.

Data Collection

All procedures were approved by the Wake Forest University School of Medicine Institutional Review Board. Data collection was completed from May through September 2007. Data collectors included eight fluent Spanish speakers, divided into three teams. One team was affiliated with the camps served by each of the community partners. All of the interviewers

completed an intensive course of training that included a thorough review of camp and participant selection, recruitment procedures, and data collection procedures. Particular attention was directed toward the protection of human subjects, obtaining informed consent, and maintaining confidentiality. At the beginning of data collection, each team of interviewers was accompanied by a supervisor to help ensure that data collection procedures were properly followed. After the first six weeks of data collection, a supervisor accompanied each team of interviewers at least once each week to assure that no drift in data collection procedures occurred.

A detailed interview was completed with farmworkers at each of the four rounds of data collection. At every contact the questionnaire included items on living conditions and recent (in the 3 days before the interview) risk factors for pesticide exposure, including workplace activities and behaviors, household behaviors, psychosocial stressors, work environment, and household environment. At the first contact, the questionnaire also included items on participant personal characteristics (e.g., age, educational attainment) and current health status. The initial interview took about 45 minutes to complete, and about 25 minutes at the second through fourth contacts. The questionnaire used in these interviews was developed in English and translated by an experienced translator who was a native Spanish speaker familiar with Mexican Spanish. Validated Spanish language versions of scales were used. The translated questionnaire was reviewed by four fluent Spanish speakers familiar with farm work. The questionnaire was then pre-tested with 16 Spanish-speaking farmworkers and revised as needed.

Measures

The agricultural season was divided into four periods. Period 1 was from May 1 to June 8, Period 2 was from June 9 to July 7, Period 3 was from July 8 to August 5, and Period 4 was from August 6 to September 4. These periods were selected as they roughly corresponded to the major periods of the eastern North Carolina agricultural season, with the major activities being tobacco and sweet potatoes being planted in Period 1; cucumbers being harvested, tobacco being topped, and sweet potatoes being planted in Period 2; tobacco being topped and harvested in Period 3; and tobacco being harvested and cured in Period 4.

Five sets of measures are used to describe the participants. The first set includes the farmworker personal characteristics sex; 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 0 to 6 years, and 7 or more years; the three dichotomous measures of language including speaks English, speaks Spanish, and speaks an indigenous (American Indian) language; H2A visa status in the categories migrant without H2A visa and migrant with H2A visa; years in US agriculture in the categories 1 year or less, 2 to 7 years, and 8 or more years; and safety concern of boss in the categories of s/he does as much as possible to make my job safe, s/he could do more to make my job safe, and s/he is only interested in doing the job fast and cheaply.

The second set of measures includes job control (i.e., decision authority) which was created from the Job Content Questionnaire.³⁸ Farmworkers frequently have low levels of education³ and have difficulty responding to standard survey items, particularly those using affectively-based response categories.³⁶ Therefore, the JCQ items were modified to replace the affective response categories (strongly agree to strongly disagree) with a four-point frequency-based response set (always to never). Grzywacz and colleagues³⁶ used a similar strategy in another study of farmworkers. Control was assessed with three items (e.g., “How often are you allowed to make your own decisions about your work?”). The variable was constructed by summing constituent items and scored such that higher values indicate greater control. Job climate was created from a validated 10-item Perceived Safety Climate Scale.²⁹ In this study, we used the 9 items focused on management practices related to safety (e.g., “my

grower/contractor tells us about dangerous work practices or conditions). Response options ranged from 1 (strongly agree) to 4 (strongly disagree). Items were summed with higher values indicating greater perceived management commitment to worker safety.

The third set of measures focuses on field sanitation and safety conditions. Participants indicated if they had ever received pesticide safety training and if they understood all, most, or some or none of the pesticide safety training they had received. Dichotomous measures of field sanitation are the presence of water for washing hands, soap for washing hands, towels for drying hands, drinking water, individual cups for drinking water, and working in a field where pesticides had been applied in the past week for at least one day.

The fourth set of measures focuses on camp sanitation conditions. These included number of people in camp per bathroom and number of people in camp per showerhead, both in the categories of fewer than 4, 4 to 8, and more than 8; number of people in camp per washtub or washing machine in the categories of 1 to 8, 8.1 to 16, 16.1 to 30, and 30.1 and above or none in camp.

The fifth set of measures considers pesticide safety behaviors. The set included dichotomous measures of whether the farmworker wore shorts, sandals, short sleeves or sleeveless shirts, sandals, and re-wore clothes without washing at least once in the three days before the interview. Other safety behaviors included the number of times per day (in the three days before the interview) the farmworker had washed his/her hands per workday while working in the categories of 1 or less, greater than 1 to 4 times, and more than 4 times; and the average time the farmworker had waited to shower after work in the three days before the interview in the categories of 0 to 30 minutes, >30 to 60 minutes, and >60 minutes or did not shower. A summary measure of the pesticide safety behaviors was constructed in which participants were given a score of one if they did not wear shorts, sandals, short sleeve or sleeves shirts, or re-wear soiled clothes, washed their hands at least four times a day, and showered within 30 minutes after work. These scores were summed and the measure had a range of 0 to 6.

Analysis

Univariate summary statistics were produced to describe the data. Frequencies and percentages were used to describe discrete variables, while means, standard deviations and ranges were used to describe continuous variables. Bivariate analyses were performed to explore potential associations between outcomes (such as pesticide training, sanitation conditions, and safety behaviors) and independent personal and job characteristic variables. For the bivariate analyses, all data points from across the four periods of the agricultural season are included; therefore, the sample size for the bivariate analyses was the 834 interviews conducted with 255 migrant farmworkers. These associations were tested with a Generalized Estimating Equations (GEE) approach to allow adjustment for intra-class correlations within camp and correlations of repeated measures across time. Therefore, all the p-values reported were adjusted for the clustering nature of our data. Within the GEE framework, dichotomous and ordinal outcomes were analyzed using binary and ordinal logistic regressions, respectively. For categorical predictors, raw frequencies and percents were reported. For continuous predictors, regression parameter estimates (log odds) and standard errors were reported. A multivariate analysis was performed to examine predictors of a summary measure of pesticide safety behaviors. The significance of these predictors was determined with a mixed model that adjusted for intra-class correlations within camp and correlations of repeated measures across time. For significant predictors, regression parameter estimates and standard errors were reported. All analyses were performed using SAS version 9.2 (Cary, NC).

Results

Participant Characteristics

Participant personal characteristics are summarized in Table 1. Workers reported having a level of control below the midpoint on a range of one to four with the mean of 1.7 (SE 0.8). The safety climate mean was 2.3 (SE 0.5) ranging from 1.0 to 3.6.

Migrant Farmworker Field Sanitation and Safety Conditions

A substantial percent of farmworkers across the four periods reported that they had never received pesticide safety training (Table 2). Of the farmworkers who did receive pesticide safety training in 2007, many understood only some or none of the information at the training.

At every time period across the season, about two-thirds of the farmworkers reported having water available for hand washing. About half said they had soap available, and approximately 40% had towels to dry their hands. Almost all farmworkers reported they had water to drink at work, and about 85% said they were provided individual cups.

The percent of migrant farmworkers who reported working in a field to which pesticides had been applied in the past week declined across the four periods. Although 27.9% reported working in such fields in the first period, this declined to about 20% in the second and third periods, and to 9.9% in the final period.

Migrant Farmworker Camp Sanitation Conditions

Approximately 36% of workers reported more than eight people per bathroom (Table 2) and about one-quarter of farmworkers reported having eight or more people per showerhead. About 20% of farmworkers reported having over 30 people per washtub or washing machine or none at all.

Migrant Farmworker Occupational Safety Behaviors

Participants reported seldom wearing shorts or sandals while working (Table 3). However, about one-fifth reported wearing short sleeves or sleeveless shirts when they worked. Across the season, approximately 7% of the workers reported re-wearing work clothes before washing them. About one-third of workers reported washing their hands one time or less during work in the first three periods, while 18.8% reported once or less during the final period. Most farmworkers reported not showering or waiting over 60 minutes to take a shower after work. Around 30% reported waiting 0 to 30 minutes to shower and 10% between >30 and 60 minutes.

Migrant Farmworker Personal Characteristics Associated with Field Safety and Sanitation Conditions

Older migrant farmworkers were more likely to receive pesticide training than younger workers: 51.7% (n=77 data points) of those aged 18 to 24 years, 86.5% (147) of those aged 25 to 29 years, 83.2% (237) of those aged 30 to 39 years, and 90.0% (206) of those aged 40 years or older report receiving pesticide safety training ($p<.05$). About half (131, 49.8%) of workers without an H2A visa reported receiving pesticide safety training, whereas 94.0% (536) of those with an H2A visa reported receiving pesticide safety training ($p<.001$). Ability to speak English, having an H2A visa, and seasons in US agriculture were associated with having soap available for washing hands. Among those who spoke English, 56.1% (32) had soap, while 51.7% (401) of those who did not speak English had soap available ($p<.05$). Among those with an H2A, 59.5% (340) had soap, while 35.4% (93) without an H2A visa had soap ($p<.01$). Fewer than one-third (35, 30.4%) of those with 1 year or less experience, compared to 53.8% (204) of those with 2 to 7 years, and 57.0% (191) of those with 8 or more years experience had soap

available ($p < .05$). H2A visa status and seasons in US agriculture were associated with having towels available for drying hands. Among those with an H2A visa, 48.4% (276) had towels, while 25.5% (67) without an H2A visa had towels ($p < .01$). About one-quarter (67, 25.2%) of those with 1 year or less experience, compared to 40.9% (155) with 2 to 7 years, and 47.5% (159) of those with 8 or more years experience had towels available ($p < .05$). Finally, perceived safety concern of the boss was associated with working in a field where pesticides had been applied in the past week; 17.9% (93) of those who perceived their boss doing as much as possible to make the job safe reported working in such fields and 19.2% (30) of those who perceived that their boss could do more to make the job safe reported working in such fields, but 33.6% (41) of those who perceived that their boss was only interested in doing the job fast and cheaply reported working in such fields ($p < .05$).

Migrant Farmworker Personal Characteristics Associated with Camp Sanitation Conditions

Several personal characteristics were associated with the camp sanitation characteristic number of people per washtub or washing machine (Table 4). Age was associated with number of people per washtub or washing machine such that older workers have fewer people per washtub or washing machine. Almost half (46.4%) of farmworkers without H2A visas had over 30 people per washtub or had none in the camp compared to 10.9% of farmworkers with H2A visas. Workers who worked 8 or more years in agriculture were more likely to have fewer people per washtub or washing machine (14.3%), compared to 21.9% of those with 2 to 7 years experience, and 46.1% of those with 1 year or less experience.

Associations of Farmworkers Personal Characteristics with Safety Behaviors

Educational attainment, speaking an indigenous language, H2A status, seasons worked in agriculture, and safety concern of boss were significantly associated with safety behaviors (Table 5). Those with more years of education were more likely to wear short sleeves or sleeveless shirts. Workers who spoke an indigenous language were more likely to re-wear clothes without first washing them and wash their hands less than those who did not speak an indigenous language. Workers without H2A visas were more likely to wear short sleeves or sleeveless shirts while working, re-wear work clothes without washing them, wash their hands one or less times during the day, and wait over an hour to shower or not shower at all. Migrants who had worked 8 years or more in agriculture in the US were less likely to re-enter a field than those who worked less years, were less likely to wear short sleeves or sleeveless shirts while working, and were more likely to shower within 30 minutes of getting home after work. Participants who thought their boss did as much as possible to make their job safe were less likely to re-enter a field where pesticides had been applied, but they were more likely to wear short sleeves/sleeveless shirts.

The summary measure of pesticide safety behaviors had a range of zero to six (mean = 3.86, Standard Deviation = 1.07). The multivariate analysis found that H2A visa status had a strong, significant association with this summary measure ($b = 0.7241$, $SE = 0.1493$, $p < .0001$), indicating that those with an H2A visa practiced a greater number of pesticide safety behaviors. Safety climate also had a significant association with the summary measure ($b = -0.2391$, $SE = 0.1020$, $p < .05$), indicating that those who reported a more positive safety climate practiced a greater number of pesticide safety behaviors.

Discussion

The goals of this paper were to document migrant farmworker perceptions of safety and sanitation conditions, describe migrant farmworker safety behaviors, and examine how personal characteristics are associated with perceptions of sanitation conditions and safety behaviors. Four main themes emerged from this analysis.

First, WPS and OSHA regulations were not consistently met across the season. Fifteen years after the revised WPS regulations were implemented, not all farmworkers are receiving training on how to protect themselves from pesticide exposure. Other studies have found similar results.^{18–20} Furthermore, less than half the participants understood all of the information received at training over the course of the agricultural season. It is uncertain that all required information listed in the WPS is covered at training sessions. Arcury et al.¹⁷ found that workers who reported having received pesticide safety training still did not know how they could be exposed to pesticides. Many farmworkers did not have the resources to help them remove pesticides from their bodies. Water, soap or towels were not always available for workers to wash their hands, and shower and laundry facilities did not always meet standards.

A lack of staff may be the major reason these regulations are not enforced. The North Carolina Department of Labor has only seven inspectors to review all the 6,000 to 10,000 farmworker camps in the state for OSHA standards. These inspectors concentrate on preoccupancy inspections. The North Carolina Department of Agriculture & Consumer Services has only ten inspectors responsible for overseeing WPS compliance. The number of inspectors is not sufficient to make sure regulations are being followed during the agricultural season when the number of farmworkers in each camp can vary from period to period. The number of inspectors should be increased to adequately examine camps and regulatory compliance. The state also relies on growers to register camps themselves in order for camps to be inspected. Growers who do not employ H2A workers might not register camps. Subsequently, inspections would not take place and violations would be more likely to occur. The state relies on violations to be reported by farmworkers or the general public; however, if workers are not trained properly, they might not know if regulations are being violated. Workers might also be afraid of losing their job or of retaliation if they report violations.²⁵ Stricter penalties for violations as well as incentives for compliance should be created.

It is also possible that regulations are not followed because many growers do not believe their workers are exposed to pesticides.^{17,26,27} Because most workers do not directly handle pesticides, growers feel their workers are at little risk for pesticide exposure.²⁶ These perceptions are in conflict with research results that demonstrate workers are exposed to pesticides.^{5,6,11,12,14,22,37,38} Efforts are needed to revise training procedures to educate growers on how their employees are being exposed to pesticides and about methods they can implement to prevent this exposure.

A second theme emerging from this analysis is that farmworkers do not always practice pesticide safety behaviors. This could result from a lack of training. As about one-quarter of workers are not trained and about one-quarter do not understand the information from the training, workers might not know how to protect themselves from pesticides. Workers with H2A visas were more likely to receive training than those without these visas; workers with H2A visas were more likely to practice safety behaviors and have better sanitation conditions. The safety training, housing sanitation, and field sanitation regulations are more stringently enforced for workers with H2A visas.

Farmworkers who have worked more seasons in agriculture were found to practice more safety behaviors and have better sanitation conditions. Seasoned workers might accumulate knowledge on how to protect themselves from pesticide exposure and on what conditions should be according to WPS and OSHA regulations.

Participants who spoke an indigenous language were less likely to practice safety behaviors and had poorer sanitation conditions. These workers were also less likely to have received safety training and might not know how to protect themselves or what conditions should be covered by the regulations. This could be related to H2A status, since workers with these visas

tend to come across more regulations than those who do not. Speaking an indigenous language was found to be negatively correlated with H2A visa. Of workers who spoke an indigenous language, only 12.7% had an H2A visa. Farquhar et al.²¹ found that safety information was inaccessible to indigenous language speakers because it was not in a language they could understand. These workers also experienced discrimination because of their unique backgrounds. Social and cultural factors, such as beliefs in Humoral Medicine, might underlie pesticide safety behaviors.

The work environment might also help explain sanitation behaviors in the camp and field. Work places that have positive safety climates can increase the practice of safety behaviors.^{33,34} Workers who had a positive safety climate were more likely to follow the WPS safety recommendations. Workers who perceived their boss was only interested in doing the job fast and cheaply were more likely to re-enter fields where pesticides had been applied, but less likely to wear short sleeved/sleeveless shirts. Austin et al.³¹ shows that workers who reported more control in their job were more likely to use protective means against pesticide exposure. Workers might not feel they are able to protest entering a field where pesticides have been applied for fear of losing their job, but they are able to wear long-sleeved shirts to help reduce exposure without conflict.

A third theme relates to crowding. More farmworkers are hired during June and July because more work, such as harvesting tobacco, needs to be done during these periods. Camps become more crowded as a result.⁴ The number of camps in which workers reported 30 or more people per washtub and the number of workers who waited over an hour to shower or did not shower at all increases in June and July. More regulations could be violated due to crowding. An influx of farmworkers could also cause facilities to breakdown. In either case, workers could not remove pesticides from their bodies as recommended by the WPS and intended by the OSHA housing standards. Inspections should be made throughout the season to insure that regulations continue to be met.

Finally, we found that workers with an H2A visa experience better sanitation and safety conditions and practice more safety behaviors than do workers who do not have an H2A visa. Workers with H2A visas live in specific camps with few or no workers without such visas. H2A workers experience more regulation than workers who do not have an H2A visa; for example, the camps they live in are registered with the North Carolina Department of Labor and must be inspected, which reduces improper sanitation conditions. They are also more likely to have received pesticide safety training to know how to protect themselves from pesticides. Workers who do not have H2A visas are more likely to be undocumented and live in unregistered camps. In this situation, inspections do not occur. Undocumented workers are more likely to be afraid of losing their job or of being deported and are less likely to report violations. This visa status illustrates how regulations increase safety conditions and behaviors that protect farmworkers from pesticide exposure.

Limitations of the study need to be taken into account with regards to the results. This research was conducted in a selected area of one state; other states may differ in their patterns of safety behaviors and conditions as well as regulations. The sample was limited to the camps known to community partner organizations, and participants were limited to those living in the camps at the time of recruitment. However, the partner agencies have long-term experience and actively seek out camps. A strength of the study is the fact that a large number of farmworkers participated with a very low rate of refusal. The data were collected from 44 camps across an eleven county area.

Further research on field sanitation and pesticide safety needs to account for social and cultural factors. Farmworkers might have beliefs that conflict with recommended safety behaviors.²⁷

Their work environments also might not be conducive for finding compliant sanitation conditions and for practicing safety measures. More regulations, such as having soap available for hand washing or having one washtub for every 30 people, should also be examined against pesticide metabolite levels to see how effective they are in protecting farmworkers from pesticide exposure. Being able to measure pesticide exposure with conditions and behaviors will allow us to further understand this relationship. This study illustrates seasonal crowding by examining safety conditions and behaviors across the season, which other studies overlook. Future studies should look at the whole agricultural season to be able to further understand temporal trends.

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Table 1

Migrant Farmworker Personal Characteristics, Eastern North Carolina, 2007.

Personal Characteristics	N	%
Sex		
Male	241	94.5
Female	14	5.5
Age		
18 to 24 years	55	21.6
25 to 29 years	51	20.0
30 to 39 years	84	32.9
40 or more years	65	25.5
Educational Attainment		
0 to 6 years	133	52.2
7 or more years	122	47.8
Language		
Speaks English	24	9.4
Speaks Spanish	255	100.0
Speaks indigenous language	63	24.7
H2A Status		
Without H2A visa	109	42.7
With H2A visa	146	57.3
Years in US Agriculture		
1 year or less	44	17.3
2 to 7 years	117	46.1
8 or more years	93	36.6
Safety Concern of Boss		
S/he does as much as possible to make my job safe	170	66.9
S/he could do more to make my job safe	47	18.5
S/he is only interested in doing the job fast and cheaply	37	14.6

Note: Sample size varies due to missing data.

Table 2
Migrant Farmworker Perceived Field Sanitation and Safety Characteristics, and Perceived Camp Sanitation Conditions, Eastern North Carolina, 2007.

	5/1-6/8 (N=233)		6/9-7/7 (N=207)		7/8-8/5 (N=202)		8/6-9/4 (N=192)	
	N	%	N	%	N	%	N	%
Field Sanitation and Safety Conditions								
Received Pesticide Training								
No	54	23.2	45	21.7	37	18.3	27	14.1
Yes	179	76.8	162	78.3	165	81.7	165	85.9
Level Understood Pesticide Safety Training								
All	56	33.1	7	20.6	9	47.4	1	14.3
Most	58	34.3	5	14.7	5	26.3	1	14.3
Some or none	55	32.5	22	64.7	5	26.3	5	71.4
Water for Washing Hands Available	179	76.8	142	68.6	134	66.3	125	65.1
Soap for Washing Hands Available	111	47.6	104	50.2	111	55.0	107	55.7
Towels for Drying Hands Available	74	31.8	89	43.0	89	44.1	91	47.4
Drinking Water Available	224	96.1	198	95.7	191	94.6	186	96.9
Individual Cups for Drinking Water Available	180	77.3	177	85.5	165	81.7	163	84.9
Worked in Field Where Pesticides Have Been Applied in the Past Week (re-entry) At Least One Day	65	27.9	43	20.8	38	18.8	19	9.9
Camp Sanitation Conditions								
Number of People in Camp per Bathroom								
Fewer than 4	31	13.3	20	9.7	26	12.9	43	22.4
4 to 8	102	43.8	118	57.0	113	55.9	95	49.5
More than 8	100	42.9	69	33.3	63	31.2	54	28.1
Number of People in Camp per Showerhead								
Fewer than 4	52	22.3	36	17.4	38	18.8	69	35.9
4 to 8	120	51.5	126	60.9	130	64.4	96	50.0
More than 8	61	26.2	45	21.7	34	16.8	27	14.1
Number of People in Camp per Washtub/Washing Machine								
1 to 8	135	57.9	107	51.7	81	40.1	93	48.4
8.1 to 16	22	9.4	31	15.0	73	36.1	52	27.1
16.1 to 30	33	14.2	12	5.8	0	0.0	10	5.2
30.1 and above or none in camp	43	18.5	57	27.5	48	23.8	37	19.3

Note: Sample size varies due to missing data.

Table 3

Migrant Farmworker Pesticide Behaviors, Eastern North Carolina, 2007

	5/1-6/8 (N=233)		6/9-7/7 (N=207)		7/8-8/5 (N=202)		8/6-9/4 (N=192)	
	N	%	N	%	N	%	N	%
Wearing Shorts at Least One Day	7	3.0	4	1.9	5	2.5	10	5.2
Wearing Sandals at Least One Day	6	2.6	3	1.4	3	1.5	3	1.6
Wearing Short Sleeves/Sleeveless Shirts At Least One Day	61	26.2	49	23.7	23	11.4	27	14.1
Re-wears Clothes Without Washing at Least One Day	26	11.2	14	6.8	9	4.5	11	5.7
Washing Hands per Day Worked								
1 or less	87	37.3	72	34.8	62	30.7	36	18.8
>1 to 4 times	135	57.9	126	60.9	134	66.3	146	76.0
More than 4 times	11	4.7	9	4.3	6	3.0	10	5.2
Showering After Work								
0 to 30 minutes waited	73	31.3	53	25.6	44	21.8	61	31.8
>30 to 60 minutes waited	29	12.4	29	14.0	24	11.9	18	9.4
Did not shower/waited more than 60 minutes	131	56.2	125	60.4	134	66.3	113	58.9

Bivariate Associations of Migrant Farmworker Personal Characteristics with Camp Sanitation, Eastern North Carolina, 2007.

Table 4

Personal Characteristics	Number of People in Camp per Washtub or Washing Machine												
	1 to 8			>8 to 16			>16 to 30			Greater than 30 or None in Camp			
	n	%	n	%	n	%	n	%	n	%			
Age*													
18 to 24 years	40	26.8	36	24.2	13	8.7	60	40.3					
25 to 29 years	89	52.4	29	17.1	14	8.2	38	22.4					
30 to 39 years	147	51.6	66	23.2	18	6.3	54	18.9					
40 or more years	140	61.1	47	20.5	10	4.4	32	14.0					
Educational attainment													
0 to 6 years	228	53.8	64	15.1	29	6.8	103	24.3					
7 or more years	188	46.0	114	27.9	26	6.4	81	19.8					
Speaks English													
No	387	49.9	172	22.2	45	5.8	172	22.2					
Yes	29	50.9	6	10.5	10	17.5	12	21.1					
Speaks Indigenous Language													
No	358	54.0	172	25.9	37	5.6	96	14.5					
Yes	58	34.1	6	3.5	18	10.6	88	51.8					
H2A Status*													
Without H2A visa	94	35.7	14	5.3	33	12.5	122	46.4					
With H2A visa	322	56.5	164	28.8	22	3.9	62	10.9					
Years in US agriculture*													
1 year or less	31	27.0	13	11.3	18	15.7	53	46.1					
2 to 7 years	175	46.2	102	26.9	19	5.0	83	21.9					
8 or more years	209	62.4	61	18.2	17	5.1	48	14.3					
Safety Concern of Boss													
S/he does as much as possible to make my job safe	249	46.3	107	19.9	45	8.4	137	25.5					
S/he could do more to make my job safe	92	56.8	42	52.9	7	4.3	21	13.0					
S/he is only interested in doing the job fast and cheaply	75	58.1	29	22.5	3	2.3	22	17.1					
Job Control Estimate (Std. Err.)	-0.08 (0.16)												
Safety Climate Estimate (Std. Err.)	-0.05 (0.22)												

Note: Sample size varies due to missing data.

* p<.05

Bivariate Associations of Personal Characteristics with Pesticide Behaviors among Migrant Farmworkers in Eastern North Carolina, 2007.

Table 5

Personal Characteristics	Worked in Field Where Pesticides Have Been Applied in the Past Week (re-entry) At Least One Day			Washing Hands per Day Worked						Showering After Work								
	n	%		1 or less	>1 to 4 times	More than 4 times	0 to 30 minutes	>30 to 60 minutes	Did not Shower or waited more than 60 minutes	n	%		n	%	n	%		
Age																		
18 to 24 years	35	23.5	45	31.3	18	12.5	55	36.9	88	59.1	6	4.0	30	20.1	13	8.7	106	71.1
25 to 29 years	26	15.3	31	19.0	10	6.1	50	29.4	113	66.5	7	4.1	43	25.3	20	11.8	107	62.9
30 to 39 years	59	20.7	55	20.0	23	8.4	82	28.8	191	67.0	12	4.2	93	32.6	36	12.6	156	54.7
40 or more years	45	19.7	29	13.1	9	4.1	70	30.6	148	64.6	11	4.8	65	28.4	31	13.5	133	58.1
Educational attainment																		
0 to 6 years	87	20.5	68	16.7*	35	8.6	139	32.8	266	62.7	19	4.5	127	30.0	48	11.3	249	58.7
7 or more years	78	19.1	92	23.2	25	6.3	118	28.9	274	67.0	17	4.2	104	25.4	52	12.7	253	61.9
Speaks English																		
No	154	19.9	150	20.1	56	7.5	244	31.4	500	64.4	32	4.1	212	27.3	95	12.2	469	60.4
Yes	11	19.3	10	18.2	4	7.3	13	22.8	40	70.2	4	7.0	19	33.3	5	8.8	33	57.9
Speaks Indigenous Language																		
No	134	20.2	119	18.5	33	5.1*	177	26.7	451	68.0	35	5.3*	194	29.3	85	12.8	384	57.9
Yes	31	18.2	41	25.5	27	16.8	80	47.1	89	52.4	1	0.6	37	21.8	15	8.8	118	69.4
H2A Status																		
Without H2A visa	58	22.1	79	32.2**	34	13.9**	114	43.3	144	54.8	5	1.9**	52	19.8	22	8.4	189	71.9*
With H2A visa	107	18.8	81	14.5	26	4.7	143	25.1	396	69.5	31	5.4	179	31.4	78	13.7	313	54.9
Years in US agriculture																		
1 year or less	13	11.3*	34	32.1*	14	13.2	43	37.4	71	61.7	1	0.9	18	15.7	10	8.7	87	75.7**
2 to 7 years	86	22.7	84	22.6	32	8.6	114	30.1	250	66.0	15	4.0	96	25.3	38	10.0	245	64.6
8 or more years	64	19.2	41	12.7	14	4.3	99	29.6	218	65.1	18	5.4	115	34.3	52	15.5	168	50.1
Safety Concern of Boss																		
S/he does as much as possible to make my job safe.	93	17.3*	124	23.8*	36	6.9	169	31.4	351	65.2	18	3.3	140	26.0	64	11.9	334	62.1
S/he could do more to make my job safe.	30	18.5	20	12.8	13	8.3	43	26.5	107	66.0	12	7.4	51	31.5	19	11.7	92	56.8
S/he is only interested in doing the job fast and cheaply.	41	32.0	15	12.3	9	7.4	44	34.1	79	61.2	6	4.7	40	31.0	17	13.2	72	55.8
Job Control – Estimate (Std. Err.)	0.12 (0.15)		0.06 (0.15)		-0.17 (0.20)		0.04 (0.12)						-0.05 (0.09)					
Safety Climate – Estimate (Std. Err.)	-0.02 (0.16)		-0.06 (0.19)		0.03 (0.27)		-0.28 (0.17)						0.11 (0.16)					

Note: Sample size varies due to missing data.

* p<.05

** p<.01