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Occupational Health of Immigrant Workers in the Agriculture, Forestry and Fishing Industries in the Southeast United States

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Review Article

Overview of Immigrant Worker Occupational Health and Safety for the Agriculture, Forestry, and Fishing (AgFF) Sector in the Southeastern United States

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Background *Manual labor in the Agriculture, Forestry, and Fishing (AgFF) Sector is provided primarily by immigrant workers. Limited information is available that documents the demographic characteristics of these manual workers, the occupational illnesses, injuries and fatalities they experience; or the risk factors to which they are exposed.*

Methods *A working conference of experts on occupational health in the AgFF Sector was held to address information limitations. This paper provides an overview of the conference. Other reports address organization of work, health outcomes, healthcare access, and safety policy.*

Contents *This report addresses how best to define the population and the AgFF Sector, occupational exposures for the sector, data limitations, characteristics of immigrant workers, reasons for concern for immigrant workers in the AgFF Sector, regulations, a conceptual model for occupational health, and directions for research and intervention.* Am. J. Ind. Med. 56:912–924, 2013. *© 2013 Wiley Periodicals, Inc.*

KEY WORDS: immigrant workers; migrant workers; agriculture; forestry; fishing; health disparities; minority health

INTRODUCTION

Manual labor is essential to agriculture, forestry, and fishing in the southeastern United States (US), and much of this manual labor is provided by immigrant workers. Immigrant manual workers plant, cultivate, and harvest vegetables, fruits, tobacco, and Christmas trees within southeastern US agriculture [Elmore and Arcury, 2001; Arcury et al., 2008; Arcury and Marín, 2009]. They work in the confined animal feeding operations producing chickens and hogs (CAFOs). They plant and cut trees for forestry [Melton et al., 2007; Sarathy and Casanova, 2008], and catch and process crustaceans and shellfish for fisheries [Selby et al., 2001; Carruth et al., 2010; Levin

Additional supporting information may be found in the online version of this article.

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et al., 2010]. Industries within the Agriculture, Forestry, and Fishing (AgFF) Sector share many organizational and environmental characteristics that affect the health of immigrant workers, including exposure to hazards in the natural environment, use of hazardous machinery and chemicals, and unconventional work arrangements.

The objectives for the "Agriculture, Forestry, and Fisheries in the Southeastern US: Immigrant Worker Health" conference were to consolidate and disseminate current knowledge on the health and safety of immigrant workers in the AgFF Sector, to delineate the most pertinent directions for health and safety research among immigrant workers in the AgFF Sector, and to facilitate the development of working groups to implement projects that can address the health and safety needs of immigrant workers in the AgFF Sector. This article provides an overview for this issue by defining: (1) the region, the categories of immigrant workers, the AgFF Sector, and the occupational exposures of immigrant workers in this Sector; (2) current data limitations for documenting the occupational health and safety of immigrant workers in the AgFF Sector; (3) characteristics of immigrant workers in the AgFF Sector; (4) reasons for concern about immigrant workers in this Sector; (5) policies affecting the health and safety of workers in the AgFF Sector; (6) a conceptual model of the occupational health and safety of immigrant workers in the AgFF Sector; and (7) directions for future research and intervention addressing the occupational health and safety of immigrant workers in the AgFF Sector. Other articles in this collection examine organization of work, occupational health outcomes, healthcare access, occupational health and safety policy for immigrant workers in the AgFF Sector.

DEFINITIONS

Region

The conference focused on immigrant workers in the southeastern US. This region includes Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, South Carolina, Tennessee, and Virginia, as well as Puerto Rico.

Immigrant Workers

Definitions of what constitutes an immigrant or migrant worker vary. Formal definitions in governmental regulations delineate those who can receive services. For example, the US Department of Health and Human Services defines a migrant farmworker as, "an individual whose principal employment is in agriculture on a seasonal basis, who has been so employed within the last 24 months, and who establishes for the purpose of such employment a temporary abode." Research programs have developed operational definitions for migrant workers. For example, the National Agricultural Workers Survey (NAWS) classifies agricultural workers into three major types: non-migrants, domestic migrants, and international migrants [Carroll et al., 2005]. Domestic migrants are further classified as domestic shuttle migrants and domestic follow-the-crop migrants. International migrants are classified as foreign-born newcomers, international shuttle migrants, and international follow-the-crop migrants. The different definitions of immigrant and migrant workers often extend to the non-working spouses and children that accompany the immigrants and migrants.

Standard definitions often miss characteristics important for analyses of occupational health and safety. Four dimensions are important (Fig. 1). The first is the legal status of the individual, whether the individual is a natural resident or immigrant. Immigrants include authorized permanent residents, authorized temporary residents (e.g., those with H-2A and H-2B visas), unauthorized permanent residents, and unauthorized temporary residents. The second is employment status, which can vary from full-time permanent employment, to unemployment, precarious employment, informal employment, child labor, and slavery and bonded labor [Benach et al., 2010]. The third is mobility, whether the individual migrates or changes residence to work. Changing residence for work could be within the US or internationally. The intersection of legal status, employment status, and mobility affects the final dimension: vulnerability and exposure of the individual worker and the worker's family members. Vulnerability to discrimination, risk for occupational and other health exposures, and potential for abuse and exploitation increase with a decline in legal status, increased mobility, and a decline in employment status.

Those with the least vulnerability and exposure are US citizens (non-immigrants) and authorized permanent residents (immigrants) who have full-time permanent employment and who do not change their residence (do not migrate) for work. Those US citizens and authorized permanent residents who do change their residences for work in the AgFF Sector increase their vulnerability and exposure due to the current state of occupational health and safety regulations that apply to the industries in this sector. The employment status of those in the AgFF Sector is often precarious and informal; even US citizens and authorized permanent residents with these employment arrangements face increased vulnerability and exposure.

Child labor is an important concern for the AgFF Sector, especially for agriculture. Current regulations allow children as young as 12 years of age (10 years of age with parental permission) to be formally employed in

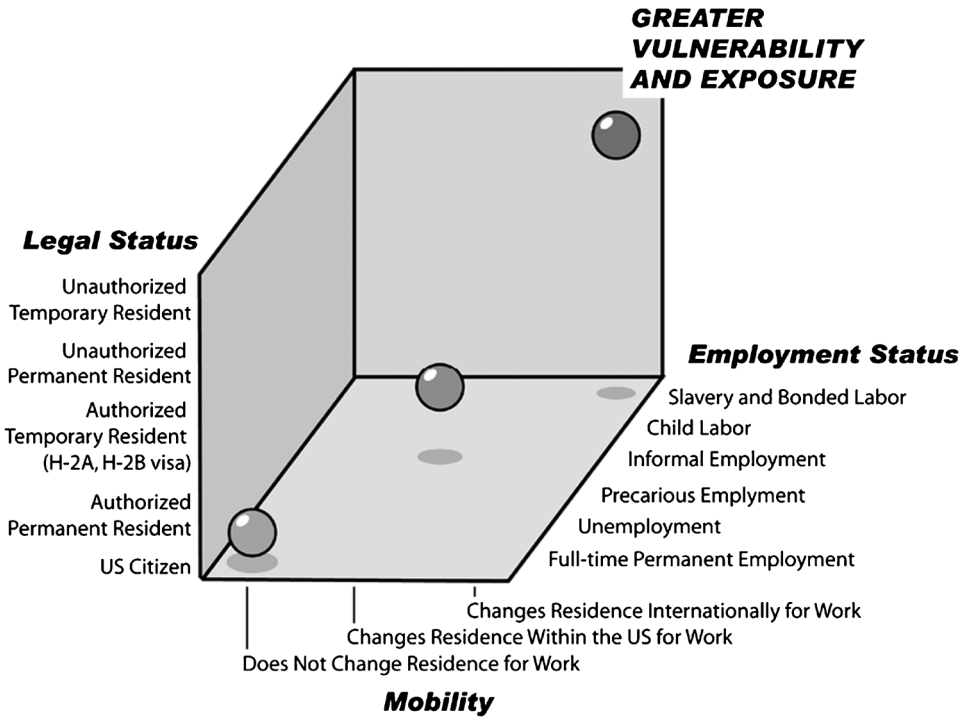

FIGURE 1. Defining workers in the AgFF sector legal status, employment status, mobility, and vulnerability and exposure.

agriculture. Children of all ages often accompany adults to the fields if no other child care arrangements are affordable, and young children often help their parents, particularly when pay is based on a piece rate [Human Rights Watch, 2010]. Slave labor and human trafficking are a concern for workers in the AgFF Sector [Pendygraft, 2010].

Authorized temporary residents have formal legal protections stated in the H-2A and H-2B visa regulations. However, these visa programs have been criticized for their potential for worker intimidation, limitations on freedom of association, and limitations on other labor rights [Bauer, 2007]. Unauthorized workers have fewest regulatory protections and the greatest vulnerability; they often do not report violations as they fear losing their jobs if they confront their employers and fear deportation if they interact with government representatives [Hiott et al., 2008]. Although the protections of workers with guest worker visas have been criticized [Bauer, 2007], research shows that agricultural workers with H-2A visas compared to those without these visas are more likely to receive pesticide safety training and to work for employers who follow the pesticide safety regulations [Whalley et al., 2009]; to be provided with housing that has fewer safety and sanitation violations [Arcury et al., 2012; Quandt et al., 2013]; and to receive appropriate wages [Robinson et al., 2011].

The Agriculture, Forestry, and Fishing Sector

The AgFF Sector has the greatest illness, injury, and fatality rates of any occupational sector [Bureau of Labor Statistics (BLS), 2010a]. Although the AgFF Sector accounts for less than 1% of annual employment, 13% of occupational fatalities are experienced by workers in this Sector [BLS, 2009a]. The reported AgFF Sector incidence rate for occupational injury and illness is 4.9, compared to an overall rate of 4.0 for all industries, and rates of 2.9 and 4.6 for mining and construction, respectively [BLS, 2009b].

Understanding the immense burden of occupational illnesses, injuries, and fatalities in the AgFF Sector requires an appreciation of the diverse scope of job tasks involved in this sector, an awareness of who AgFF Sector workers typically are, and recognition of the circumstances in which AgFF Sector work is characteristically performed. The AgFF Sector includes highly diverse occupational activities. As outlined by the National Institute for Occupational Safety and Health (NIOSH) and the North American Industry Classification System (NAICS), the AgFF Sector is held together by activities focused on the production or collection of plants and animals. The NAICS defines the AgFF Sector as "... establishments primarily engaged in growing crops, raising animals,

harvesting timber, and harvesting fish and other animals from a farm, ranch, or their natural habitats.'' The AgFF Sector involves a wide variety of discrete activities, including planting and harvesting of field crops, bailing pine straw or collecting galax used in floral arrangements, aquaculture and animal production, working on deep-sea vessels involved in shrimping or shoreline activities like ''crab picking'' (Fig. 2). Despite the substantial diversity of activities in the AgFF Sector, the vast majority of workers within the sector (>75%) are classified as ''miscellaneous agricultural workers'' [BLS, 2010b]. Consequently, a great deal more information describing worker safety and health in the AgFF Sector is available for agriculture than for forestry and fishing.

The occupational health exposures and risks for immigrant workers in this Sector are diverse. Agriculture in the Southeast includes fruit and vegetable production, on-farm packing of agricultural products, and the production of ornamental plants [Flocks et al., 2001], tobacco [Arcury et al., 2008], and Christmas trees [Elmore and Arcury, 2001]. It also includes aquaculture, CAFOs for livestock, poultry, and egg production, horse breeding and dairy. Nearly half of the US establishments involved in aquaculture are located in the southeastern US; very little is known about the workers in these establishments (Supplement Table I). Mitloehner and Calvo [2008] discuss worker health and safety in CAFOs, but this research is not limited to immigrant workers. Quandt et al. [2012] provide qualitative details of exposures of immigrant workers who collect chickens for shipment to processing plants. Swanberg et al. [2012] present a pilot study of the health of immigrant workers in the horse breeding industry. Data on immigrant workers employed on dairy farms in the southeastern US are not available; however, research conducted in other regions documents the increasing participation of immigrant workers in dairy [Jenkins et al., 2009]. The substantial growth in meat production, particularly poultry production, draws heavily on immigrant workers (Supplement Table II) [Government Accountability Office, 2005]. Employment opportunities in both poultry production and processing, combined with relatively low cost of living, partially fueled exponential growth in Latino settlement communities in the Southeast [Kochlar et al., 2005].

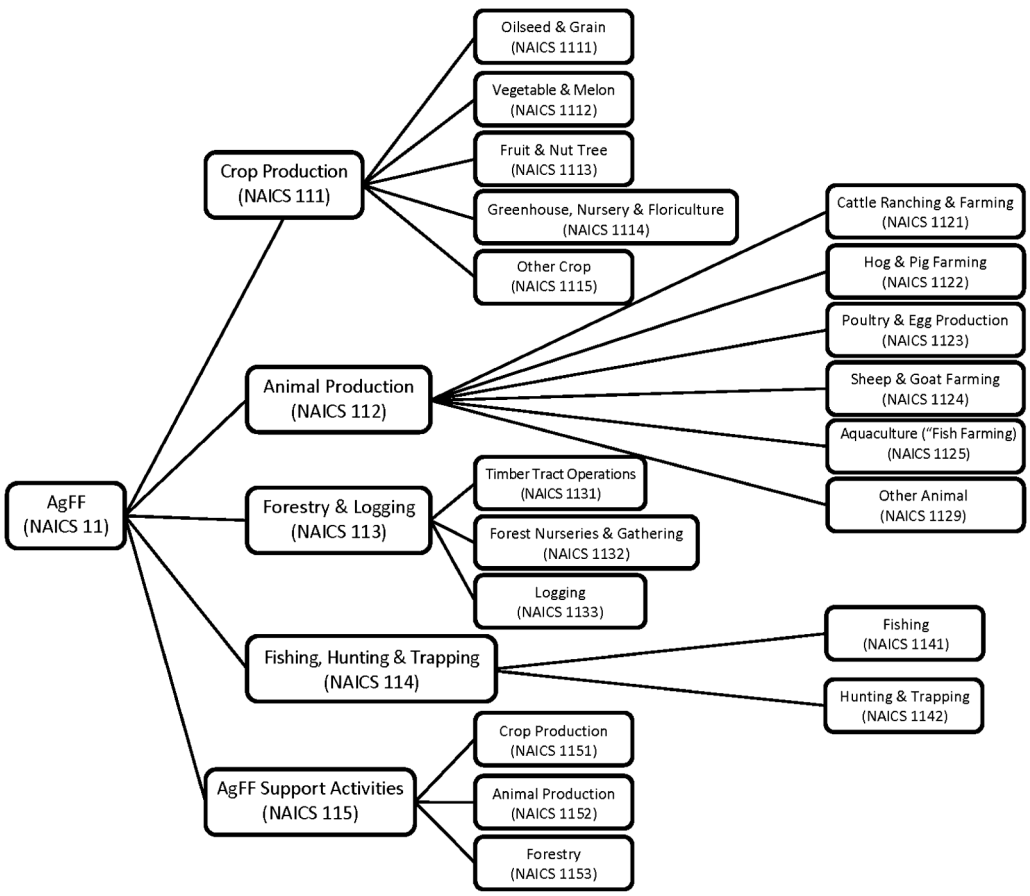

FIGURE 2. The Agriculture, Forestry, and Fishing sector.

Immigrant workers within forestry are involved in planting and cutting trees [McDaniel and Casanova, 2005]. They also work in non-timber forest work, such as raking pine straw and gathering forest products, such as Galax [Emery et al., 2006].

Little information is available for immigrant fishers in the southeastern US. Vietnamese and Latino immigrants have worked catching shrimp in the Gulf of Mexico [Carruth et al., 2010]. Many immigrants work as crab pickers in the southeastern US; these workers tend to be women with H-2B visas [Selby et al., 2001].

Occupational Exposures for Immigrant Workers in the AgFF Sector

The occupational exposures of immigrant workers in the AgFF Sector in the southeastern US are numerous. Many of these exposures are similar across the industries within the Sector. The organization of work within the AgFF Sector underlies many of these occupational exposures [Grzywacz et al., this issue]. For example, exceptions for agriculture and some forestry and fishing activities to the Fair Labor Standards Act and the National Labor Relations Act create systematic opportunities for worker exploitation and undermine the provision of safe working conditions [Wiggins, 2009]. Frequent use of piece-rate compensation systems contributes to negative occupational health outcomes. Workers in the AgFF Sector have little control over how their work is performed, although they experience heavy physical and psychological demands [Grzywacz et al., 2008]. Heavy reliance on a part-time and temporary labor force limits adequate safety training and promotes a migratory lifestyle characterized by a myriad of psychosocial stressors [Hovey and Magaña, 2002], including poverty, long-term separations from family and community [Grzywacz et al., 2006], poor living conditions [Arcury et al., 2012], and concerns about immigration, documentation, and discrimination [Hiott et al., 2008].

Eight specific sets of occupational exposures affect the occupational health of immigrant workers in the AgFF Sector (Table I). These exposure sets include the natural environment, toxic biological substances, transportation, the interface with manufacturing, mechanical and machines, physical and physiological demands, chemicals and medical care.

DATA LIMITATIONS

Understanding the occupational health and safety of immigrant workers in the AgFF Sector is limited due to the lack of official or accessible data on the number of workers, their characteristics, or on the occupational illnesses, injuries or fatalities they experience [Arcury et al., 2010]. Census data are available for the number of agricultural workers, but not for the number of forestry or fishing workers. However, different sources of information about agricultural workers in general, and specifically for immigrant agricultural workers, conflict. Existing data sources differ in their definitions of agricultural workers,

TABLE I. Examples for Occupational Exposure Sets Affecting the Occupational Health Of Immigrant Workers in the AgFF Sector

Exposure sets	Examples
Natural environment	Solar radiation, high temperatures, adverse weather events [Centers for Disease Control and Prevention, 2008]
	Dirt [Archer et al., 2002; Schenker, 2010]
	Plants (e.g., poison ivy) [Oltman and Hensler, 1986]
	Wild animals (e.g., poisonous snakes, ticks) [Langley, 1994; Brei et al., 2009]
	Ponds and lakes [Arcury et al., 2002; Lincoln and Lucas, 2010]
Toxic biological substances	Allergens [Jeebhay et al., 2008; Gautrin et al., 2010]
	Organic dust [Iversen et al., 2000; Kirychuk et al., 2010]
Transportation	Driver knowledge [Grieshop et al., 1998; Stiles and Grieshop, 1999]
	Traffic accidents [Costello et al., 2003]
Interface with manufacturing	Air quality and rapidly moving frontend loaders in chicken houses [Nielsen and Breum, 1995; Quandt et al., 2012]
Mechanical and machine	Winches [Schroeder et al., 2008]
	Power-take-offs [Hallman et al., 2005]
	Noise [Rabinowitz et al., 2005]
Physical and physiological demands	Vibrations caused by tools and equipment [Workers' Compensation Board of British Columbia, 2006; May et al., 2008]
	Work on moving platforms [Kucera et al., 2009]
Chemicals	Pesticides [McCauley et al., 2006; Quandt et al., 2006]
	Fertilizers, petrochemicals, cleaning fluids [Mills et al., 2009]
Medical care	Limited access to health care [Arcury and Quandt, 2007; Frank et al., this issue]

and they provide different estimates of their numbers. Further, immigrant workers often do not want to be noticed and thus avoid being counted in the Census or in surveys. Finally, migrant and immigrant workers are a dynamic population, with individuals changing jobs to other sectors, workers changing their residences, and companies changing locations.

The US Census of Agriculture provides a count of the number of hired agricultural workers and the number of farmers who hire migrant and contract labor, but it does not provide a report of the number of migrant and contract workers [United States Department of Agriculture, 2009]. Indicators of the number of immigrant workers, such as reports from the US Department of Labor and the US Department of Homeland Security on the number of workers in the AgFF Sector with H-2A and H-2B visas, differ. National surveys, such as the NAWS [Carroll et al., 2005], and the Current Population Survey [Kandel, 2008], provide some insight into the characteristics of agricultural workers; however, they do not provide counts of the number of immigrant workers.

No surveillance system exists for reporting occupational illnesses, injuries, or fatalities for workers in the AgFF Sector. Many workers in the Sector are not included in the Workers Compensation system, limiting the value of records in documenting illnesses, injuries, or fatalities. BLS reports are available for the number of non-fatal (http://www.bls.gov/iif/oshwc/osh/os/ostb2071.pdf) and fatal injuries (http://www.bls.gov/iif/oshwc/cfoi/cftb0232.pdf) in the Sector. However, these data have several limitations. BLS reports are limited to larger employers; farms with fewer than 11 full-time employees are not included. BLS reports are subject to underreporting due to structural features that limit the willingness of employers, workers, and healthcare providers to report injuries [Azaroff et al., 2002]. Finally, BLS reports do not include specific types or causes for non-fatal injuries and provide only limited information on causes for fatal injuries. Investigators have tried to develop approaches to integrate data from several sources to establish the incidence and prevalence of occupational injuries among agricultural workers; these approaches have had limited success [Earle-Richardson et al., 2011].

Without national, regional, or local occupational surveillance data for AgFF Sector workers, information on the prevalence of injuries and illness for immigrant workers must be based on observational studies and reports from health, service, and advocacy organizations. Most of the observational surveys and agency reports on occupational injury and illness of immigrant workers for the AgFF Sector in southeastern US are for agriculture. The observational studies are limited to areas smaller than a single state [e.g., Arcury et al., 2007; Quandt et al., 2008]; no observational study similar to the statewide survey of California agricultural workers has been conducted in the southeastern US [Villarejo et al., 2010]. The study designs and data collection procedures limit the generalizability and comparability of results from these small studies.

These data limitations mean that the denominator (number of workers) is not known, and that the numerator (number of injuries or illnesses) is not known when discussing occupational injuries or illnesses of immigrant workers. Therefore, injury or illness rates are not known. Not knowing these rates makes improving policy, developing occupational safety training, and training healthcare providers more difficult. The lack of information for workers in the AgFF Sector is not limited to the southeastern US; this is a national problem.

CHARACTERISTICS OF IMMIGRANT WORKERS

Agricultural workers are the best enumerated and described immigrant workers in the AgFF Sector, but information even for this group remains limited. The number of all agricultural workers in the southeastern US is large. The 2007 Census of Agriculture reports 575,742 agricultural workers across the southeastern US (Table II) [United States Department of Agriculture, 2009]. Of these agricultural workers, 358,183 worked for less than 150 days, indicating that they are seasonal or migrant farmworkers. The number of agricultural workers in the region who are immigrant workers is not reported. Of the 123,122 farms present in the southeastern US in 2007, 93,313 farms reported having workers who worked less than 150 days, and 14,195 farms in the region reported hiring migrant and contract farm labor. Kandel [2008] estimates the number of hired farmworkers in the US to be 1.01 million for 2006 based on Current Population Survey data. He reports that 9.7% of hired farmworkers in 2006 worked in the South in livestock production (106,700 individuals), and 12.1% worked in the South in crop production (133,100), for a total of 239,800.

A large percentage of the US agricultural workers are Latino. The NAWS [Carroll et al., 2005; Gabbard, 2006] reports that 84% of crop workers in the US and 69% in the eastern US self-identified as Hispanic or Latino (Table III). The NAWS also reports that most crop workers were born in Mexico (72% in the US, 55% in the eastern US). Kandel [2008] reports that 43% of hired farmworkers are of Hispanic ethnicity, with 37% born in Mexico and 27% living in monolingual Spanish-speaking households. A growing proportion of the immigrant farmworker population is from indigenous communities [Farquhar et al., 2009]. For 2002, the NAWS reports that 5% of agricultural workers were indigenous. Approximately one-quarter of farmworkers in North Carolina participating in a 2007 survey spoke an indigenous language [Arcury

TABLE II. Hired Farm Labor Workers and Payroll 2007 (2007 Census of Agriculture)

States, region, and nation	Farms	Workers	Migrant labor both hired and contracted, number of farms	Work less than 150 days,[a] number of farms	Work less than 150 days, number of workers
Alabama	9,541	30,932	661	7,870	21,489
Arkansas	10,265	32,502	722	7,858	19,509
Florida	10,081	115,306	2,763	7,148	63,165
Georgia	10,225	48,088	937	7,650	30,901
Kentucky	18,846	74,496	2,721	16,807	59,533
Louisiana	6,278	27,470	647	5,054	18,406
Mississippi	8,441	31,510	530	6,958	21,527
North Carolina	12,284	77,400	2,413	9,521	48,305
South Carolina	4,310	23,197	417	3,363	13,917
Tennessee	14,575	45,716	1,322	12,690	35,594
Virginia	10,571	39,484	1,062	8,394	25,837
Puerto Rico	7,705	29,641			
Southeast	123,122	575,742	14,195	93,313	358,183
United States	482,186	2,636,509	47,272	384,051	1,725,070

Source: http://www.agcensus.usda.gov.
[a]Less than 150 days indicates seasonal worker.

et al., 2009]. The most common language spoken among agricultural workers is Spanish (78% for US, 60% for eastern US). Nationally, 25% indicate that they are able to speak English well, and 40% indicate that they are able to speak English at all; for the eastern US, 37% indicate that they are able to speak English well, and 31% indicate that they can speak English at all.

TABLE III. Selected Eastern United States and National Farmworker Demographic Characteristics From the 2002* and 2004** National Agricultural Workers Survey

Demographic characteristic	Eastern United States	United States
Ethnicity		
Stating not Hispanic or Latino	31%	16%
Foreign born	63%	76%
Born in Mexico	55%	72%
Indigenous (2002)		5%
Language		
Spanish is primary language	60%	78%
Able to speak English well	37%	25%
Able to speak English at all	31%	40%
Mean age in years	33.6	34.1
Male	81%	75%
Median highest grade completed	—	6
Percent married	48%	58%
Percent who are parents	41%	50%
Percent who are unaccompanied males	—	52%
Percent with families below poverty	26%	28%

*Carroll et al. [2005].
**Gabbard [2006].

Agricultural workers are young (average of about 34 years), male (75%), and have limited formal education (median of 6 years of school completed) [Carroll et al., 2005]. About half are married, but about 60% are not living with their spouses or children. About one-quarter have family incomes below poverty. Kandel [2008] reports that 30% of agricultural workers have less than nine years of education, and 24.5% have from nine to 12 years of school. Fewer than 50% of agricultural workers are high school graduates; this is lower for non-citizens, with 63.4% having less than nine years of education.

Almost no data are available on the number of forestry or fishing workers for the southeastern US or on the number of immigrant workers in these industries. Specific reports show that the number of immigrant workers in forestry is large [Sarathy and Casanova, 2008]. Reports also indicate that Vietnamese immigrants have become involved in catching shrimp [Carruth et al., 2010], and female Latino immigrants have become involved in crab-picking [Selby et al., 2001].

US Departments of Labor and Homeland Security documentation of H-2A and H-2B visas indicate the number and ethnicity of immigrants in the AgFF Sector. The number of H-2A visas certified for the southeastern US by the US Department of Labor has ranged from 50,000 to 55,000 over the past several years (Supplement Table III). The number of workers arriving in each of these states documented by the US Department of Homeland Security

is lower than the number certified by the US Department of Labor; the number of documented immigrant agricultural workers is 33,000 to almost 38,000 per year. The number of H-2B visas certified for agriculture, forestry, and fishing has declined greatly since 2000 for the southeastern US (Supplement Table IV).

REASONS FOR CONCERN ABOUT IMMIGRANT WORKERS IN THE AgFF SECTOR

Characteristics of immigrant workers in the AgFF Sector make them particularly vulnerable to occupational illness and injury [Arcury and Quandt, 2007], as well as to exploitation [Bauer, 2007]. Their lack of English proficiency, low formal education, and low literacy skills limit their access to safety information and training, making them vulnerable to injury and illness. These workers are seldom willing to confront their employers about safety issues and do not wish to interact with those who enforce safety regulations because they often lack proper work documentation.

Immigrant workers commonly share values and beliefs that increase their risks for occupational injury and illness [Arcury and Quandt, 2007]. They value hard work to support themselves and their families. They are often willing to ignore safety if it increases their ability to earn money and if they perceive following safety rules will lead to their loss of employment. Immigrant workers often will not seek medical care for occupational injuries or illnesses unless they are severe; they do not want to take time from work for health care, and they do not want their employers to think that they are not willing to work hard. Many immigrant workers have specific health beliefs, which lead them to ignore some safety rules [Arcury et al., 2010].

Those who employ immigrants in the AgFF Sector have values and beliefs that increase the risks for occupational injury and illness among immigrant workers [Arcury and Marín, 2009]. Employers in the AgFF Sector are often business people who are accustomed to taking risks; agriculture, forestry, and fishing are risky endeavors. Many believe that they as employers take most of the risk for the business and take most of the risk of occupational injury and illness. For example, farmers believe that, since they most often mix and apply pesticides, they, not farmworkers, are most at risk for any negative health outcomes from this exposure [Rao et al., 2004].

Finally, the organization of work [Grzywacz et al., this issue] for immigrant workers often increases their risks for occupational injury and illness. For example, these workers frequently change employers and therefore may not receive the safety training they need [Quandt et al., 2002].

OCCUPATIONAL SAFETY AND HEALTH REGULATIONS

Regulations protecting the health and safety of workers in the AgFF Sector are often lacking and unevenly applied [Liebman et al., this issue]. Two general sets of regulations affect the occupational health of immigrant workers: those that address occupational health and safety directly, and those that address health and safety indirectly by addressing wages and the organization of work.

Agricultural occupational health and safety policy reflects ''agricultural exceptionalism'' [Wiggins, 2009]. Dating back to the 1930s, safety and labor laws have excluded farmworkers altogether or provided lesser protections for them. In 1987, OSHA finally included farmworkers; the Field Sanitation Standard was enacted after a decade of litigation led by farmworkers and worker organizations. The Migrant and Seasonal Farmworker Protection Act, which covers basic safety, housing, wages, and record keeping provisions of farm labor employment, was not enacted until 1983. In 1992, farmworkers gained another major health and safety protection through the revision of the Worker Protection Standard by the US Environmental Protection Agency. Research documents the uneven application and enforcement of these health and safety regulations [Shipp et al., 2005; Buhler et al., 2007; Farquhar et al., 2009; Whalley et al., 2009].

Agricultural workers are excluded from the right to engage in union activity without retaliation from their employers (National Labor Relations Act 1935, 29 USC § 151). They were excluded from the 1938 National Labor Relations Act, leaving them without the leverage to be included in the federal minimal wage and hour, child labor, and overtime law that passed several years afterwards (Fair Labor Standards Act 1938, 29 U.S.C. § 203, et seq). Congress passed the Farm Labor Contractor Registration Act in the early 1960s to regulate farm labor issues controlled by crew leaders. The minimum wage was extended to agricultural workers who work on large farms in the 1970s. Farmworkers continue to be excluded from overtime pay unless they are employed in a state that has passed a specific law granting this benefit; no states in the Southeast have such laws. Farmworkers were excluded from the Social Security Act. Only in the late 1970s did those that work on large farms gain the right to unemployment compensation. State laws protecting farmworkers tend to be less strict than federal laws.

Forestry includes reforestation and tree planting, logging, and gathering; each of these activities has different regulations. However, some general regulations apply across forestry. For example, forestry guest workers can be hired under the H-2B visa program and thus are covered by the rules governing this workforce. The Fair Labor Standards Act prohibits the employment of workers under

the age of 18 in forestry or reforestation activities deemed ''hazardous'' by the US Department of Labor. The Migrant and Seasonal Agricultural Worker Protection Act states that state laws must be followed when transporting workers.

For reforestation and tree planting, the Field Sanitation Standards of the Occupational Safety and Health Act establishes minimum standards for toilets, drinking water, and hygiene for those that perform ''hand labor.'' As with agriculture, pesticide application in forests is regulated under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), and workers applying pesticides fall under the Worker Protection Standard (40 CFR Part 170) for Agricultural Pesticides (WPS). Logging is by far the most dangerous of these occupations, and it is also the best regulated. OSHA's Logging Standards (29 CFR 1910.266), developed in 1994, require training for all employees and include all manner of tree harvest rather than being limited only to pulpwood operations. No federal laws regulate health and safety specifically for workers gathering forest products though there are regulations governing where and sometimes how forest products can be gathered [Emery et al., 2006].

The fishing industry largely lacks occupational safety and health regulation. The Commercial Fishing Industry Vessel Safety Act of 1988 eliminates some hazards in the industry by requiring vessels to meet minimum safety requirements. Pursuant to that Act, the Coast Guard adopted regulations detailing equipment, design, and operational requirements for commercial fishing industry vessels. The Coast Guard Authorization Act of 2010 added several features to strengthen occupational safety and health; these protections will undoubtedly benefit workers on vessels that go beyond the three nautical mile boundary from baseline stipulated in the law. However, it provides no additional protections for workers within the three-mile boundary, including those working shore operations.

Minimum wage and overtime laws mandated by the Fair Labor Standards Act do not apply to employees in commercial fishing crews. Workers engaged in other tasks in conjunction with the catching and harvesting of fish at sea also are not covered by minimum wage laws (29 U.S.C. § 213(a)(5)). Once commercial vessels bring their catch to shore, a second group of fishery workers is involved. Processing work is considered seasonal, and employers can hire them through the H-2B visa program.

The Coast Guard's regulations and oversight do not cover those workers that work on land in fish farms. Likewise, the Field Sanitation Standards of the Occupational Safety and Health Act do not apply to fish farms because the workers are not engaged in hand-harvesting. Although aquaculture is often considered part of the agriculture sector, it does not fall within the Fair Labor Standards Act's definition of agriculture. Therefore, aquaculture workers do not face the same exceptions from laws that traditional farmworkers do, such as exceptions from minimum wage and overtime requirements.

CONCEPTUAL MODEL FOR IMMIGRANT OCCUPATIONAL HEALTH

A conceptual model for occupational health of immigrant workers in the AgFF Sector must integrate concepts and propositions from several disciplines (Fig. 3). The core of this framework holds two fundamental principles of occupational medicine. First, ''health'' is a complex endpoint typically observed by concepts reflecting the absence of health; that is, injury, illness, and death. Discussed in more detail by Quandt et al. [this issue], the diverse time horizons of typical measures of occupational health further exaggerate their complexity. Injury and illness are frequently acute, such as trauma resulting from mechanical equipment or feelings of nausea or lightheadedness following exposure to toxic chemicals. By contrast, many occupational diseases such as asthma, carpal tunnel syndrome, and many cancers have complex etiologies that unfold over many years. The second core feature of the model is the premise that occupational health is fundamentally ''influenced by'' an exposure in the workplace. Exposures take multiple forms and mediums; they may take the form of physical equipment, specific or complex chemical or biological agents, or job-related tasks. Consistent with a basic proposition of occupational health, exposure to an agent in the workplace is the most proximal determinant of any occupational illness or injury.

The basic occupational health model is complemented by concepts and principles from other disciplines. The organization of work concept, borrowed from Occupational Health Psychology, focuses on the way jobs are designed and performed, as well as the management, production methods, and human resource policies that shape work

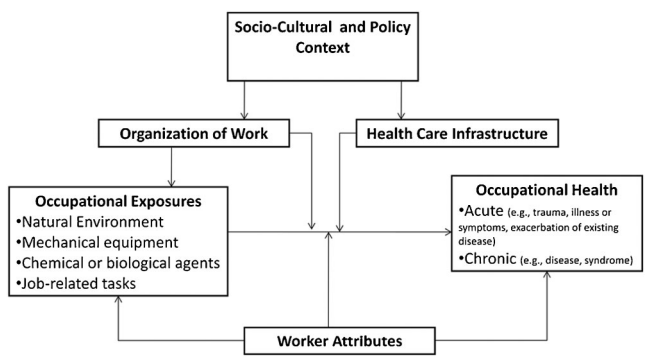

FIGURE 3. Conceptualization of the occupational health of immigrants in the Agriculture, Forestry, and Fishing sector.

processes [NIOSH et al., 2002; Grzywacz et al., this issue]. This framework suggests that work organization acts in distinct ways to affect worker health. First, it posits that work organization shapes workers' exposure to various hazards. This is illustrated by within-industry variation in adherence to safety principles, variation in the degree of automation or mechanization, and between-organization or work crew differences in staffing models (e.g., use of regular employees versus a contingent, just-in-time workforce). Second, variation in the way work is organized modifies the effect of occupational exposure on subsequent health outcomes. The short and long-term occupational health of workers exposed to agents in an operation that has well developed safety procedures is likely to be better than workers exposed to the same agents in another operation that has poorly developed procedures.

The healthcare infrastructure plays a key role in this model of occupational health [Frank et al., this issue]. At least two elements of the healthcare infrastructure are relevant to the occupational health of immigrant workers. The first is the capacity of the healthcare system to meet the occupational health needs of the immigrant workforce. The ability to address occupational health is influenced by multiple factors, such as the presence of health facilities, healthcare providers trained in occupational medicine, and the ability to effectively communicate. Healthcare infrastructure also involves the notion of accessibility, including the ability of workers to locate and pay for health care, and the ability to seek care without fear of retaliation from the employer.

Overlaying both the organization of work and healthcare infrastructure is the broader socio-cultural and policy context. Regions of the country with a long history of migrant or immigrant labor are likely to have better developed systems to meet the healthcare needs of this labor force [Kochlar et al., 2005]. Similarly, in these regions, employers are likely to have more culturally appropriate management systems, or organizations may have adapted in response to actions brought about by worker advocacy groups. By contrast, in regions with only a short history of immigrant labor, few organized groups exist to help protect immigrant workers from exploitation, and employers and organizations have had little opportunity to modify how they do business.

An important component of the socio-cultural context is occupational health and safety policy [Liebman et al., this issue]. Occupational health and safety regulations provide limited protections for immigrant workers across the AgFF Sector. These regulations are not completely or uniformly enforced [Whalley et al., 2009]. Changes in regulation, such as those related to agricultural exceptionalism, and decisions to provide sufficient resources for enforcement of existing regulations, reflect societal values related to workers in the AgFF Sector.

Finally, the model argues that characteristics of the workforce themselves affect occupational health in three ways. First, different members of the workforce encounter different occupational exposures; for example, women are disproportionately located in jobs requiring repeated fine-motor activities, whereas men are frequently overrepresented in jobs requiring the use of heavy equipment. Second, the effect of an occupational exposure on a health outcome may differ depending on worker characteristics; some individuals may be more vulnerable than others. Several factors, including knowledge and beliefs about safety behavior, genetic predisposition, or lifestyle, can all minimize or exaggerate the effect of a comparable exposure on an occupational health outcome. Finally, individual worker characteristics can affect health outcomes directly: older workers, for example, are more likely to experience work-related limitations than are younger workers [Kenny et al., 2008].

DIRECTIONS FOR RESEARCH AND INTERVENTION

Immigrant workers are a major force in the AgFF Sector. Work in the AgFF Sector is dangerous for everyone. However, the characteristics of these workers raise concerns for their occupational health and safety. These characteristics include limited English language skills and limited formal educational attainment. At the same time, limited information is available on the number of immigrant workers in the AgFF Sector; their characteristics; the occupational illness, injury, or mortality experienced by these workers; and the occupational health and safety training that is provided to them (or that they need). Current occupational health and safety policy for immigrant workers in the AgFF Sector, particularly those employed in agriculture, is also a concern. Conceptually, several domains should be considered when documenting the risk factors for occupational illness, injury, and mortality among immigrant workers in the AgFF Sector. These domains begin with the diverse occupational exposures in the AgFF Sector and include the characteristics of the immigrant workers, the organization of work, and the healthcare infrastructure. Each of these domains rests in the socio-cultural context of work in this sector.

Needed research on the occupational health and safety of immigrant workers in the AgFF Sector includes:

- The accurate count of immigrant workers and all workers across this sector as well as the geographic distribution of these workers. Knowledge of the level of formal education and primary language of these workers is also important for health and safety training.
- A surveillance system for occupational injuries and illnesses among AgFF Sector workers so that we know

the issues that health and safety training materials for these workers should address. We need state surveillance systems for the AgFF Sector; state data could then be aggregated to regions and the nation.
- Documentation of the healthcare needs of AgFF Sector workers.
- Delineation of the beliefs of immigrant workers and of their employers about health and safety. This includes documentation of their perceptions and acceptance of risk and of their health beliefs.
- Determination of how a migratory life among many of these workers affects their health.
- A thorough review of occupational health and safety policy that will document what policies and regulations are working, which need to be enforced, and which need to be modified or expanded.
- Occupational health and safety training that is culturally, linguistically, literacy, and educationally appropriate for workers and their employers needs to be developed [Arcury et al., 2010].

REFERENCES

Archer JD, Cooper GS, Reist PC, Storm JF, Nylander-French LA. 2002. Exposure to respirable crystalline silica in eastern North Carolina farm workers. AIHA J 63(6):750–755.

Arcury TA, Marín AJ. 2009. 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. p 15–36.

Arcury TA, Quandt SA. 2007. Delivery of health services to migrant and seasonal farmworkers. Annu Rev Public Health 28:345–363.

Arcury TA, Quandt SA, Elmore RC, Russell GB. 2002. Water safety among Latino farmworkers in North Carolina. J Agromedicine 8: 77–84.

Arcury TA, Feldman SR, Schulz MR, Vallejos QM, Verma A, Fleischer AB, Rapp SR, Davis SF, Preisser JS, Quandt SA. 2007. Diagnosed skin diseases among migrant farmworkers in North Carolina: Prevalence and risk factors. J Agric Saf Health 13:407–418.

Arcury TA, Vallejos QM, Schulz MR, Feldman SR, Fleischer AB, Verma A, Quandt SA. 2008. Green tobacco sickness and skin conditions among migrant Latino farmworkers. Am J Ind Med 51:195–203.

Arcury TA, Grzywacz JG, Chen H, Vallejos QM, Galván L, Whalley LE, Isom S, Barr DB, Quandt SA. 2009. Variation across the agricultural season in organophosphorus pesticide urinary metabolite levels for Latino farmworkers in eastern North Carolina: Project design and descriptive results. Am J Ind Med 52:539–550.

Arcury TA, Estrada JM, Quandt SA. 2010. Overcoming language and literacy barriers in safety and health training of agricultural workers. J Agromedicine 15(3):236–248.

Arcury TA, Weir M, Chen H, Summers P, Pelletier LE, Galván L, Bischoff WE, Mirabelli MC, Quandt SA. 2012. Migrant farmworker housing regulation violations in North Carolina. Am J Ind Med 55:191–204.

Azaroff LS, Levenstein C, Wegman DH. 2002. Occupational injury and illness surveillance: Conceptual filters explain underreporting. Am J Public Health 92(9):1421–1429.

Bauer M. 2007. Close to slavery: Guestworker programs in the United States. Montgomery, AL: Southern Poverty Law Center.

Benach J, Solar O, Santana V, Castedo A, Chung H, Muntaner C, EMCONET Network. 2010. A micro-level model of employment relations and health inequalities. Int J Health Serv 40(2):223–227.

Brei B, Brownstein JS, George JE, Pound JM, Miller JA, Daniels TJ, Falco RC, Stafford KC III, Schulze TL, Mather TN, Carroll JF, Fish D. 2009. Evaluation of the United States Department of Agriculture Northeast Area-wide Tick Control Project by meta-analysis. Vector Borne Zoonotic Dis 9(4):423–430.

Buhler WG, Langley RL, Luginbuhl RC, Jones JP, Burnette JW, Jr. 2007. Violations of pesticide use and worker safety regulations in North Carolina. J Agric Saf Health 13(2):189–203.

Bureau of Labor Statistics. 2009a. National census of fatal occupational injuries in 2008. US Department of Labor Release # 09-09079, Table 2. http://www.bls.gov/news.release/cfoi.nr0.htm. Accessed June 16, 2011.

Bureau of Labor Statistics. 2009b. Workplace injuries and illness: 2008. US Department of Labor Release # 09-1302, Table 5. http://www.bls.gov/news.release/cfoi.nr0.htm. Accessed June 29, 2010.

Bureau of Labor Statistics. 2010a. National Census of Fatal Occupational Injuries in 2009 (preliminary results). http://www.bls.gov/news.release/pdf/cfoi.pdf. Accessed August 25, 2010.

Bureau of Labor Statistics. 2010b. Employment by industry, occupation, and percent distribution, 2008 and Projected 2018, Table TOT001: Total employment all workers. http://ftp.bls.gov/pub/special.requests/ep/ind-occ.matrix/ind_pdf/ind_TOT001.pdf. Accessed June 29, 2010.

Carroll DJ, Samardick R, Bernard S, Gabbard S, Hernandez T. 2005. Findings from the National Agricultural Workers Survey (NAWS) 2001–2002: A demographic and employment profile of United States farm workers. Rep. 9. Washington, DC: US Department of Labor, Office of the Assistant Secretary for Policy.

Carruth AK, Levin JL, Gilmore K, Bui T, Gallardo G, Evert W, Sealey L. 2010. Cultural influences on safety and health education among Vietnamese fisherman. J Agromedicine 15:375–385.

Centers for Disease Control and Prevention (CDC). 2008. Heat-related deaths among crop workers—United States, 1992–2006. MMWR Morb Mortal Wkly Rep 57(24):649–653.

Costello TM, Schulman MD, Luginbuhl RC. 2003. Understanding the public health impacts of farm vehicle public road crashes in North Carolina. J Agric Saf Health 9:19–32.

Earle-Richardson GB, Jenkins PL, Scott EE, May JJ. 2011. Improving agricultural injury surveillance: A comparison of incidence and type of injury event among three data sources. Am J Ind Med 54(8): 586–596.

Elmore RC, Arcury TA. 2001. Pesticide exposure beliefs among Latino farmworkers in North Carolina's Christmas tree industry. Am J Ind Med 40(2):153–160.

Emery M, Ginger C, Chamberlain J. 2006. Migrants, markets, and the transformation of natural resources management: Galax harvesting in Western North Carolina. In: Smith HA, Furuseth OJ, editors Latinos in the New South: Transformations of place. Vermont: Ashgate Publishing. p 69–87.

Farquhar SA, Goff NM, Shadbeh N, Samples J, Ventura S, Sanchez V, Rao P, Davis S. 2009. Occupational health and safety status of indigenous and Latino farmworkers in Oregon. J Agric Saf Health 15(1):89–102.

Flocks J, Clarke L, Albrecht S, Bryant C, Monaghan P, Baker H. 2001. Implementing a community-based social marketing project to improve agricultural worker health. Environ Health Perspect 109(Suppl. 3):461–468.

Frank AL, Liebman AK, Ryder B, Weir M, Arcury TA. Report 4. Health care access and health care workforce for immigrant workers in the agriculture, forestry and fishing sector in the southeastern US. Am J Ind Med (this issue).

Gabbard S. 2006. Emerging trends in farmworker demographics: Results from the National Agricultural Workers' Survey. Presentation at the NACHC National Farmworker Health Conference (May) San Antonio: TX.

Gautrin D, Cartier A, Howse D, Horth-Susin L, Jong M, Swanson M, Lehrer S, Fox G, Neis B. 2010. Occupational asthma and allergy in snow crab processing in Newfoundland and Labrador. Occup Environ Med 67(1):17–23.

Government Accountability Office. 2005. Workplace safety and health: Safety in the meat and poultry industry, while improving, could be further strengthened. Report No.: GAO-05-096. Washington, DC: U.S. Government Accountability Office.

Grieshop J, Grajales-Hall M, Bates C, Stiles M, Ortiz L. 1998. On the road with the Loteria: The Evolution of a Motor Vehicle Safety Social Marketing Program for Latino Farm Workers. Soc Mar Q 4:36–46.

Grzywacz JG, Quandt SA, Early J, Tapia J, Graham CN, Arcury TA. 2006. Leaving family for work: Ambivalence and mental health among Mexican migrant farmworker men. J Immigr Minor Health 8(1):85–97.

Grzywacz JG, Quandt SA, Arcury TA. 2008. Immigrant farmworkers' health-related quality of life: An application of the job demands-control model. J Agric Saf Health 14(1):79–92.

Grzywacz JG, Lipscomb HJ, Casanova V, Neis B, Fraser C, Monaghan P, Ballejos QM. Report 2. Organization of work in agricultural, forestry and fishing sector in the US Southeast: Implications for immigrant workers' occupational safety and health. Am J Ind Med (this issue).

Hallman EM, Gelberg KH, Hallisey JL. 2005. The NIOSH Fatality Assessment and Control Evaluation (FACE) program: A New York case study illustrating the impact of a farm manure pump PTO entanglement. J Agromedicine 10(3):57–64.

Hiott AE, Grzywacz JG, Davis SW, Quandt SA, Arcury TA. 2008. Migrant farmworker stress: Mental health implications. J Rural Health 24(1):32–39.

Hovey JD, Magaña CG. 2002. Exploring the mental health of Mexican migrant farm workers in the Midwest: Psychosocial predictors of psychological distress and suggestions for prevention and treatment. J Psychol 136(5):493–513.

Human Rights Watch. 2010. Fields of peril: Child labor in US agriculture. New York: Human Rights Watch.

Iversen M, Kirychuk S, Drost H, Jacobson L. 2000. Human health effects of dust exposure in animal confinement buildings. J Agric Saf Health 6(4):283–288.

Jeebhay MF, Robins TG, Miller ME, Bateman E, Smuts M, Baatjies R, Lopata AL. 2008. Occupational allergy and asthma among salt water fish processing workers. Am J Ind Med 51(12):899–910.

Jenkins PL, Stack SG, May JJ, Earle-Richardson G. 2009. Growth of the Spanish-speaking workforce in the Northeast dairy industry. J Agromedicine 14(1):58–65.

Kandel W. 2008. Profile of hired farmworkers: A 2008 update. Economic Research Report 2008, June Report No. 60. Economic Research Service, US Department of Agriculture.

Kenny GP, Yardley JE, Martineau L, Jay O. 2008. Physical work capacity in older adults: Implications for the aging worker. Am J Ind Med 51(8):610–625.

Kirychuk SP, Reynolds SJ, Koehncke NK, Lawson J, Willson P, Senthilselvan A, Marciniuk D, Classen HL, Crowe T, Just N, Schneberger D, Dosman JA. 2010. Endotoxin and dust at respirable and nonrespirable particle sizes are not consistent between cage- and floor-housed poultry operations. Ann Occup Hyg 54(7):824–832.

Kochlar R, Suro R, Tafoya S. 2005. The new Latino south: The context and consequences of rapid population growth. Pew Hispanic Center. http://pewhispanic.org/files/reports/50.pdf. Accessed June 16, 2011.

Kucera KL, Loomis D, Lipscomb HJ, Marshall SW, Mirka GA, Daniels JL. 2009. Ergonomic risk factors for low back pain in North Carolina crab pot and gill net commercial fishermen. Am J Ind Med 52(4):311–321.

Langley RL. 1994. Fatal animal attacks in North Carolina over an 18-year period. Am J Forensic Med Pathol 15(2):160–167.

Levin JL, Gilmore K, Shepherd S, Wickman A, Carruth A, Nalbone JT, Gallardo G, Nonnenmann MW. 2010. Factors influencing safety among a group of commercial fisherman along the Texas Gulf Coast. J Agromedicine 15:363–374.

Liebman AK, Wiggins MF, Fraser C, Levin J, Sidebottom J, Arcury TA. Report 5. Occupational health policy and immigrant workers in the Agriculture, Forestry, and Fishing Sector. Am J Ind Med (this issue).

Lincoln J, Lucas D. 2010. Fatal occupational injuries in the U.S. commercial fishing industry: Risk factors and recommendations, East Coast Region. DHHS (NIOSH) Publication Number: 2011–105. Anchorage, AK: NIOSH Commercial Fishing Safety Research Program.

May JJ, Hawkes L, Jones A, Burdick P, Ginley B, Santiago B, Rowland M. 2008. Evaluation of a community-based effort to reduce blueberry harvesting injury. Am J Ind Med 51:307–315.

McCauley LA, Anger WK, Keifer M, Langley R, Robson MG, Rohlman D. 2006. Studying health outcomes in farmworker populations exposed to pesticides. Environ Health Perspect 114:953–960.

McDaniel J, Casanova V. 2005. Forest management and the H-2B Guest Worker Program in the Southeastern US: An assessment of contractors and their crews. J Forestry 103(3):114–119.

Melton M, Debonis M, Krasilovsky E. 2007. Maltreatment and injustice: An overview of the plight of Latino forest workers in the southeast. Sante Fe, NM: Forest Guild. http://www.forestguild.org/publications/Latino_Forest_Workers_07.pdf. Accessed June 16, 2011.

Mills PK, Dodge J, Yang R. 2009. Cancer in migrant and seasonal hired farm workers. J Agromedicine 14(2):185–191.

Mitloehner FM, Calvo MS. 2008. Worker health and safety in concentrated animal feeding operations. J Agric Saf Health 14(2):163–187.

Nielsen BH, Breum NO. 1995. Exposure to air contaminants in chicken catching. Am Ind Hyg Assoc J 56(8):804–808.

NIOSH, U.S. Department of Labor, Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention. 2002. National Institute for Occupational Safety and Health (NIOSH) recommendations to the U.S. Department of Labor for changes to hazardous orders. Morgantown, WV: National Institute for Occupational Safety and Health. http://youthrules.dol.gov/niosh_recs_to_dol_050302.pdf. Accessed June 16, 2011.

Oltman J, Hensler R. 1986. Poison oak/ivy and forestry workers. Clin Dermatol 4(2):213–216.

Pendygraft J. 2010. Slavery of migrant farmworkers continues in the U.S. to this day. St. Petersburg Times, May 30, 2010.

http://www.tampabay.com/features/humaninterest/slavery-of-migrant-farmworkers-continues-in-the-us-to-this-day/1098420. Accessed March 19, 2011.

Quandt SA, Preisser JS, Arcury TA. 2002. Mobility patterns of migrant farmworkers in North Carolina: Implications for occupational health research and policy. Hum Organ 61(1):21–29.

Quandt SA, Hernández-Valero MA, Grzywacz JG, Hovey JD, Gonzales M, Arcury TA. 2006. Workplace, household, and personal predictors of pesticide exposure and health outcomes for farmworkers. Environ Health Perspect 114:943–952.

Quandt SA, Feldman SR, Vallejos QM, Schulz MR, Verma A, Fleischer AB, Arcury TA. 2008. Vision problems, eye care history, and ocular protective behaviors of migrant farmworkers. Arch Environ Occup Health 63:13–16.

Quandt SA, Summers P, Bischoff WE, Chen H, Wiggins MF, Spears CR, Arcury TA. 2013. Cooking and eating facilities in migrant farmworker housing in North Carolinia. Am J Public Health. 2013 Jan 17. [Epub ahead of print]

Quandt SA, Arcury-Quandt AE, Lawlor EJ, Carrillo L, Marin AJ, Grzywacz JG, Arcury TA. 2013. 3-D jobs and health disparities: The health implications of Latino chicken catchers' working conditions. Am J Ind Med 56:206–215.

Quandt SA, Kucera KL, Haynes C, Klein BG, Langley R, Agnew M, Levin JL, Howard T, Nussbaum MA. Report 3. Occupational health outcomes for workers in the agriculture, forestry and fishing sector: Implications for immigrant workers in the southeastern US. Am J Ind Med (this issue).

Rabinowitz PM, Sircar KD, Tarabar S, Galusha D, Slade MD. 2005. Hearing loss in migrant agricultural workers. J Agromedicine 10:9–17.

Rao P, Arcury TA, Quandt SA, Doran A. 2004. Growers' and extension agents' perceptions of farmworker pesticide exposure. Hum Organ 63:151–161.

Robinson EN, Nguyen HT, Isom S, Quandt SA, Grzywacz JG, Arcury TA. 2011. Wages, wage violations, and pesticide safety experienced by migrant farmworkers in North Carolina. New Solut 21:251–268.

Sarathy B, Casanova V. 2008. Guest workers or unauthorized immigrants? The case of forest workers in the United States. Policy Sci 41(2):95–114.

Schenker MB. 2010. Inorganic agricultural dust exposure causes pneumoconiosis among farmworkers. Proc Am Thorac Soc 7(2): 107–110.

Schroeder FA, Viegas SF, Carmichael K. 2008. Shrimp winch injuries. J Trauma 65(1):142–146.

Selby E, Dixon D, Hapke H. 2001. A women's place in the crab processing industry of eastern North Carolina. Gend Place Cult 8(3):229–253.

Shipp EM, Cooper SP, Burau KD, Bolin JN. 2005. Pesticide safety training and access to field sanitation among migrant farmworker mothers from Starr County, Texas. J Agric Saf Health 11(1): 51–60.

Stiles MC, Grieshop JI. 1999. Impacts of culture on driver knowledge and safety device usage among Hispanic farm workers. Accid Anal Prev 31:235–241.

Swanberg JE, Clouser JM, Westneat S. 2012. Work organization and occupational health: Perspectives from Latinos employed on crop and horse breeding farms. Am J Ind Med 55(8):714–728.

United States Department of Agriculture. 2009. 2007 Census of Agriculture, United States, summary and state data, volume 1: Geographic area series, part 51. United States Department of Agriculture, National Agricultural Statistics Service. http://www.agcensus.usda.gov/Publications/2007/Getting_Started/Guide_to_Census_Products/index.asp. Accessed June 16, 2011.

Villarejo D, McCurdy SA, Bade B, Samuels S, Lighthall D, Williams D III. 2010. The health of California's immigrant hired farmworkers. Am J Ind Med 53(4):387–397.

Whalley LE, Grzywacz JG, Quandt SA, Vallejos QM, Walkup M, Chen H, Galván L, Arcury TA. 2009. Migrant farmworker field and camp safety and sanitation in eastern North Carolina. J Agromedicine 14:421–436.

Wiggins M. 2009. 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. p 201–220.

Workers' Compensation Board of British Columbia. 2006. Preventing tree planting injuries. WorkSafe BC Publications. http://www.worksafebc.com/publications/health_and_safety/by_topic/assets/pdf/treeplanting.pdf. Accessed June 16, 2011.