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The Association of Visa Status and Health Outcomes in South Georgia's Migrant Farmworker Population

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BS
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2007

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An abstract of
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Abstract

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By Kate Wheeler

Background: Although Latino immigrants to the US have been frequently noted to have better health than the general US population (the "Latino health paradox"), there is little research on the health of one specific group of US Latinos—migrant farmworkers. Due to their marginalized status and the dangerous nature of farmwork, they may be at risk for poor health outcomes.

Objective: This study examines the prevalence of several health outcomes (specifically anemia, elevated blood pressure, high blood glucose, and overweight/obesity) among a population of migrant farmworkers. These health outcomes are compared across H2A visa status to determine whether there are significant health differences in documented and undocumented workers; they are also examined in the context of the general US population.

Methods: A temporary summer clinic has provided health services to this population since 1993. For this study, data was extracted from the past ten years (2003-2012) of clinic records (n=2599) and health outcome prevalences calculated. These prevalences were compared across H2A visa status using chi-square tests of association. Logistic regression was used to calculate age-adjusted odds ratios for each health outcome, based on visa status. Results from the National Health and Nutrition Examination Survey (NHANES) were used for comparisons with the general US population.

Results: Overall, the prevalence of overweight/obesity was lower among farmworkers than in the general US population (57% vs. 73%), as was the prevalence of hypertension (24% vs. 34%). However, the prevalence of high or elevated blood glucose was much higher (74% vs. 46%). H2A visa-holders had significantly worse body mass index and blood glucose measurements than undocumented farmworkers ($p<.0001$). The prevalence of anemia was equal in both groups, although quite high at 33%.

Discussion: In light of rising rates of obesity and diabetes in Mexico, it is possible H2A workers are predisposed to these conditions—they return home after each growing season, while undocumented workers cannot. It is also possible that the pay differential between the two groups impacts food choices, and therefore health. There is a need for additional research examining the causal pathways between visa status, food insecurity, and poor cardiovascular health outcomes in this population.

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Thanks also to my parents, for being the first to teach me that good food must also be good for those who grow it. And most importantly, I would like to thank the farmworkers in South Georgia and across the United States, whose efforts are often unrecognized but without whom many Americans would find their dinner tables empty.

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Chapter One: Introduction

Farming has long been a vital part of the US economy, and since the 1800s, immigrant farmworkers have played a major role in crop production and harvesting (National Center for Farmworker Health, 2008a). Today approximately three million farm laborers, many of them immigrants from Latin America (National Center for Farmworker Health, 2012), help to produce nearly $300 billion dollars worth of agricultural products annually (US Department of Agriculture, 2007). Although little data on farmworker health is available, the few studies that do exist indicate that the people who produce the country's agricultural bounty are some of the unhealthiest in the nation; not only are farmworkers at risk for many of the health problems that plague America's poor—obesity, diabetes, cardiovascular disease, and hypertension—but the nature of farm work frequently results in additional health issues, such as musculoskeletal injuries and skin conditions.

Purpose

This study investigates the cardiovascular health of farmworkers in South Georgia by examining levels of blood glucose, blood pressure, and hemoglobin in the study population from 2003 to 2012, as well as body mass index from 2011-2012. An additional objective is to determine whether any of these health outcomes differ between workers with H2A visas and those without. These aims are explored through the following research questions:

1. What is the health status (specifically in regards to blood glucose, blood pressure, and hemoglobin levels) of South Georgia's farmworker population?
    a. How does their health status compare to that of the US population as a whole?
    b. How do these health outcomes compare to those in the overall population of Hispanics in the United States?
2. Do any of the above health outcomes differ significantly between farmworkers with H2A visas and those who are undocumented?
3. What trends can be seen in these health outcomes in the study population from 2003-2012?

Background

The concerns of farm operators have played a role in shaping immigration legislation for much of the past century. The Immigration Act of 1917 was largely a prohibitive act meant to prevent "undesirables" from entering the country by imposing both a literacy test and a head tax, but under pressure from large farming operations in the South, the Secretary of Labor waived those demands for Mexican farmworkers, and over 70,000 Mexicans entered the US under this act (Clark & Marshall, 1917). Although the Great Depression decreased labor demands (and many Mexicans were deported during this time period), the need for workers rose again with the United States' entry into World War II (Balderrama, 2006). In 1943, the US and Mexico signed the Bracero Accord, allowing for the importation of Mexican workers to support US agriculture (Hidalgo, Navas, McGurk, Walker, & Mecker, 1943). This program continued until the 1960s, when immigration reforms brought about the H2A visa program, under which farmworkers still enter the country to this day. However, the variable and time-sensitive nature of farm work, coupled with the advance notice required for H2A work permits, means that some farmers are unable to hire sufficient laborers through the H2A program (Austin, 2002). In addition, the Immigration Control and Reform Act (ICRA) of 1986 granted legal status to many Mexicans living in the United States and increased border security, in an attempt to halt unauthorized migration (Durand, Massey, & Parrado, 1999). In reality, this policy backfired as the reforms "…did not deter undocumented Mexicans from heading northward or prevent them from crossing the border so much as they discouraged them from returning home." (Durand et al., 1999). Additionally, the legislation triggered further migration into the US as the family members of newly legalized immigrants attempted to join them—and many of these migrants were unauthorized (Durand et al., 1999). Today, undocumented immigrants contribute considerably to American farm work—the most recent National Agricultural Workers Survey reported that 50% of farmworkers in the Southeast (Alabama, Florida, Georgia, and Mississippi) were undocumented (Sologaistoa, 2011).

The problem

Broad Public Health Implications

Despite the massive contributions farmworkers make to the US agriculture industry, and by proxy, its economy, they receive very little in return. Almost 30% of farmworker families have incomes below federal poverty guidelines, and very few of them have health insurance (Carroll, Samardick, Bernard, Gabbard, & Hernandez, 2005; Rosenbaum & Shin, 2005). This poverty, combined with a lack of access to public benefits (including health care, housing and fair labor standards), creates a set of circumstances that negatively impact the well-being of farmworkers and their families (Hawkins & Valdez, 2001). Occupational injuries are common, as are rashes and skin conditions resulting from pesticide exposure (National Center for Farmworker Health, 2009). Poor housing conditions can lead to infections and increased disease transmittal (National Center for Farmworker Health, 2009). Although information on chronic disease among farmworkers is difficult to come by, evidence indicates that this population may be at increased risk for obesity and diabetes (Arcury & Quandt, 2007; Lighthall, 2001). Prevention and treatment of both acute and chronic health problems is a serious challenge, as the high mobility, legal status, and isolation of many farmworkers makes access to healthcare difficult (Rosenbaum & Shin, 2005). The 2001 Binational Farmworker Health Survey found that "structural and behavioral factors impede agricultural workers from engaging in a regular, preventive pattern of health care", meaning that serious diseases often go untreated, resulting in debilitating chronic conditions (Mines et al., 2001).

Some states attempt to close this treatment gap by operating migrant health clinics in rural agricultural areas. However, funding issues and chronic staffing shortages mean that many of these clinics still struggle to reach their targeted clients; oftentimes outreach visits or temporary clinics run by local medical and dental schools are a key means of service provision. In Georgia, the Federally funded State Office of Rural Health provides primary health care services for 21 counties at six sites (in 2010, over 16,000 farmworkers were seen at these six centers) (Sologaistoa, 2011). The clinics offer non-traditional hours and bilingual staff to accommodate the needs of farmworkers. Families who derive at least 51% of their income from agriculture are eligible for services, and are charged on a sliding scale (Georgia Farmworker Health Program, 2008). One such treatment center is the Ellenton Health Clinic, which serves Brooks, Colquitt, Cook, and Tift counties in South Georgia. The clinic offers primary care, including preventative services, diagnostics, a pharmacy, and case-management/health education. The clinic is also able to provide a set amount of additional care to uninsured farmworkers (Georgia Farmworker Health Program, 2008).

In the summer, the Ellenton Clinic's services are extended by the Farmworker Family Health Program (FWFHP). Student groups from Emory University's Nell Hodgson Woodruff School of Nursing (along with dental hygiene, physical therapy, psychology, and pharmacy students from other Georgia schools) spend two weeks in South Georgia every summer setting up and staffing temporary health clinics at elementary schools and farm sites in the area. Over the course of those two weeks, between 800-1,000 migrant workers and their families receive services free of charge (Wold & Layne, 2012).

Knowledge Gap

Although the generally poor health status of farmworkers across the nation has been well documented, specific details about the problems faced by farmworkers in South

Georgia are unknown. Additionally, previous studies of farmworkers in other states have included only a small number of workers, making it difficult to apply the results of those studies elsewhere. Questions also remain as to whether or not lack of H2A status is associated with poor health outcomes; there is some indication that the health of South Georgia's farmworker population is not homogenous in regards to visa status, but this needs to be explored further (Hill, Moloney, Mize, Himelick, & Guest, 2011; Whalley et al., 2009). This study attempts to address this knowledge gap by documenting the health of this population and further elucidating the relationship between health and visa status.

Significance of this study

The study population is a vital component of the US food system; without the efforts of farmworkers, it would not be possible to support America's multi-billion dollar fruit and vegetable industry. Thus, their health is essential to the nation's food security. In Georgia, agriculture contributes more than $68.9 billion to the economy annually (Georgia Farm Bureau, 2013), thanks in large part to the efforts of over 90,000 migrant and seasonal farmworkers (Larson, 2008). However, there is a very small knowledge base surrounding the health and welfare of this population, making it difficult to deliver care that is targeted to their needs. Information surrounding the health of undocumented workers is particularly sparse; thus there is a need to generate additional research on the subject. The results of this study will be used by the Farmworker Family Health Program and the Ellenton Clinic to guide their clinical practice and to plan future programming. These organizations may also use the study results in grant applications or reports to secure future funding for their work—this reporting is especially important for the Ellenton Clinic, which is federally funded. Additionally, the results of the study may be used by advocacy organizations and immigrant-rights groups to lobby for better working conditions and improved healthcare for farmworkers across the US.

Definitions of terms

Agriculture: Although the term agriculture is used differently by different states and organizations, it is defined by the Georgia Office of Rural Health (which runs the Georgia Farmworker Health Program) as "farming of land in all its branches: cultivation, tillage, growing, harvesting, and preparation and processing for market or storage that occurs on the farm." This definition includes Christmas tree farming, pine seedling planting, and nursery work, but excludes livestock, lumber production, and off-farm processing.

Anemia: Hemoglobin (measured with a HemoCue device) is used as a proxy for anemia in this study. The FWFHP defines anemia as a hemoglobin level below $14.0\ mg/dL$; this is the cutoff used throughout this study.

Blood Glucose: As fasting blood glucose measurements could not be guaranteed for this study, the labels "pre-diabetic" and "diabetic" were not used. Instead, blood glucose was categorized as "high" ($> 125\ mg/dL$), "elevated" ($100 - 124.9\ mg/dL$), "normal" ($60.0 - 99.9\ mg/dL$), or "low" ($< 60\ mg/dL$).

H2A Status/H2A Worker: This term is used throughout the study to refer to workers who are employed under the US Department of Labor's H2A guest worker program, which grants visas to agricultural workers. It is important to note that while US citizens can be employed under the H2A program (and in fact, employers must first recruit them before offering jobs to non-citizens) the vast majority of H2A laborers are from Latin America.

Hypertension/Elevated Blood Pressure: The Farm Worker Family Health Program defines any blood pressure measurement above $135/90\,mmHg$ as abnormal or high; measurements above this cutoff are described interchangeable as "hypertension" or "elevated blood pressure" throughout the study. However, the FWFHP does not actually diagnose farmworkers with hypertension based on a single measurement; those with elevated readings are referred to the Ellenton Clinic for follow up.

Migrant Farmworker: According to the Georgia State Office of Rural Health, a migrant farmworker is an individual whose "principal employment is in agriculture on a seasonal basis and who establishes a temporary abode for the purposes of such employment". Dependent family members are included in this definition, as are former migrant farmworkers who no longer work due to age or disability. The majority of the participants in this study are migrant farmworkers.

Obese: Obesity is defined as a body mass index (BMI) of $30\,kg/m^2$ or greater; for this study, no further distinctions beyond this cutoff are made (e.g. morbidly obese, super morbidly obese).

Overweight: A person having a body mass index (BMI) between $25.0\,kg/m^2$ and $29.9\,kg/m^2$ is considered overweight for this study.

Seasonal Farmworker: The definition of seasonal farmworker is similar to that of a migrant farmworker, except that seasonal farmworkers do not earn an income from agriculture all year round, as they live in one location (instead of traveling from job to job).

Unauthorized Worker/Undocumented Worker/Non-H2A Worker: For the purpose of this study, unauthorized or undocumented farmworkers are persons who lack legal authorization to work in the US, yet are employed in agricultural labor (typically to meet work demands not filled by H2A visa-holders). Undocumented migrants arrive in the US in a variety of ways, for a variety of reasons—some were brought here as children and have lived in this country most of their lives, while others arrived more recently, for the promise of work or to reunite with family. "Undocumented" is a colloquial term and not a technical one, as non-H2A workers may have documents relating to their identity or immigration status, yet still lack work authorization.

Chapter Two: Review of the Literature

Latino Migration and Health

In the 2010 United States census, 47% of America's foreign-born population reported having Hispanic or Latino origins—approximately 18.8 million people (US Census Bureau, 2012). Thus, although the majority of US Latinos (63%) are native born, Latino immigrants make up a significant proportion (16%) of the US population (US Census Bureau, 2012).

Factors typically associated with migration such as stress, lowered socioeconomic status, language barriers, limited access to healthcare, and change in diet might reasonably be expected to cause poor health in immigrant populations (Lassetter & Callister, 2009). However, while US Latinos have higher poverty rates, lower education, and lower rates of health insurance than the general population (Abraido-Lanza, Dohrenwend, Ng-Mak, & Turner, 1999; Vega, Rodriguez, & Gruskin, 2009), the expectation of poor health does not appear to bear out for this group—they are in fact healthier than the rest of the US population. This so-called "Latino health paradox", where Latino immigrants are healthier despite a worse profile of risk factors, is a well-documented phenomenon. Latino all-cause mortality is lower than that of both whites (A. J. Thomas, Eberly, Neaton, & Smith, 2005) and the general US population (Vega et al., 2009). However, Latino health appears to decline with time spent in the US. Patterns of deteriorating health can be seen post-migration, especially in coronary heart disease, body mass index, blood pressure, and depression (Lassetter & Callister, 2009). Mexican-born migrants have better cardiovascular health profiles than their US-born counterparts (Sundquist & Winkleby, 1999), and a 2009 study found that diabetes prevalence among Latinos increased with generational status and length of stay (Ahmed et al., 2009).

There are several possible explanations for this paradox. One theory is the healthy migrant effect, which states that there is a positive selection bias for healthy Latinos in the US because those who are healthier and more able are the ones who choose to migrate. However, US-born Latinos also have lower mortality relative to US-born whites, and several studies argue that this difference cannot be due to selection (Abraido-Lanza et al., 1999). It is actually still possible that selection does contribute to the health of these US-born Latinos, especially for second-generation Latinos whose parents were highly selected; these children share many traits with their parents, including a home, and so are likely to share their health. However, it is unlikely that the paradox can be fully explained by the healthy migrant effect. Another possibility is the "salmon bias": those in poor health return to their country of origin, where their deaths are not counted. There is some evidence that Latinos who return to Mexico are in worse health than those who remain in the US (S. H. Ullmann, Goldman, & Massey, 2011), but this difference still does not explain the full difference in mortality rates (Turra & Elo, 2008; S. H. Ullmann et al., 2011). The salmon bias has also been contradicted by a study that examined mortality among two US immigrant populations where this theory should not apply: Cubans (who face barriers to return migration) and Puerto Ricans (whose deaths are counted in US statistics). The study found that these groups still had lower mortality rates than whites (Abraido-Lanza et al., 1999). Another possible explanation for this paradox is that behaviors and psychosocial factors relating to Latino culture are protective against poor health, although this hypothesis has not been systematically tested (Abraido-Lanza et al., 1999). Barcellos et al have recently posited that there is no paradox—they argue that the Latino health advantage is actually an artifact of existing cases of diabetes that go undiagnosed until after migration to the United States (Barcellos, Goldman, & Smith, 2012). Although further research needs to be done, and no conclusive determination can yet be made about the reasons for the Latino health paradox, it is likely that all of the above explanations play some part.

One group of US Latinos that appears to have worse health than the general population is migrant and seasonal farmworkers (MSFWs) (National Center for Farmworker Health, 2012). There are several important factors that may explain this difference. Aside from the dangers associated with farm work which may contribute to work-related illness and injury, the protective factors of family and community are not available to many in this population. Migration within the US can disrupt social services and networks that protect against health risks—following a migrant stream and participating in it over several years may help families build social networks and communities along the route, but services to assist with this process are still limited (Borre, Ertle, & Graff, 2010). It is also possible that a significant proportion of the US Latino population has been excluded from many of the studies on Latino health. Migrant farmworkers are, in general, difficult to access and follow for studies, due to their isolated and temporary living conditions; obtaining health data on undocumented immigrants is even more difficult, as they are ineligible for many services and many of them actively avoid being contacted by anyone with an "official" presence. Thus there may be significant differences in health between the Latinos in these studies and those who enter the US without documentation. This is especially relevant to the MSFW population, as only about half of all US farmworkers have legal authorization to be in the country, either through citizenship, a green card, or the H2A visa program (Carroll, Georges, & Saltz, 2011). Additionally, the early life experiences of farmworkers may be very different socioeconomically from other US Latinos. Based on associations between poor fetal growth and development of cardiovascular disease, Barker hypothesizes that these early life experiences can create a dangerous sort of fetal programming, where babies who are undernourished become highly susceptible to the effects of an affluent diet later in life (Godfrey & Barker, 2001). It is possible that many farmworkers may be "programmed" from the very start to have worse health than other Latinos; once they arrive in the United States and are exposed to a relatively more affluent lifestyle, they are at greater risk for cardiovascular disease than their counterparts.

The H2A program

For over 60 years, farmworkers from Latin America have been a key component of the United States' agriculture industry. The Bracero program, which ran from 1942-1964, allowed four million workers into the US to address labor shortages, and upon its termination in 1964, the program was replaced with the H2 Temporary Guest Worker program (the H2A visa is for agricultural workers, while H2B visas are given for non-agricultural jobs)(National Center for Farmworker Health, 2012). Farmers who recruit employees under the H2A visa program must first actively recruit available US citizens for any open positions and are required to meet certain minimum standards for all employees as outlined by the US Department of Labor: they must pay minimum wage, supply housing that complies with Occupational Safety and Health Administration (OSHA) standards, provide either three hot meals per day (which they are allowed to charge for) or convenient and free cooking facilities, and cover some of the transportation costs of employees (US Department of Labor, 1952). However, these minimum standards become, in effect, maximums, because any US citizen who desires a higher pay rate or more benefits is no longer considered “available”, at which point farmers are free to recruit workers who will settle for the minimum (Geffert, 2002). It is also worth noting that the H2A terms contain no specific clause of action to enforce these work conditions, meaning that workers have no way to insist upon their rights in court if violations occur (Geffert, 2002).

Farmworker demographics

How are migrant and seasonal farmworkers counted?

The US migrant farmworker population is difficult to measure due to their high mobility, language barriers, and variable legal status, but several surveys do attempt to enumerate this population. The National Agricultural Workers Survey (NAWS), performed under a Department of Labor contract, interviews between 1,500 and 4,000 farmworkers every year in an effort to determine the demographic, employment, and health characteristics of the U.S. crop labor force (National Agricultural Workers

Survey, 2011). Interviews are conducted at farm sites, in three cycles each year (to reflect the seasonality of agricultural work) (National Agricultural Workers Survey, 2011). Interviewers record information on the demographic characteristics and composition of the respondents’ household, the respondents’ employment and migration profile, income, benefits, use of social services, housing, health, safety, and legal status (National Agricultural Workers Survey, 2011). Migrant health clinics and state agencies may also conduct surveys from time to time, but these are typically performed on an ad hoc basis as need arises (or as funding can be found). For example, in 1999 California conducted a statewide Agricultural Worker Health Survey, wherein 654 workers completed in-person interviews, comprehensive physical examinations, and personal risk behavior interviews, but the survey has not been repeated since (Villarejo & McCurdy, 2008). The USDA Farm Labor Survey provides regional and national estimates of the number of farmworkers, average hours worked, and wage rates (National Agricultural Statistics Service, 2009). This data is used by the USDA and US Department of Labor to estimate the demand for seasonal agricultural labor (National Agricultural Statistics Service, 2009). In addition, the US Department of Labor tracks and reports figures on H2A visas, although these numbers of course count only those farmworkers who are employed by the H2A program (US Department of Labor, 1952). The National Center for Farmworker Health (NCFH) is a non-profit corporation located just south of Austin, Texas, dedicated to improving the health status of farmworker families; their online resource center contains over 5,000 different farmworker-related materials (National Center for Farmworker Health, 2008b). Finally, the Migrant

Clinician's Health Network, based in North Carolina, provides support to clinicians who care for migrants, and their website (http://www.migrantclinician.org/) includes a resource database covering a wide variety of issues.

A demographic portrait

Estimates indicate that there are more than three million migrant and seasonal farmworkers in the US today (National Center for Farmworker Health, 2012). In 2011, the US State Department granted 55,384 H2A visas (US Department of State, 2012). However, data from the National Agricultural Workers Survey indicates that only 52% of farmworkers have legal authorization to be in the US, and only 33% are citizens; thus, H2A visa holders make up a small proportion (19%) of the United States' agricultural workforce (Carroll et al., 2011). Other information from the NAWS provides a demographic picture of who these farmworkers are: the majority of them are foreign born (72%), mostly from Mexico (68%), and male (78%), with an average age of 36 (Carroll et al., 2005). Thirty-five percent of workers report that they cannot speak English "at all", while only 30% say that they speak English "well" (Carroll et al., 2005). In addition, 23% of workers have an income below US federal poverty guidelines and only 8% have employer-supplied health insurance (a number that drops to 5% for part time and seasonal workers) (Carroll et al., 2005).

The dangers of farming

Agriculture is consistently ranked as one of the most dangerous jobs in the US, along with construction, hunting, fishing, and mining (Myers & Steeg, 2004). In 2007, the United States had 25.7 deaths for every 100,000 agricultural workers, compared to an average of 3.7 deaths for every 100,000 workers in all other industries during the same year (National Center for Farmworker Health, 2009). A recent study of North Carolina farmworkers found that most of the participants reported that safe work practices were important to their grower, but they also reported behaviors for their employers that did not reflect a value for safety (such as failure to provide safety equipment); 95% of respondents believed they would be injured in the next year (T. A. Arcury et al., 2012). Farmworkers face frequent exposure to pesticides, which is most commonly associated with respiratory problems and skin conditions, but has also been linked to neurologic deficits, cancer, miscarriages, and birth defects (Arcury, Quandt, & Mellen, 2003). Respiratory problems may also be exacerbated by natural fungi and dust (Emmi et al., 2010) while hot, wet working conditions increase the risk for skin conditions—the agricultural industry has the highest incidence of skin disease compared to all other industries (Bureau of Labor Statistics, 2011). Infectious diseases caused by poor sanitation and crowded conditions at work and housing sites, including inadequate washing and drinking water, are common among farmworkers (Early et al., 2006). Tractor overturns, runovers, entanglements, and highway collisions are the leading causes of death and serious injury in farming, accounting for about 250 deaths per year in the United States (National Agricultural Tractor Safety Initiative, 2011). In addition to the injuries and deaths often caused by tractors and other farm machinery, musculoskeletal injuries are a common consequence of heavy lifting, stooping, and the repetitive nature of farm work (Emmi et al., 2010). Heat and sun exposure are also a concern, as farmworkers typically labor for 10-12 hours a day with little access to shade or water (National Center for Farmworker Health, 2009). In 2005, 20% of farmworkers reported no access to drinking water and cups, and only 2.8% reported having ever used sunscreen (Salas, Mayer, & Hoerster, 2005).

However, despite the dangers of farm work and the inherent potential for illness and injury, utilization of healthcare services among farmworkers remains exceedingly low—a 2009 survey of male farmworkers in North Carolina found that while self-reported skin conditions were extremely common (95% reported experiencing a problem in the past seven days), only 3.2% of participants reported a clinic visit in that same time period, and none of those clinic visits were for treatment of the skin condition (Feldman et al., 2009). A report published by the Kaiser foundation found that only 42% of women in farmworker families reported seeking early prenatal care compared to over three-quarters of women (76%) nationally (Rosenbaum & Shin, 2005), and data from the 2006 and 2007 NAWS indicate that only 55% of farmworkers used any kind of healthcare service in the past two years (Hoerster, Beddawi, Peddecord, & Ayala, 2010). It is important to keep in mind that these low utilization numbers are not reflective of low healthcare needs; as noted above, migrant and seasonal farmworkers are often in poor health and they are at risk for a wide range of injuries and illnesses due to the nature of their jobs (Rosenbaum & Shin, 2005). Rather, the low incidence of care-seeking behavior is due to significant barriers that farmworkers and their families face in accessing healthcare.

Barriers to care

A 2006 study of California farmworkers found that workers faced many barriers to receiving adequate care for occupational injuries and illnesses, including being sent to company doctors who trivialize injuries; being left without care; being forced to work despite injuries; and being offered cash payments not to report injuries (Lashuay & Harrison, 2006). A variety of factors may influence MSFWs ability and/or willingness to seek health care services: long working hours, low income, lack of health insurance, and risk of lost income during the time spent seeking care (Emmi et al., 2010). Hoerster, et al. examined factors associated with healthcare use for California farmworkers, and found that cost of healthcare was by far the biggest barrier (noted by 90.6% of respondents) (Hoerster et al., 2010); this issue is exacerbated by the fact that the majority of farmworkers are uninsured and ineligible for worker's compensation (Schell, 2002). Other barriers identified in these studies were language difficulties, providers not understanding problems, fear of job loss, and lack of transportation (Feldman et al., 2009; Hoerster et al., 2010).

In Georgia, House Bill 87 was passed in 2011 (Ramsey et al., 2011), allowing law enforcement personnel to question the immigration status of suspects at roadblocks. Among its other provisions, the bill requires that anyone applying to receive a public benefit show via a secure and verifiable document that they are a legal resident and to swear and sign an affidavit to that effect. Policies such as HB 87 have fostered a climate of fear among Georgia's farmworkers, and many of them are reluctant to seek care for fear of drawing attention to themselves or their families (specifically, fear of deportation).

Farmworkers and Cardiovascular Risk Factors

In addition to health issues caused by poor workplace safety or sanitation, many farmworkers also experience conditions that are associated with an increased risk for cardiovascular disease, such as food insecurity, hunger, and consumption of processed foods and sodas (despite working all day with fresh fruits and vegetables). Many low-income populations in the US regularly consume low-cost foods, which are high in calories but low in nutrients, increasing their risk for overnutrition disorders such as diabetes, high blood pressure, cardiovascular disease and obesity (French, Wall, & Mitchell, 2010); it appears that farmworkers are no exception. In a study of North Carolina farmworker families, two-thirds of participants reported a change in eating habits with immigration, consuming more processed foods, sodas, and meats in the US than they did in Mexico (Borre et al., 2010). A dietician who worked with many MSFWs in New York State notes that farmworkers are often "overwhelmed by the variety of available foods in this country, especially those of lesser nutritional value" (Brieger, 2006). A study of MSFW families living near the US-Mexico border in Texas found the surveyed population to have a very high prevalence of obesity (66%), elevated blood cholesterol (51%), high blood glucose (30%), and high blood pressure (30%), as well as anemia (23.2%) (Weigel, Armijos, Hall, Ramirez, & Orozco, 2007). All parents in the North Carolina study reported being concerned about being overweight and the development of obesity in themselves and their children, regardless of food security level; farmworkers reported that although they got plenty of exercise working in the fields all day, and did not eat much, their weight continued to increase each year (Borre et al., 2010).

This last point illustrates how lack of access to food, regardless of nutritional quality, can also be associated with obesity. The connection between food insecurity and obesity (and its associated cardiovascular ailments) has been well documented in the general US population, and in Hispanics as a subgroup (Adams, Grummer-Strawn, & Chavez, 2003; Leung, Williams, & Villamor, 2012; Pan, Sherry, Njai, & Blanck, 2012). It appears that MSFW may be at particular risk for food insecurity—in the North Carolina study, 63.8% of families were food insecure, and of those, 34.7% experienced hunger (Borre et al., 2010). Levels in the Texas study were even higher, with 82% and 49% of households experiencing food insecurity and hunger, respectively; these numbers represent a two- to-eightfold increase compared to figures for the general US population (Weigel et al., 2007). Additionally, a Georgia study of migrant farmworkers found that the overall prevalence of food insecurity was 62.8%, but the risk of food insecurity was nearly three times as high in non-H2A workers as in those who had H2A visas (Hill et al., 2011). Thus, if farmworkers are at risk for food insecurity, it is likely they are at risk for obesity and diabetes as well.

Knowledge gaps

Lack of an H2A visa has been found to be associated with poor housing conditions (Vallejos et al., 2011), food insecurity (Hill et al., 2011), and workplace hazards (Whalley et al., 2009). Additionally, documentation status is a barrier to seeking and accessing healthcare (Feldman et al., 2009; Hoerster et al., 2010). However, it is not clear whether or not health outcomes in MSFWs differ by H2A status. This seems likely, given that H2A status appears to be associated with many predictors of health, such as housing, workplace safety, and access to care, but there is a lack of evidence for any difference in health based on documentation status. Furthermore, there is limited data on the extent of cardiovascular disease in migrant and seasonal farmworkers, although they appear to be at risk for such conditions. This paper attempts to address this knowledge gap by examining cardiovascular health outcomes in South Georgia's farmworker population and then comparing health across H2A status.

Chapter Three: Methodology and Results

Methodology

Introduction

The purpose of the study was to examine the general health status of South Georgia's migrant farmworkers, especially in comparison to the general US population and Hispanic immigrants in the US, and to determine whether any of those health outcomes differ by H2A visa status. The Emory School of Nursing Farm Worker Family Health Program (FWFHP) has conducted annual 2-week clinics in South Georgia since 1993; clinic records from 2003 onward are maintained in an electronic database. For this investigation, de-identified data was extracted from the ten years of clinic records available electronically (2003-2012), and analyzed for trends and differences.

Population and sample

The study population was chosen based on ease of partnering with the FWFHP, a decision that was supported by the large health burden faced by this population. The FWFHP holds "night camps", where adult migrant and seasonal farmworkers are seen after work, as well as children's clinics at elementary schools during the day. Records from all clinics are maintained in the FWFHP database, but for this study, only the records from the night camps were used, and any patients under the age of 18 at those camps were excluded from the analysis.

Women were also excluded from the study, due to poor coverage and small sample size—although they are eligible for care at the night camps, women make up a very small proportion of the workers (less than 13%), and rarely present for treatment (though they sometimes receive obstetric or gynecological care at the Ellenton clinic). Thus, the actual study population is made up exclusively of adult male farmworkers. Coverage for the men is considered to be good at the farms visited, despite the fact that this is a very hard population to measure. However, the scope of the program still does not include all workers in the clinic's four-county catchment area every year.

Procedures

The FWFHP is an annual program, held for two weeks each summer (timed to coincide with peak harvest season and thus the annual farmworker migration through South Georgia). Any migrant or seasonal farmworker is eligible for the program; citizenship or legal status is not a requirement and is not questioned by the program. Health screening and episodic care is provided; all services are free of charge. Students and other program volunteers drive to Ellenton in vans and cars full of supplies and are based in an area hotel for the duration of the 2-week program. Each night they caravan out to a farm site and set up clinic stations with tables, chairs, and medical equipment. Additionally, the Ellenton Clinic mobile health care unit with a generator is on-site each evening to provide a restroom, private exam room or refrigeration for medications if needed.

While children get complete physical exams during the day at summer school, evening clinics are for episodic care only. Farmworkers first check in at the clinic intake table, then proceed to the stations of their choosing; stations include blood pressure, blood glucose, hemoglobin for anemia, body mass index (BMI), dental exams, foot care, nurse practitioner consults, and physical therapy (if referred by the nurse practitioner). Students and instructors administer treatment and record clinical data according to standard procedures. Before leaving the clinic site, patients turn in their charts at the exit station and receive a “goody bag” containing various hygiene items such as washcloths, toothpaste and toothbrush, soap, shampoo, new socks, and flip-flops.

Data from all night camp and school charts are entered into both the Ellenton Clinic database and the School of Nursing database while in Moultrie. All charts are returned to the Ellenton Clinic when the program ends due to HIPAA requirements. Retrospective de-identified information from the School of Nursing database on sex, age, camp, height, weight, body mass index, blood pressure, and blood glucose was then extracted from the database for this study; no additional surveys or questionnaires were administered to participants.

Ethics

Plans for data analysis were submitted to Emory IRB, and determined to be exempt from review, as only secondary clinic data with no personal identifiers were used. The PI did not have any interaction with the study participants. The director of the FWFHP and the Director of Research for the Nell Hodgson Woodruff School of Nursing at Emory University both granted permission to access and use the clinical data.

Data Analysis

Cleaning and recoding

The original dataset contained 3194 unique patient visits of all ages. Some participants ($n = 180$) were under the age of 18 and were excluded from the analytical sample. All women's records, regardless of age, were also removed from the dataset ($n = 415$). The final dataset used for analysis, consisting of only adult male patients, contained 2599 records.

In some instances, multiple measurements existed for the same individual; in those cases, the last recorded measurement was used, as per FWFHP protocol. Data were examined for improbable values, and exclusion criteria determined for each variable based on recommendations from Emory Nursing School staff. The chosen cutoff points were as follows: hemoglobin measurements below $6\, mg/dL$ or above $20\, mg/dL$, any BMI below $15\, kg/m^2$ or above $50\, kg/m^2$, blood glucose level under $50\, mg/dL$ or over $500\, mg/dL$, systolic blood pressure below $40\, mmHg$ or above $240\, mmHg$, and diastolic blood pressure below $20\, mmHg$ or above $140\, mmHg$.

Select variables were recoded according to FWFHP definitions. For hemoglobin, a measurement less than $14\, mg/dL$ was considered anemic and categorized as "anemic" (1); this is slightly more cautious than the WHO's cutoff of $13\, mg/dL$ for men. Any hemoglobin level equal to or greater than $14\, mg/dL$ was considered "not anemic" (0). The Centers for Disease Control (CDC) defines hypertension as a blood pressure above $140/90\, mmHg$; the FWFHP's definition is only slightly different ($135/90\, mmHg$). If an individual's systolic blood pressure was above $135\, mmHg$, their diastolic blood pressure was above $90\, mmHg$, or both, they were classified as "hypertensive" (1). If both measurements fell below the $135/90\, mmHg$ cutoff, they were placed in the "not hypertensive" (0) category. However, it is important to note that this is simply the label used for this study and that farmworkers were not diagnosed as hypertensive by the FWFHP based on this screening; individuals with a blood pressure reading above this cutoff were referred to the Ellenton Clinic. Blood glucose level was categorized as "high", "elevated", "normal", or "low"; due to the walk-in nature of the clinics, a fasting blood glucose measurement could not be guaranteed, so these more cautious terms were used instead of the labels "diabetic" and "pre-diabetic". However, as most participants came to the clinics straight from the fields, before having had a chance to eat, it is likely that their blood glucose levels approximated fasting measurements. A blood glucose level above $125\, mg/dL$ was classified as "high blood glucose" (4), while those with measurements between $100 - 124\, mg/dL$ were categorized as having "elevated blood glucose" (3). Any measurement between $60 - 100\, mg/dL$ was considered "normal" (2), while those below 60 were "low" (1) (these standards match those of the American Diabetes Association). Body mass index was divided into "obese", "overweight", and "normal" designations: a BMI between $25.0\, kg/m^2$ and $29.9\, kg/m^2$ was classified as "overweight" and a BMI greater than or equal to $30\, kg/m^2$ as "obese" (under $25\, kg/m^2$ was considered normal). The cutoffs for BMI were in accordance with CDC definitions. The blood glucose and body mass index variables were then further simplified into dichotomous variables to aid with statistical analysis. The "high" and "elevated" blood glucose groups were consolidated into the new category of “abnormal blood glucose” (1) while normal and low blood glucose levels were re-labeled as “normal” (0). For body mass index, the “overweight” and “obese” classifications were combined as “above normal” (1), while “normal” (0) remained the same.

A new variable was also created to indicate whether or not workers in a camp had H2A status. Three of the camps (referred to in this report as “H2A Farm 1”, “H2A Farm 2”, and “H2A Farm 3”) housed workers who were authorized under the H2A program; these were labeled as “H2A camps” (1), while the remaining sites were considered “non-H2A camps” (0).

Statistical analysis

Data were analyzed using SAS 9.3 (SAS Institute, Inc., Cary, NC). Simple descriptive statistics were calculated to provide an overview of the clinical data. The distribution of participants by camp and year was calculated. Univariate analyses were then performed with continuous variables (hemoglobin level, blood glucose level, BMI, and blood pressure) in order to determine the mean and standard deviation of each outcome for each year, as well as the overall mean. These statistics were calculated for all camps combined as well as separately for H2A and non-H2A camps. For categorical variables (hypertension, anemia, blood glucose, and BMI), the frequency distributions by category were calculated for each year and overall. These statistics were also calculated for all camps combined as well as separately for H2A and non-H2A camps

Unpaired t-tests were used to compare continuous variables in H2A camps and non-H2A camps. Categorical health outcomes were compared using a Cochran Mantel-Haenszel test because ordinal variables (the health outcomes) were being compared across two non-ordinal groups (camp status). The relationship between H2A status and each of the four outcomes of interest (anemia, hypertension, high blood glucose, and body mass index) was analyzed using logistic regression to calculate odds ratios and their 95% Wald confidence intervals. Crude models were created using each health outcome and H2A status, and then those models were adjusted for age and, in cases where it was significant, age-squared. A p-value of 0.05 was considered significant for all tests.

Limitations

The scope of this study was deliberately narrowed by the PI through the decision to eliminate women and children from the analysis. It is possible that by ignoring these more vulnerable segments of the population, the study fails to capture the true severity of health problems faced by migrant and seasonal farmworkers. However, the intent in excluding women from the study was to make the results more accurate, as women did not consistently appear at the clinics from year to year and were a small proportion of the overall sample. This also eliminated the issue of undetected pregnancies impacting the anemia results. Children were also excluded in order to obtain a more homogenous sample; another researcher will be publishing an analysis of that data, so comparing the health of children and adults in this population will eventually be possible.

This study has several other limitations. Because the sample was limited to only FWFHP participants, the results may not be generalizable to the US farmworker population outside of the Southeast. In addition, as the clinics are optional and many of these health conditions are asymptomatic, workers with hypertension or high blood glucose may have felt healthy and declined to be screened. It is also possible that some workers were afraid of being diagnosed with a health problem, or afraid of attending the clinic because of recent immigration legislation, and thus avoided the screening. Another major issue is that out of necessity, each clinic visit was treated as an independent event, because the PI had no way of knowing whether or not a patient was a repeat from the year before. However, due to the travel patterns typically followed by migrant farmworkers, it is likely that some of the same patients were seen year-to-year, and thus not all measurements were truly independent. Finally, due to the cross-sectional nature of the study, it is not possible draw causal conclusions about health outcomes and visa status; only associations can be inferred. Nevertheless, an analysis of almost 3000 individuals is a significant contribution to the body of knowledge surrounding the health of South Georgia's farmworkers, as their transient (and often undocumented) nature makes them an extremely difficult population with which to conduct research.

Results

Descriptive Overview

The final dataset used for analysis contained records for 2599 individuals; these were almost equally distributed between H2A ($n = 1475, 57\%$) and non-H2A ($n = 1174, 43\%$) workers. Data for body mass index was only collected in 2011 and 2012, so the sample size for that variable was comprised of only 238 workers, 134 of whom were classified as H2A. See Tables A1-A2 in the Appendix for details.

The age of the workers ranged from 18 to 87 years, with mean age being 31 years. Overall, the workers had a mean blood pressure of $123/77\ mmHg$, a mean hemoglobin level of $14.5\ g/dL$, mean blood glucose of $120\ g/dL$, and mean body mass index of $26.1\ kg/m^2$ (Table 1). When these variables were categorized according to FWFHP cutoffs, 32.5% of workers were anemic, 24.2% were hypertensive, 74% had abnormal blood glucose and 57% had an abnormal body mass index (Table 2).

Table 1: Distribution of Continuous Variables; all years (2003-2012) and all ages (18 years and older)

Variable	N	Mean (SD)	Median	Min	Max
Body Mass Index (kg/m^2)	238†	26.1 (4.16)	26	18.1	46.8
Hemoglobin (mg/dL)	2159	14.5 (1.49)	14.6	7.1	19.3
Glucose (mg/dL)	2165	120 (36.49)	113	50	468
SBP ($mmHg$)	2427	123 (12.4)	122	82	182
DBP ($mmHg$)	2423	77 (10)	78	35	122
Age ($years$)	2599	31 (9.6)	29	18	87

†Data on this outcome was only collected in 2011-2012.

Key Findings

When categorical health outcomes were compared between H2A and non-H2A workers, body mass index and blood glucose were highly significantly different in the two groups ($p < .0001$; Table 2). Seventy-seven percent of H2A workers had abnormally high blood glucose, while only 70% of non-H2A workers fell into this category. Sixty-nine percent of H2A workers had an abnormally high BMI, a number that fell to 41% for those in the non-H2A group. There was also a statistically significant ($p = 0.04$; Table 2) difference in hypertension for the two groups, with 23% and 26% of H2A and non-H2A workers being categorized as hypertensive, respectively. However, the means of the two groups were the same ($p = 0.09$; Table A4, Appendix), and this difference may not be clinically significant. The prevalence of anemia was essentially identical among H2A and non-H2A workers (32% and 33%, $p = 0.55$; Table 2).

Table 2: Comparison of health outcomes (categorical variables) between H2A and non-H2A camps

All values given as n (%). An asterisk (*) denotes significance (p<0.05).					
Variable	**Overall n=2599†**	**H2A Camps n=1475**	**Non-H2A Camps n=1124**	**Chi-square**	**p-value**
Anemia					
Anemic ($Hb < 14\ mg/dL$)	701 (32.5)	378 (31.93)	323 (33.13)	0.35	0.55
Hypertension					
Hypertensive ($BP > 135/90\ mmHg$)	587 (24.2)	312 (22.64)	275 (26.34)	4.43	0.04*
Blood Glucose					
Abnormal ($Glucose > 100\ mg/dL$)	1603 (74.1)	933 (77.4)	670 (69.9)	15.32	<.0001 *
Body Mass Index					
Abnormal ($BMI > 25\ kg/m^2$)	136 (57.1)	93 (69.4)	43 (41.4)	18.74	<.0001 *
†The overall sample size for body mass index is $n = 238$, as data on this outcome was only collected in 2011-2012.					

Results were also stratified based on age; workers were grouped as ages 18-39 or 40 and older. For the younger age group, the differences between H2A and non-H2A workers remained essentially the same as the overall findings—abnormal outcomes were significantly different for blood glucose and BMI ($p < .0001$), but not for hypertension and anemia (see Table 3). In the older age group, H2A and non-H2A workers did not exhibit any significant difference in health except for BMI, which remained highly significant ($p < .0001$) (Table 4).

Table 3: Comparison of health outcomes (categorical variables) between H2A and non-H2A camps among workers ages 18-39 years

All values given as n (%). An asterisk (*) denotes significance (p<0.05).				
Variable	**Overall n=2095**	**H2A Camps n=1187**	**Non-H2A Camps n=908**	**p-value**
Anemia				
Anemic ($Hb < 14\ mg/dL$)	543 (25.9)	287 (30.2)	256 (32.3)	0.33
Hypertension				
Hypertensive ($BP > 135/90\ mmHg$)	434 (20.7)	234 (21.2)	200 (23.8)	0.17
Blood Glucose				
Abnormal ($Glucose > 100\ mg/dL$)	1283 (61.2)	747 (77.1)	536 (69.5)	0.0004*
Body Mass Index				
Abnormal ($BMI > 25\ kg/m^2$)	92 (52.0)	62 (63.9)	30 (37.5)	0.0005*

Table 4: Comparison of health outcomes (categorical variables) between H2A and non-H2A camps among workers aged 40 years and older

All values given as n (%). An asterisk (*) denotes significance (p<0.05).				
Variable	**Overall n=504**	**H2A Camps n=288**	**Non-H2A Camps n=216**	**p-value**
Anemia				
Anemic ($Hb < 14\ mg/dL$)	158 (31.3)	91 (39.22)	67 (36.6)	0.59
Hypertension				
Hypertensive ($BP > 135/90\ mmHg$)	153 (30.4)	78 (28.6)	75 (37.0)	0.053
Blood Glucose				
Abnormal ($Glucose > 100\ mg/dL$)	320 (63.5)	186 (78.5)	134 (71.7)	0.11
Body Mass Index				
Abnormal ($BMI > 25\ kg/m^2$)	44 (72.1)	31 (83.8)	13 (54.2)	0.012*

To further examine the associations between H2A status and health outcomes, odds ratios were calculated and adjusted for age. The odds of having an abnormal BMI were more than three times as high in H2A workers as in those without H2A status (OR=3.217, 95% CI: 1.882, 5.499 and adjusted OR=3.105, 95% CI: 1.775, 5.430; Table 5). The odds of having abnormal blood glucose were almost 1.5 times as high in H2A workers as in non-H2A workers (OR=1.432, 95% CI: 1.180, 1.739 and adjusted OR=1.469, 95% CI: 1.211, 1.782; Table 5). The odds of hypertension were nearly 20% lower in H2A workers than in non-H2A workers (OR=0.818, 95% CI: 0.679, 0.987 and adjusted OR=0.817, 95% CI: 0.677, 0.987; Table 5). Anemia was not significantly associated with H2A status.

Table 5: Crude and adjusted associations between H2A status and health outcomes

An asterisk (*) denotes significance (p<0.05).

Variable	**Crude Odds Ratio (95% CI)**	**p-value**	**Age-Adjusted Odds Ratio (95% CI)†**	**p-value**
Anemia				
Anemic ($Hb < 14\ mg/dL$)	0.947 (0.790, 1.134)	0.5523	0.943 (0.787, 1.131)	0.5270
Hypertension				
Hypertensive ($BP > 135/90\ mmHg$)	0.818 (0.679, 0.987)	0.0355*	0.817 (0.677, 0.987)	0.0357*
Blood Glucose				
Abnormal ($Glucose > 100\ mg/dL$)	1.432 (1.180, 1.739)	0.0003*	1.469 (1.211, 1.782)	<.0001*
Body Mass Index				
Abnormal ($BMI > 25\ kg/m^2$)	3.217 (1.882, 5.499)	<.0001*	3.105 (1.775, 5.430)	<.0001*

†*Anemia, hypertension, and blood glucose models adjusted for age (continuous form), body mass index model adjusted for age and age squared*

Other Findings

Figure 1 and Figure 2 show trends over time. Prevalences appear to hold steady from 2003-2012, with a few exceptions. In 2008, blood glucose levels spiked dramatically for both H2A and non-H2A workers, and then dropped far below their 2007 levels the following year (Figures 1-2). However, the prevalence of abnormal blood glucose in both groups has since returned to its previous levels. Without additional information, it is impossible to identify the causes of these spikes and dips, but given the immediate return to previous levels, it is likely that a systematic data error occurred that year (either during collection or recording). Anemia in non-H2A workers spiked in 2009, and although the prevalence went back down the following year, it has not quite returned to its pre-2009 levels. Overall, health outcomes were remarkably consistent over the 10 year period.

Figure 1: Health Outcomes in H2A Workers, 2003-2012

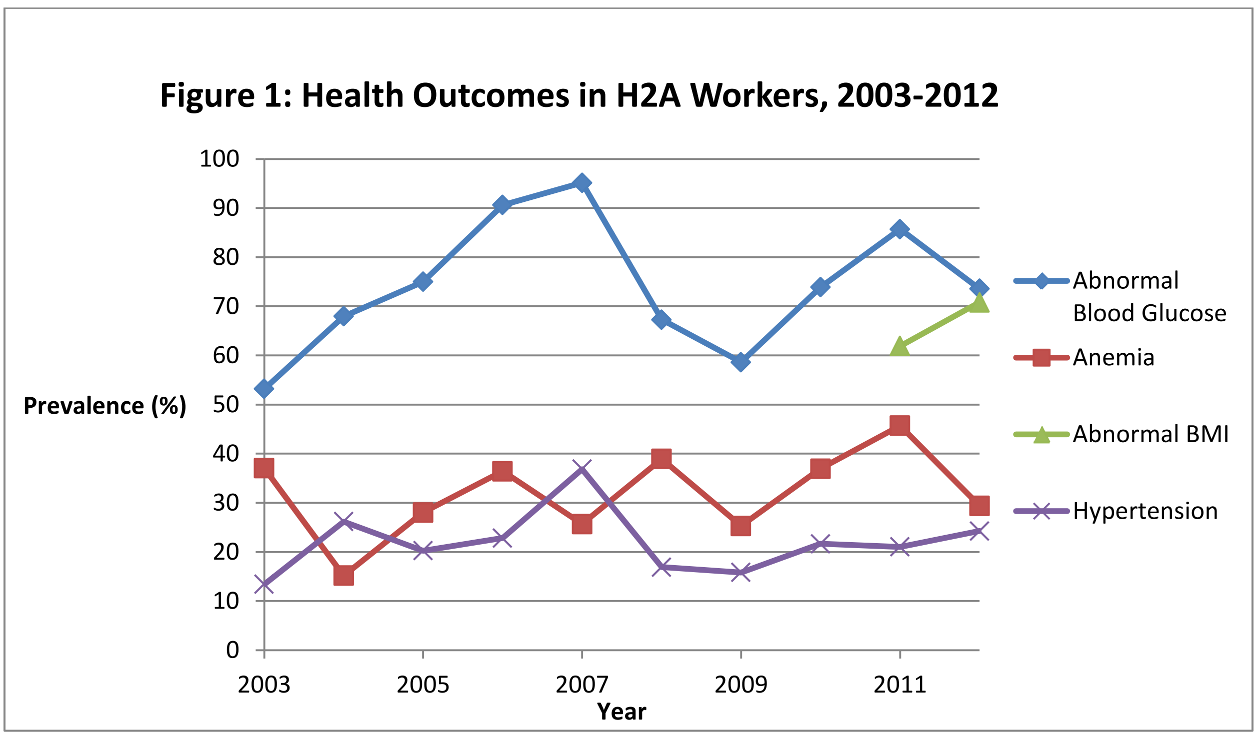
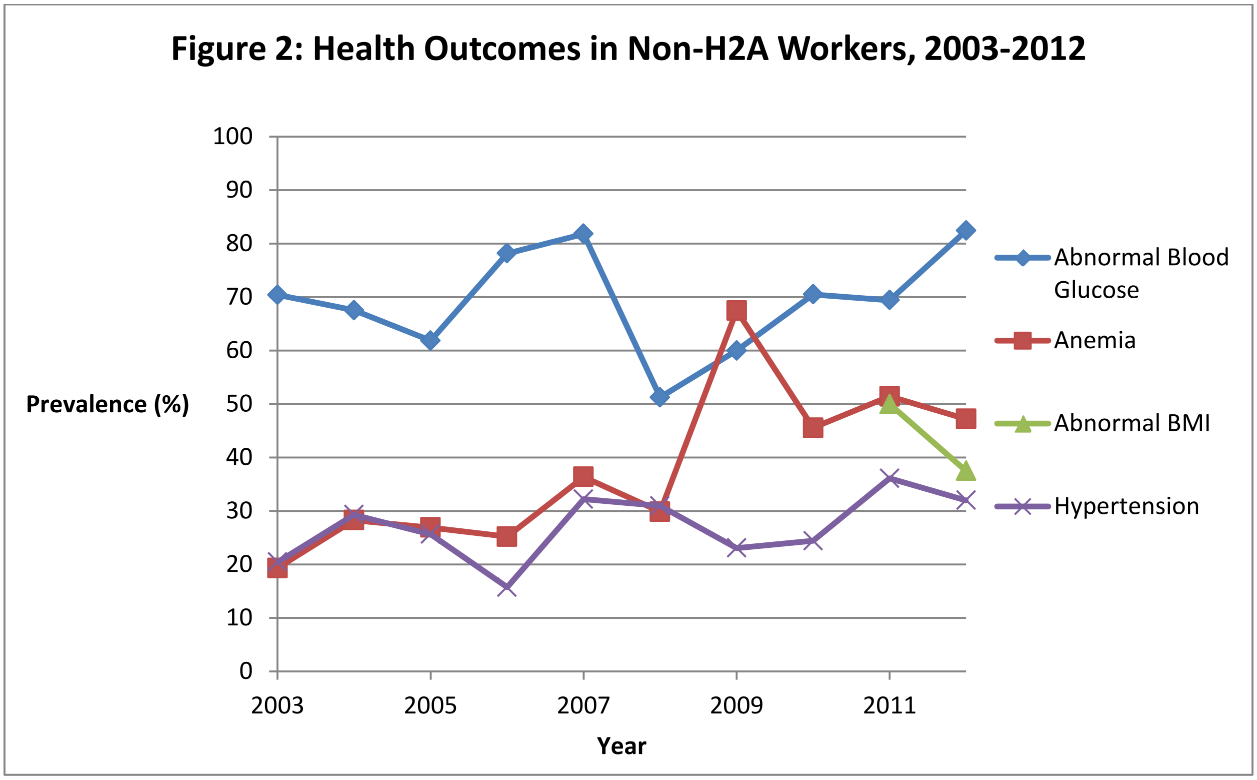


Figure 2: Health Outcomes in Non-H2A Workers, 2003-2012



Comparisons to Other Populations

Abnormal Body Mass Index

Overall, 57% of the study participants were overweight or obese. While this prevalence may seem high, it is actually much lower than in the US population as a whole. According to data from the 2007-2010 National Health and Nutrition Examination Survey (NHANES), the age-adjusted prevalence of overweight and obesity for men 20 years of age and older was 73.3% (National Center for Health Statistics, 2012a). The prevalence for non-Hispanic white men was similar at 73.6%, while for Mexican-American men it was 81.3% (National Center for Health Statistics, 2012a). Among study participants without H2A visas, the prevalence of overweight and obesity was only

41%, while the prevalence for H2A workers was 69%— a value that approaches the national figures, but is still considerably lower.

Hypertension

Twenty-four percent of the study participants were hypertensive; this value was slightly higher for non-H2A workers (26%) and slightly lower for those with H2A status (22%). NHANES data from 2007-2010 show that the prevalence of hypertension in men ages 20 and older is 33.9% (National Center for Health Statistics, 2012b). White men and Mexican men experience similar rates of hypertension, at 34.1% and 36.3% respectively (National Center for Health Statistics, 2012b). Based on these statistics, it appears that the farmworkers in this study have better blood pressure than the general population. However, it is important to note that hypertension was defined by the NHANES as blood pressure greater than $140/90\, mmHg$, while the FWFHP used a cutoff of $135/90\, mmHg$; this difference in definitions may account for at least some of the difference in prevalence.

Abnormal Blood Glucose

Seventy-four percent of the farmworkers surveyed had abnormal blood glucose levels ($> 100\, mg/dL$). For non-H2A workers the prevalence was 70%, while it rose to 77% among the H2A workers. Fasting blood glucose measurements could not be guaranteed for this study, which creates some difficulty when making direct comparisons with the general population; however, data from the 2005-2008 NHANES provide some estimate of the magnitude of the difference. Based on fasting glucose/A1C measurements, 35%

of those age 20 or older (36% for Mexican-Americans) had pre-diabetes, and an additional 11.3% (13.3% for Mexican-Americans) were diagnosed with diabetes (Centers for Disease Control and Prevention, 2011). When categorized in the same way as this study, these numbers would translate to an “abnormal blood glucose” prevalence of 46% (for the general population) to 49% (for Mexican-Americans). Even accounting for differences in measurement, these prevalences are drastically lower than in the study population.

Anemia

The overall prevalence of anemia in the study population was 33%, and no difference was detected between H2A and non-H2A workers. Anemia is rarely investigated as a health problem among adult men, especially in the United States, meaning that data to which these results can be compared is hard to find. However, an analysis of NHANES data from 1999-2002 by the CDC’s Division of Nutrition and Physical Activity estimates that the prevalence of anemia in US men ages 20-60 years is only 1.5% (World Health Organization, 2007). In light of this information, the prevalence of anemia in the study population appears to be alarmingly high.

Summary

Overall, the study population experience lower rates of overweight/obesity than the general US population, as well as slightly lower rates of elevated blood pressure. On the other hand, the prevalences of abnormal blood glucose and anemia are much higher.

H2A workers were found to have significantly worse outcomes for body mass index and blood glucose level than their non-H2A counterparts. However, non-H2A workers were more likely to be hypertensive. Although no difference between the two groups was found for anemia, the overall prevalence is quite high at 33%; the World Health Organization categorizes any anemia prevalence between 20% and 39.9% as a problem of moderate public health concern.

Chapter Four: Discussion, Conclusions, and Recommendations

Summary of Findings

This was a cross-sectional study investigating the health of 2599 farmworkers in South Georgia. Data on blood pressure, blood glucose, and hemoglobin was collected over a 10 year period, and body mass indices were collected during the last two years of that time. Fifty-seven percent of the workers were overweight or obese, 24% experienced hypertension, 74% had abnormal blood glucose, and 33% were anemic. H2A workers appeared to have worse health than non-H2A workers in terms of body mass index and blood glucose, but these results were more mixed when compared with the general US population; the study population had a lower prevalence of abnormal BMI than both the general population and Mexican-Americans, but the prevalence of abnormal blood glucose was much higher than in both the general US population and in Mexican-Americans.

Cardiovascular Health

It is possible that the cardiovascular health differences between the farmworkers and the US population are artifacts of income and activity levels. Farmworkers may have less control over their food choices or less access to healthy food than other segments of the US population, both due to their low salaries and relative isolation. Performing hard physical labor all day is liable to help reduce body mass index, even if non-nutritious foods are being consumed—these high activity levels paired with poor nutritional intake may help to explain the dichotomy of (relatively) low BMI yet high blood glucose levels seen in this population.

Farmworkers with H2A work visas appear to have worse cardiovascular health than those working without documentation—this may seem counterintuitive because the H2A work visa carries certain minimum terms (in regards to payment, housing, meals, and transportation) that a farm operator must comply with, while of course those who employ unauthorized workers are under no such requirements. However, several less-obvious factors may play a part in determining the health of migrant farmworkers.

It is possible that the observed differences are a result of the "healthy migrant effect": unauthorized workers are more strongly selected (because it is a bigger challenge for them to make it to the US) and are therefore healthier than their H2A counterparts. However, this seems unlikely because a slight increase in body mass index is probably not a dramatic enough health effect to impact migration potential. Nonetheless, it may be possible that selection plays a role in a different way: H2A workers on any given farm typically come from the same sending location in Latin America, as the farm operator generally arranges for group transport through a contractor (Geffert, 2002). Additionally, H2A workers are returned to their city or town of origin after each growing season (US Department of Labor, 1952), while undocumented workers are rarely able to make the return journey. If H2A workers tend to originate from areas with a higher prevalence of diabetes and obesity (compared to non-H2A workers), they may be more predisposed to those conditions before they ever enter the US. Unfortunately, it has been difficult to find any research documenting respective sending locations of H2A and non-H2A migrants. This makes it difficult to determine whether the poor cardiovascular health of H2A workers is due to their time in the US, their time at home, or some combination of the two.

H2A farm operators are required to provide either three meals per day (for which they are allowed to charge workers) or free and convenient cooking facilities (Geffert, 2002); however, there is no guarantee that the meals provided are superior in nutritional quality to those that non-H2A workers provide for themselves. Similarly, H2A workers are guaranteed minimum wage, and it is possible that these increased earnings are, perversely, detrimental to their health, as the money may be used to buy foods that are less healthy or to treat family members to meals at fast food restaurants (both in the US and upon returning to Latin America). A recent study shows that adolescent obesity in Mexico is positively associated with household wealth (H. S. Ullmann, Buttenheim, Goldman, Pebley, & Wong, 2011), and another found that high rates of migration in Mexican communities were associated with increased obesity, especially when migration was accompanied by remittances (Riosmena, Frank, Akresh, & Kroeger, 2012).

Anemia

The prevalence of anemia in this sample is disturbing; at 33%, it qualifies as a moderate public health problem according to WHO classification criteria (World Health Organization, 2011).

It is likely that the etiology of anemia in the study population is multi-factoral: poor intake of iron (or other nutrients needed for hemoglobin formation, such as B12), gastrointestinal conditions such as ulcers or hemorrhoids, and chronic diseases. Individuals with diabetes have been shown to be at increased risk for anemia, particularly those with reduced renal function (Bonakdaran, Gharebaghi, & Vahedian, 2011; M. C. Thomas, MacIsaac, Tsalamandris, Power, & Jerums, 2003); based on the elevated levels of blood glucose in this population, diabetes is a likely contributor to the high prevalence of anemia. Additionally, several studies have confirmed a possible etiologic association between pesticide use (especially organophosphates and organochloroquines) and aplastic anemia (Fleming & Timmeny, 1993; Prihartono et al., 2011); thus, it is plausible that pesticide exposure may contribute to anemia in the study subjects. However, this is pure conjecture as the pesticide exposure of the study population has not been systematically assessed and aplastic anemia cannot be diagnosed without a bone marrow sample.

Strengths and Weaknesses

This study examines health outcomes in relation to visa status, but without information on risk factors or behaviors that may potentially be related to those health outcomes, it is difficult to draw strong conclusions. Many of the study's limitations are related to the fact that data came from clinical records (as opposed to surveys or interviews). This meant it was difficult to identify factors that may have had an impact on cardiovascular health, such as length of stay in the US, or those that may have contributed to the observed differences between H2A and non-H2A workers, such as sending cities/regions in Latin America. Other studies have examined issues surrounding health and food security in this population; in 2011 Hill et al explored predictors of food insecurity, including visa status (Hill et al., 2011), and Sibley followed this in 2012 with an unpublished examination of the relationship between food insecurity and chronic disease risk (Sibley, 2012). This investigation expands on those two studies by evaluating the risk of chronic disease in relation to visa status. However, Hill et al found that H2A status was associated with increased food security (Hill et al., 2011), and Sibley found that food insecurity was strongly associated with high blood glucose (Sibley, 2012). These findings make the health differences observed here somewhat surprising. A comprehensive study may need to examine food insecurity and disease as well as visa status and other migration factors.

The large, homogenous sample is a particular strength of this study. The study also adds to the knowledge base about this underserved population, filling in gaps in information and identifying clear priorities for care. Unfortunately, the cross-sectional nature of the study meant that only associations could be examined, not causations—in the future, a longitudinal study of migrant workers might help untangle some of the relationships between migration and obesity.

Recommendations

Research

These results highlight the opportunity for future research that further examines the relationship between migration history and health. One opportunity to extend this research is by gathering additional information during clinics; for example, a sub-sample of clinic intake forms could be amended with questions asking patients about their place of origin and length of stay in the US. As mentioned previously, a longitudinal study of this population may also help to shed new light on these issues; however, this is a notoriously difficult population to follow, so implementation of such a study may prove to be unrealistic.

There is also a need for additional research examining the causal pathways between visa status, food insecurity, and poor cardiovascular health outcomes. Some studies have identified a possible relationship between food insecurity and diabetes, especially in Latinos (Fitzgerald, Hromi-Fiedler, Segura-Perez, & Perez-Escamilla, 2011; Sibley, 2012) and low-income populations (Bawadi et al., 2012; Seligman, Laraia, & Kushel, 2010); additional research can help to clarify this association. It may also be worthwhile to examine housing conditions, and specifically kitchen facilities, in relation to visa status; studies of North Carolina farmworkers have noted that substandard housing conditions appear to be associated with H2A status (Thomas A. Arcury et al., 2012; Vallejos et al., 2011). A recent study that focused on cooking and eating facilities found that not only did a substantial number of them violate state and federal standards, but these violations were more common in residences with fewer H2A workers (Quandt et al., 2013).

Additionally, the high prevalence of anemia in this population indicates the need for a comprehensive assessment of possible risk factors. Specifically, the potential relationship between diabetes and anemia in this population should be evaluated.

Public Health Practice

Based on the high level of abnormal blood glucose in this population, diabetes prevention and management should remain a key area of focus for the Ellenton Clinic and FWFHP. When possible, the clinic should explore additional ways to reach out and present information on this topic to farmworkers; this could include training lay health educators (*"promotoras"*) in the farmworker community or producing health-focused broadcasts for Spanish-language radio stations. Staff will need to collaborate with farmworkers to develop realistic strategies for managing glucose and obtaining nutritious, culturally appropriate foods, given the constraints of their work and financial situations. Community-based diabetes prevention programs have been shown to be particularly effective at reducing obesity and blood glucose levels in Latino populations (Ockene et al., 2012; Ruggiero, Oros, & Choi, 2011; Shaibi et al., 2012), so with careful planning it may be possible to effect a dramatic health improvement without overly taxing the clinic's limited resources.

Policy

Of course, the excellent work done by the FWFHP and the Ellenton Clinic is only a temporary solution to many of these health problems. All farmworkers need the consistent ability to access and afford healthcare, including preventative services. Making this a reality will likely require not just revamping the H2A program, but comprehensive immigration policy reform. Reforms are also needed in the agribusiness industry; this study adds to the abundance of evidence showing the ill health effects of industrial-scale farmwork. It is time we moved towards a more just food system—one that treats farmworkers as the human beings they are, and not as machines.

References

Abraido-Lanza, A. F., Dohrenwend, B. P., Ng-Mak, D. S., & Turner, J. B. (1999). The Latino mortality paradox: a test of the "salmon bias" and healthy migrant hypotheses. *Am J Public Health, 89*(10), 1543-1548.

Adams, E. J., Grummer-Strawn, L., & Chavez, G. (2003). Food insecurity is associated with increased risk of obesity in California women. *J Nutr, 133*(4), 1070-1074.

Ahmed, A. T., Quinn, V. P., Caan, B., Sternfeld, B., Haque, R., & Van Den Eeden, S. K. (2009). Generational status and duration of residence predict diabetes prevalence among Latinos: the California Men's Health Study. [Article]. *Bmc Public Health, 9*. doi: 10.1186/1471-2458-9-392

Arcury, T. A., O'Hara, H., Grzywacz, J. G., Isom, S., Chen, H. Y., & Quandt, S. A. (2012). Work Safety Climate, Musculoskeletal Discomfort, Working While Injured, and Depression Among Migrant Farmworkers in North Carolina. *American Journal of Public Health, 102*, S272-S278. doi: 10.2105/ajph.2011.300597

Arcury, T. A., & Quandt, S. A. (2007). Delivery of health services to migrant and seasonal farmworkers *Annual Review of Public Health* (Vol. 28, pp. 345-363).

Arcury, T. A., Quandt, S. A., & Mellen, B. G. (2003). An exploratory analysis of occupational skin disease among Latino migrant and seasonal farmworkers in North Carolina. [Research Support, U S Gov't, P H S]. *J Agric Saf Health, 9*(3), 221-232.

Arcury, T. A., Weir, M., Chen, H., Summers, P., Pelletier, L. E., Galván, L., . . . Quandt, S. A. (2012). Migrant farmworker housing regulation violations in north Carolina. *American Journal of Industrial Medicine, 55*(3), 191-204. doi: 10.1002/ajim.22011

Austin, C. (2002). The struggle for health in times of plenty. In C. Thompson & M. Wiggens (Eds.), *The Human Cost of Food*. Austin: University of Texas Press.

Balderrama, F. (2006). *Decade of Betrayal: Mexican Repatriation in the 1930s*. Albuquerque, New Mexico: University of New Mexico Press.

Barcellos, S. H., Goldman, D. P., & Smith, J. P. (2012). Undiagnosed Disease, Especially Diabetes, Casts Doubt On Some Of Reported Health 'Advantage' Of Recent Mexican Immigrants. *Health Affairs, 31*(12), 2727-2737. doi: 10.1377/hlthaff.2011.0973

Bawadi, H. A., Ammari, F., Abu-Jamous, D., Khader, Y. S., Bataineh, S., & Tayyem, R. F. (2012). Food insecurity is related to glycemic control deterioration in patients with type 2 diabetes. *Clinical Nutrition, 31*(2), 250-254. doi: 10.1016/j.clnu.2011.09.014

Bonakdaran, S., Gharebaghi, M., & Vahedian, M. (2011). Prevalence of anemia in type 2 diabetes and role of renal involvement. *Saudi J Kidney Dis Transpl, 22*(2), 286-290.

Borre, K., Ertle, L., & Graff, M. (2010). Working to Eat: Vulnerability, Food Insecurity, and Obesity Among Migrant and Seasonal Farmworker Families. *American Journal of Industrial Medicine, 53*(4), 443-462. doi: 10.1002/ajim.20836

Brieger, K. (2006). A dietician's perspective on diabetes among migrant farmworkers. [Editorial Material]. *Journal of Health Care for the Poor and Underserved, 17*(3), 469-476. doi: 10.1353/hpu.2006.0100

Bureau of Labor Statistics. (2011). Incidence rates of nonfatal occupational illness, by industry and category of illness, 2011 Retrieved 15 November, 2012, from http://www.bls.gov/iif/oshwc/osh/os/ostb3186.pdf

Carroll, D., Georges, A., & Saltz, R. (2011). *Changing Characteristics of US Farm Workers: 21 Years of Findings from the National Agricultural Workers Survey*. Paper presented at the Immigration Reform and Agriculture Conference: Implications for Farmers, Farm Workers, and Communities, Washington, D.C. http://migration.ucdavis.edu/cf/files/2011-may/carroll-changing-characteristics.pdf

Carroll, D., 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*: US Department of Labor.

Centers for Disease Control and Prevention. (2011). National diabetes fact sheet: national estimates and general information on diabetes and prediabetes in the United States. Atlanta, GA: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention.

1917 Immigration Act (1917).

Durand, J., Massey, D. S., & Parrado, E. A. (1999). The New Era of Mexican Migration to the United States. *The Journal of American History, 86*(2), 518-536.

Early, J., Davis, S. W., Quandt, S. A., Rao, P., Snively, B. M., & Arcury, T. A. (2006). Housing characteristics of farmworker families in North Carolina. [Research Support, N I H , Extramural]. *J Immigr Minor Health, 8*(2), 173-184.

Emmi, K. E., Jurkowski, J. M., Codru, N., Bell, E. M., Kacica, M. A., & Carter, T. P. (2010). Assessing the Health of Migrant and Seasonal Farmworkers in New York State: Statewide Data 2003-2005. *Journal of Health Care for the Poor and Underserved, 21*(2), 448-463.

Feldman, S. R., Vallejos, Q. M., Quandt, S. A., Fleischer, A. B., Schulz, M. R., Verma, A., & Arcury, T. A. (2009). Health Care Utilization Among Migrant Latino Farmworkers: The Case of Skin Disease. *Journal of Rural Health, 25*(1), 98-103. doi: 10.1111/j.1748-0361.2009.00205.x

Fitzgerald, N., Hromi-Fiedler, A., Segura-Perez, S., & Perez-Escamilla, R. (2011). Food insecurity is related to increased risk of type 2 diabetes among Latinas. [Research Support, N I H , Extramural

Research Support, Non-U S Gov't]. *Ethn Dis, 21*(3), 328-334.

Fleming, L. E., & Timmeny, W. (1993). APLASTIC-ANEMIA AND PESTICIDES - AN ETIOLOGIC ASSOCIATION. [Review]. *Journal of Occupational and Environmental Medicine, 35*(11), 1106-1116. doi: 10.1097/00043764-199311000-00013

French, S. A., Wall, M., & Mitchell, N. R. (2010). Household income differences in food sources and food items purchased. *Int J Behav Nutr Phys Act, 7*(77), 1479-5868.

Geffert, G. (2002). H-2A guest worker program: a legacy of importing agricultural labor. In C. Thompson & M. Wiggens (Eds.), *The Human Cost of Food*. Austin: University of Texas Press.

Georgia Farm Bureau. (2013). Georgia Agriculture – The State's $68 Billion Industry, 2013, from http://www.gfb.org/aboutus/georgia_agriculture.html

Georgia Farmworker Health Program. (2008). Georgia Farmworker Health Program Policies and Procedures Manual. Atlanta, Georgia: State Office of Rural Health.

Godfrey, K. M., & Barker, D. J. (2001). Fetal programming and adult health. [Review]. *Public Health Nutr, 4*(2B), 611-624.

Hawkins, D., & Valdez, A. (2001). Migrant Health Issues *Migrant Health Monograph Series*. Buda, TX: National Center For Farmworker Health, Inc.

Bracero Accord (1943).

Hill, B. G., Moloney, A. G., Mize, T., Himelick, T., & Guest, J. L. (2011). Prevalence and predictors of food insecurity in migrant farmworkers in Georgia. *Am J Public Health, 101*(5), 831-833.

Hoerster, K. D., Beddawi, S., Peddecord, K. M., & Ayala, G. X. (2010). Healthcare Use Among California Farmworkers: Predisposing and Enabling Factors. *Journal of Immigrant and Minority Health, 12*(4), 506-512. doi: 10.1007/s10903-009-9305-0

Larson, A. (2008). Migrant and Seasonal Farmworker Enumeration Profiles Study. In Georgia Farmworker Health Program (Ed.). Cordele, Georgia: State Office of Rural Health.

Lashuay, N., & Harrison, R. (2006). Barriers to Occupational Health Services for Low-Wage Workers in California. San Francisco, CA: Commission on Health and Safety and Workers' Compensation, California Department of Industrial Relations.

Lassetter, J. H., & Callister, L. C. (2009). The Impact of Migration on the Health of Voluntary Migrants in Western Societies A Review of the Literature. [Article]. *Journal of Transcultural Nursing, 20*(1), 93-104. doi: 10.1177/1043659608325841

Leung, C. W., Williams, D. R., & Villamor, E. (2012). Very low food security predicts obesity predominantly in California Hispanic men and women. [Article]. *Public Health Nutrition, 15*(12), 2228-2236. doi: 10.1017/s1368980012000857

Lighthall, D. (2001). The poor health of farm workers. [Research Support, Non-U S Gov't]. *West J Med, 175*(4), 223-224.

Mines, R., Mullenax, N., Saca, L., Nagiecki, J., Studies, C. I. f. R., & Endowment, C. (2001). *The binational farmworker health survey: an in-depth study of agricultural worker health in Mexico and the United States*: California Institute for Rural Studies.

Myers, J., & Steeg, A. (2004). Chapter 3: Focus on Agriculture. In J. Sestito, R. A. Lunsford, A. Hamilton & R. Rosa (Eds.), Worker Health Chartbook, 2004: Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health. Retrieved from http://www.cdc.gov/niosh/docs/2004-146/pdfs/2004-146.pdf.

National Agricultural Statistics Service. (2009). USDA Farm Labor Survey Retrieved 4 Feb, 2013, from http://www.nass.usda.gov/Surveys/Guide_to_NASS_Surveys/Farm_Labor/index.asp

National Agricultural Tractor Safety Initiative. (2011). Surveillance: Deaths and Injuries from Tractor Incidents Retrieved 15 November, 2012, from http://depts.washington.edu/trsafety/stats_research.php

National Agricultural Workers Survey. (2011). The National Agricultural Workers Survey Retrieved 5 March, 2013, from http://www.doleta.gov/agworker/naws.cfm

National Center for Farmworker Health. (2008a). The History of Migrant Health. Buda, Texas: National Center for Farmworker Health.

National Center for Farmworker Health. (2008b). NFCH Library and Resource Center Retrieved 5 March, 2013, from http://www.ncfh.org/?sid=38

National Center for Farmworker Health. (2009). Occupational Health and Safety Retrieved 15 November, 2012, from http://www.ncfh.org/?pid=5

National Center for Farmworker Health. (2012). Facts about Farmworkers Retrieved 15 November, 2012, from http://www.ncfh.org/?pid=5

National Center for Health Statistics. (2012a). Health, United States, 2011: With Special Feature on Socioeconomic Status and Health *Table 74: Healthy weight, overweight, and obesity among persons 20 years of age and over, by selected characteristics: United States, selected years 1960–1962 through 2007–2010*. Hyattsville, MD: Department of Health and Human Services, Centers for Disease Control and Prevention.

National Center for Health Statistics. (2012b). Health, United States, 2011: With Special Feature on Socioeconomic Status and Health. *Table 70: Hypertension among persons 20 years of age and over, by selected characteristics: United States, selected years 1988–1994 through 2007–2010.* Hyattsville, MD: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention.

Ockene, I. S., Tellez, T. L., Rosal, M. C., Reed, G. W., Mordes, J., Merriam, P. A., . . . Ma, Y. S. (2012). Outcomes of a Latino Community-Based Intervention for the Prevention of Diabetes: The Lawrence Latino Diabetes Prevention Project. *American Journal of Public Health, 102*(2), 336-342. doi: 10.2105/ajph.2011.300357

Pan, L., Sherry, B., Njai, R., & Blanck, H. M. (2012). Food Insecurity Is Associated with Obesity among US Adults in 12 States. *Journal of the Academy of Nutrition and Dietetics, 112*(9), 1403-1409. doi: http://dx.doi.org/10.1016/j.jand.2012.06.011

Prihartono, N., Kriebel, D., Woskie, S., Thetkhathuek, A., Sripaung, N., Padungtod, C., & Kaufman, D. (2011). Risk of Aplastic Anemia and Pesticide and Other Chemical Exposures. [Article]. *Asia-Pacific Journal of Public Health, 23*(3), 369-377. doi: 10.1177/1010539511403605

Quandt, S. A., Summers, P., Bischoff, W. E., Chen, H., Wiggins, M. F., Spears, C. R., & Arcury, T. A. (2013). Cooking and Eating Facilities in Migrant Farmworker Housing in North Carolina. [Journal article]. *Am J Public Health, 103*(3), e78-e84.

HB 87 - Illegal Immigration Reform and Enforcement Act of 2011 (2011).

Riosmena, F., Frank, R., Akresh, I. R., & Kroeger, R. A. (2012). U.S. Migration, Translocality, and the Acceleration of the Nutrition Transition in Mexico. *Annals of the Association of American Geographers, 102*(5), 1209-1218. doi: 10.1080/00045608.2012.659629

Rosenbaum, S., & Shin, P. (2005). Migrant and Seasonal Farmworkers: Health Insurance Coverage and Access to Care: The George Washington University.

Ruggiero, L., Oros, S., & Choi, Y. K. (2011). Community-Based Translation of the Diabetes Prevention Program's Lifestyle Intervention in an Underserved Latino Population. *Diabetes Educator, 37*(4), 564-572. doi: 10.1177/0145721711411107

Salas, R., Mayer, J. A., & Hoerster, K. D. (2005). Sun-protective behaviors of California farm workers. [Research Support, N I H , Extramural]. *J Occup Environ Med, 47*(12), 1244-1249.

Schell, G. (2002). Farmworker Exceptionalism Under the Law: How the Legal System Contributes to Farmworker Poverty and Powerlessness. In M. Wiggens & C. Thompson (Eds.), *The Human Cost of Food* (pp. 118-146). Austin, TX: University of Texas Press.

Seligman, H. K., Laraia, B. A., & Kushel, M. B. (2010). Food Insecurity Is Associated with Chronic Disease among Low-Income NHANES Participants. *Journal of Nutrition, 140*(2), 304-310. doi: 10.3945/jn.109.112573

Shaibi, G. Q., Konopken, Y., Hoppin, E., Keller, C. S., Ortega, R., & Castro, F. G. (2012). Effects of a Culturally Grounded Community-Based Diabetes Prevention Program for Obese Latino Adolescents. *Diabetes Educator, 38*(4), 504-512. doi: 10.1177/0145721712446635

Sibley, C. (2012). *Mixed methods analysis of migrant farm workers' health outcomes and access to healthy food in Moultrie, Georgia, USA*. Masters Thesis. Emory University.

Sologaistoa, E. (2011). Farmworkers in the Southeast: Alabama, Florida, Georgia, Mississippi. Tallahassee, Florida.

Sundquist, J., & Winkleby, M. A. (1999). Cardiovascular risk factors in Mexican American adults: a transcultural analysis of NHANES III, 1988-1994. [Research Support, Non-U S Gov't

Research Support, U S Gov't, P H S]. *Am J Public Health, 89*(5), 723-730.

Thomas, A. J., Eberly, L. E., Neaton, J. D., & Smith, G. D. (2005). Latino risk-adjusted mortality in the men screened for the multiple risk factor intervention trial. [Article]. *American Journal of Epidemiology, 162*(6), 569-578. doi: 10.1093/aje/kwi220

Thomas, M. C., MacIsaac, R. J., Tsalamandris, C., Power, D., & Jerums, G. (2003). Unrecognized anemia in patients with diabetes: a cross-sectional survey. [Research Support, Non-U S Gov't]. *Diabetes Care, 26*(4), 1164-1169.

Turra, C. M., & Elo, I. T. (2008). The Impact of Salmon Bias on the Hispanic Mortality Advantage: New Evidence from Social Security Data. [Journal article]. *Popul Res Policy Rev, 27*(5), 515-530.

Ullmann, H. S., Buttenheim, A. M., Goldman, N., Pebley, A. R., & Wong, R. (2011). Socioeconomic differences in obesity among Mexican adolescents. [Research Support, N I H , Extramural]. *Int J Pediatr Obes, 6*(2-2), 1.

Ullmann, S. H., Goldman, N., & Massey, D. S. (2011). Healthier before they migrate, less healthy when they return? The health of returned migrants in Mexico. [Article]. *Social science & medicine, 73*(3), 421-428. doi: 10.1016/j.socscimed.2011.05.037

US Census Bureau. (2012). American Fact Finder Retrieved 20 November, 2012, from http://factfinder2.census.gov/faces/nav/jsf/pages/index.xhtml

US Department of Agriculture. (2007). 2007 Census of Agriculture: Economics.

US Department of Labor. (1952). Work Authorization for Non-U.S. Citizens: Temporary Agricultural Workers (H-2A Visas). *eLaws-- Employment Law Guide* Retrieved 15 November, 2012, from http://www.dol.gov/compliance/guide/taw.htm

US Department of State. (2012). Visa Statistics: Multi-Year Graphs Retrieved 15 November, 2012, from http://travel.state.gov/visa/statistics/graphs/graphs_4399.html

Vallejos, Q. M., Quandt, S. A., Grzywacz, J. G., Isom, S., Chen, H. Y., Galvan, L., . . . Arcury, T. A. (2011). Migrant Farmworkers' Housing Conditions Across an Agricultural Season in North Carolina. *American Journal of Industrial Medicine, 54*(7), 533-544. doi: 10.1002/ajim.20945

Vega, W. A., Rodriguez, M. A., & Gruskin, E. (2009). Health Disparities in the Latino Population. [Review]. *Epidemiologic Reviews, 31*(1), 99-112. doi: 10.1093/epirev/mxp008

Villarejo, D., & McCurdy, S. A. (2008). The California Agricultural Workers Health Survey. *J Agric Saf Health, 14*(2), 135-146.

Weigel, M. M., Armijos, R. X., Hall, Y. P., Ramirez, Y., & Orozco, R. (2007). The household food insecurity and health outcomes of U.S.-Mexico border migrant and seasonal farmworkers. [Research Support, U S Gov't, P H S]. *J Immigr Minor Health, 9*(3), 157-169.

Whalley, L. E., Grzywacz, J. G., Quandt, S. A., Vallejos, Q. M., Walkup, M., Chen, H. Y., . . . Arcury, T. A. (2009). Migrant Farmworker Field and Camp Safety and Sanitation in Eastern North Carolina. *Journal of Agromedicine, 14*(4), 421-436. doi: 10.1080/10599240903389508

Wold, J., & Layne, L. (2012). *Clinical Experience Manual*. Farmworker Family Health Program. Emory University, Atlanta, Georgia.

World Health Organization. (2007). Vitamin and Mineral Nutrition Information System (VMNIS) *WHO Global Database on Anemia*.

World Health Organization. (2011). Haemoglobin concentrations for the diagnosis of anaemia and assessment of severity. In Vitamin and Mineral Nutrition Information System (Ed.). Geneva: World Health Organization.

Appendices

Appendix A: Tables

Appendix Table A 1: Distribution of study participants by camp and year

All values given as n (%). H2A camps are labeled as "H2A Farm 1", "H2A Farm 2", etc. All other camps (labeled with letters) are non-H2A.										
Camp	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**Total**
H2A Farm 1	0 (0)	0 (0)	0 (0)	79 (3.04)	0 (0)	38 (1.46)	0 (0)	22 (0.85)	0 (0)	54 (2.08)	193 (7.43)
Farm A	0 (0)	0 (0)	18 (0.69)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	18 (0.69)
Farm B	0 (0)	33 (1.27)	55 (2.12)	30 (1.15)	29 (1.12)	32 (1.23)	29 (1.12)	24 (0.92)	12 (0.46)	12 (0.46)	256 (9.85)
Farm C	0 (0)	0 (0)	13 (0.5)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	13 (0.5)
Farm D	7 (0.27)	57 (2.19)	27 (1.04)	0 (0)	32 (1.23)	34 (1.31)	0 (0)	0 (0)	11 (0.42)	15 (0.58)	183 (7.04)
Farm E	0 (0)	25 (0.96)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	25 (0.96)
Farm F	62 (2.39)	65 (2.5)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	127 (4.89)
Farm G	0 (0)	0 (0)	26 (1)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	26 (1)
Farm H	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	24 (0.92)	0 (0)	23 (0.88)	47 (1.81)
Farm I	0 (0)	0 (0)	0 (0)	4 (0.15)	4 (0.15)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	8 (0.31)
Farm J	5 (0.19)	0 (0)	0 (0)	5 (0.19)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	10 (0.38)
H2A Farm 2	67 (2.58)	87 (3.35)	79 (3.04)	124 (4.77)	112 (4.31)	111 (4.27)	56 (2.15)	81 (3.12)	48 (1.85)	82 (3.16)	847 (32.59)
Farm K	27 (1.04)	42 (1.62)	25 (0.96)	0 (0)	15 (0.58)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	109 (4.19)
Farm L	0 (0)	11 (0.42)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	11 (0.42)
Farm M	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	23 (0.88)	0 (0)	0 (0)	23 (0.88)
Farm N	0 (0)	0 (0)	0 (0)	70 (2.69)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	32 (1.23)	102 (3.92)
Farm O	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	21 (0.81)	19 (0.73)	0 (0)	40 (1.54)
H2A Farm 3	8 (0.31)	0 (0)	74 (2.85)	79 (3.04)	74 (2.85)	64 (2.46)	69 (2.65)	58 (2.23)	0 (0)	9 (0.35)	435 (16.74)
Farm P	0 (0)	0 (0)	0 (0)	40 (1.54)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	40 (1.54)
Farm Q	0 (0)	0 (0)	0 (0)	0 (0)	44 (1.69)	28 (1.08)	14 (0.54)	0 (0)	0 (0)	0 (0)	86 (3.31)
Total	176 (6.77)	320 (12.31)	317 (12.2)	431 (16.58)	310 (11.93)	307 (11.81)	168 (6.46)	253 (9.73)	90 (3.46)	227 (8.73)	2599 (100)

Appendix Table A 2: Distribution of participants from H2A camps vs. non-H2A camps by year.

All values given as n (%).											
Camp Status	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**Total**
H2A	75 (2.89)	87 (3.35)	153 (5.89)	282 (10.85)	186 (7.16)	213 (8.2)	125 (4.81)	161 (6.19)	48 (1.85)	145 (5.58)	1475 (56.75)
Non-H2A	101 (3.89)	233 (8.96)	164 (6.31)	149 (5.73)	124 (4.77)	94 (3.62)	43 (1.65)	92 (3.54)	42 (1.62)	82 (3.16)	1124 (43.25)
Total	176 (6.77)	320 (12.31)	317 (12.2)	431 (16.58)	310 (11.93)	307 (11.81)	168 (6.46)	253 (9.73)	90 (3.46)	227 (8.73)	2599 (100)

Appendix Table A 3: Univariate statistics for continuous variables.

All values given as mean (standard deviation).			
Variable	**H2A Camps n=1475**	**Non-H2A Camps n=1124**	**Overall n=2599†**
Age $(years)$	31 (9.5)	31 (9.7)	31 (9.6)
Blood Glucose (mg/dL)	121.4 (35.3)	118.4 (37.89)	120 (36.49
Blood Pressure (Diastolic) $(mmHg)$	77 (9.7)	77 (10.4)	77 (10)
Blood Pressure (Systolic) $(mmHg)$	123 (11.9)	124 (12.9)	123 (12.4)
Body Mass Index (kg/m^2)	27 (3.8)	24.8 (4.20)	26.1 (4.16)
Hemoglobin (mg/dL)	14.5 (1.45)	14.5 (1.53)	14.5 (1.49)
†*Note: Date for body mass index was only collected in 2011 and 2012, so the BMI variable has an overall sample size of only 238 (134 H2A, 104 non-H2A).*			

Appendix Table A 4: Comparison of health outcomes (continuous variables) between H2A and non-H2A camps.

All values given as mean (standard deviation). An asterisk (*) denotes significance (p<0.05).			
Variable	**H2A Camps n=1475**	**Non-H2A Camps n=1124**	**p-value**
Blood Glucose (mg/dL)	121.4 (35.30)	118.4 (37.89)	0.06
Blood Pressure (Diastolic) ($mmHg$)	77 (9.67)	77 (10.41)	0.11
Blood Pressure (Systolic) ($mmHg$)	123 (11.9)	124 (12.9)	0.09
Body Mass Index (kg/m^2)	27.1 (3.85)	24.8 (4.20)	<.0001*
Hemoglobin (mg/dL)	14.5 (1.45)	14.5 (1.53)	0.72

Appendix B: List of Acronyms

BMI Body Mass Index

CDC Centers for Disease Control

FWFHP Farmworker Family Health Program

ICRA Immigration Control and Reform Act

MSFW Migrant and Seasonal Farmworkers

NAWS National Agricultural Workers Survey

NCFH National Center for Farmworker Health

NHANES National Health and Nutrition Survey

OSHA Occupation Health and Safety Administration

SORH State Office of Rural Health

USDA United States Department of Agriculture

WHO World Health Organization