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Rebecca Russ

Date 11/15/2015

**Prevalence and Risk Indicators of Visual Impairment and Eye Exams among Latino
Migrant Farmworkers**

By

Rebecca Megan Russ
Degree to Be Awarded: MPH

Hubert Department of Global Health

Dr. Danny Haddad, MD
Committee Chair

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Migrant Farmworkers**

By

Rebecca Megan Russ

Bachelor of Arts with Distinction
Yale University
2011

Thesis Committee Chair: Dr. Danny Haddad, MD

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Abstract

Prevalence and Risk Indicators of Visual Impairment and Eye Exams among Latino Migrant Farmworkers

By Rebecca Megan Russ

Purpose: Little is known about vision loss and eye health in migrant farmworkers in the United States. The purpose of this study was to assess the prevalence and independent risk indicators of visual impairment and access to eye care among migrant farmworkers.

Methods: A cross-sectional study was performed using nationally-validated survey questions. Participants (n=162) were migrant farmworkers 18+ years working in agricultural camps throughout Lowndes County, Georgia, recruited from a primary care clinic. Primary measures included prevalence of self-reported moderate-to-severe visual impairment and history of eye exam within the last year. Predictors of visual impairment and eye exam within the last year were identified through bivariate analysis and stepwise multivariate logistic regression (all p-values <0.05).

Results: Prevalence of moderate-to-severe visual impairment was 12.3% overall, with 6.7% reported by those <40 years and 32.4% reported by those ≥40 years. Of those ≥ 65 years, with moderate-to-severe visual impairment, or diabetes, 33.3%, 15.8% and 33.3% had an eye exam in the last year. Predictors (odds ratio [95% confidence interval]) of moderate-to-severe visual impairment were eye pain (12.6 [2.6-68.5]); age 40-64 years (12.1 [2.7-54.7]) or ≥65 years (41.6 [1.9-914.5]); and current smoking status (7.6 [1.6-36.8]). Predictors of eye exam within the last year include ≥ high school education (4.7 [1.6-13.2]) and moderate-to-severe far vision impairment (0.2 [0.04-0.9]).

Conclusions: Migrant farmworkers have high rates of visual impairment, but have limited access to care. Concerted efforts are needed to improve prevention education, increase detection, and facilitate treatment of eye disease and injuries in migrant farmworkers.

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Chapter 1: Introduction

Migrant farmworkers have a long and complicated history in the United States. The term “migrant farmworker,” initially referred to the contractual and temporary nature of hired, or non-family, farmhands. Now the term has come to connote migrant farmworkers’ predominantly immigrant background. Beginning with the Bracero Program, a series of laws and diplomatic agreements on importing laborers from Mexico to satisfy the post-World War II shortage of farmworkers, farms in the United States have become increasingly economically reliant on migrant farmworkers.

Today, an estimated 1 to 3 million hired farmworkers live and work in the United States. Of these, somewhere between 43% and 80% are Hispanic. Roughly half of all hired farmworkers are non-citizens and are unauthorized to be in the United States. Of those without authorization, an estimated 90.3% originate from Mexico. On average, migrant farmworkers are young, with median age of the migrant farmworker is 34 years old. Migrant farmworkers are also 86% male. They experience significant economic disadvantage. Most migrant farmworkers are contracted on a temporary basis, and thus, more likely to be unemployed. Those migrant farmworkers earn a weekly wage that is 59% of the average United States wage and salary earner.¹

In addition to economic disadvantage, migrant farmworkers are exposed to increased occupational hazards. In general, agricultural labor is regarded as one of the most dangerous occupations, with foreign-born farmworkers experiencing significantly higher rates of occupational-related injury, illness, and death.^{1,2} Part of this increased health risk can be explained by poor and inconsistent enforcement of federal regulations like the EPA Worker Protection Standard and the OSHA Field Sanitation Standard.³ Working long, labor-intensive days harvesting crops, the migrant farmworker population is chronically exposed to wind, dust,

chemicals, and ultraviolet light. Such exposure increases risk for musculoskeletal injury, asthma or allergies, pesticide exposure-related illness, and dermatological diseases.¹

Given their increased environmental and occupational risk factors, migrant farmworkers also have a significant amount of ophthalmologic disease. Acute ophthalmologic problems include eye irritation, photokeratitis, or ultraviolet light burns of the cornea and conjunctiva, and trauma. Chronic irritation and exposure to UV light also increases migrant farmworkers' risk for development of pterygia. Pterygia are superficial, callous-like membranes that cover the surface of the eye. They can subsequently extend to the corneal surface impairing vision.⁴ In one study, of 296 migrant workers in North Carolina, 23.3% had at least one pterygium. Of the workers, 6.8% had at least one pterygium of moderate severity and 0.3% had severe pterygia, with greater than 25% encroachment of the cornea.⁴ Migrant farmworkers also self-report untreated near and far visual impairment. A study with 79 participants revealed that one in five migrant farmworkers in North Carolina rated their vision as fair or poor. In that same study, about a quarter of the participants reported eye symptoms of pain, redness, or itching in the last 7 days.⁵ In a larger survey of 970 Californian migrant farmworkers, contact with pesticides was significantly associated with eye itching and irritation.⁶

Nevertheless, much eye disease goes untreated in the migrant farmworker population. Only eight percent of all hired farmworkers report that they are covered by their employer's private health insurance. Migrant farmworkers authorized to be in the US have access to and greater utilization of social insurance programs like Medicaid at a rate of roughly 35%. However, undocumented migrant farmworkers have no access to Medicaid. Only their citizen children are eligible for Medicaid. Most migrant farmworkers, especially undocumented workers, are left to self-pay for the health services they need. However, with 23% of

farmworker families producing an average family income below poverty guidelines, private insurance remains beyond their financial means. With limited access to healthcare, few migrant farmworkers have seen a primary care physician in the past year.⁷ Fewer have ever seen an ophthalmologist. In one study, 38.5% had never seen an ophthalmologist, with approximately 25% of these patients reporting cost or unavailability of an eye care professional as reason.⁵

Problem and Significance

Despite the confluence of factors that put migrant farmworkers at risk for eye disease, migrant farmworkers' poor access to care has resulted in a paucity of data reflecting the exact epidemiology of eye disease. To date, only a few studies have reported on subjective assessments of eye health and access to eye care. These studies are limited in size and often utilize non-validated surveys. Fewer studies have determined significant predictors of eye disease or access to care among migrant farmworkers. Finally, existing studies of eye health and access to care among migrant farmworkers are geographically-limited. So far, studies have only included North Carolina and California. Though a large population of roughly 88,000 migrant farmworkers lives and works in the state of Georgia, no literature exists reflecting their eye health, eye care history, and access to eye care.⁸

More complete epidemiologic information on eye health and eye care in migrant farmworkers in Georgia and the United States is necessary to understand the overall health and quality of life of the migrant farmworker. Determining the burden of eye disease and disparities among migrant farmworkers can inform distribution of health resources at a local, state and national level. Identifying risk factors of visual impairment can help focus prevention efforts at modifiable risk factors. Finally, defining predictors of poor access to care, can direct community,

statewide, and national providers and policymakers to efficiently target resources and address barriers in this population.

Purpose statement

In this study, we perform a cross-sectional analysis of a validated survey of eye health and access to eye care in order to:

1. Analyze the prevalence of visual impairment, eye irritation, eye injury and access to eye care among migrant farmworkers in Georgia.
2. Determine important predictors (demographic and health-related) associated with visual impairment in migrant farmworkers.
3. Identify important predictors (demographic and health-related factors) of poor access to eye care among migrant farmworkers.

Definition of Terms

Hired Farmworker

A hired farmworker is an individual, not related to the farm owner, who is contracted for a permanent full-time, part-time, or temporary position to perform agricultural work, including crop production, post-harvest food processing, and reforestation. Not included in this definition are those who work with livestock, poultry, dairy, fishing, or final transportation of crop products. The hired farmworker may be authorized or unauthorized.

Seasonal Farmworker

A seasonal farmworker is an individual who meets the above definition and who is employed seasonally, depending on the crop production cycle and need for additional

farmworkers. A seasonal farmworker should be employed for greater than half of the time in agricultural work (as agricultural work is described above).

Migrant Farmworker

A migrant farmworker is a seasonal farmworker as described above, but who establishes a temporary residency for the purposes of that employment. For simplification, the term as it is used in the subsequent thesis, is used to describe only foreign-born, immigrant farmworkers who are authorized or unauthorized to be in the United States. It should be noted that this is a generalization of migrant farmworkers: United States seasonal farmworkers may also be permanent residents to that community and citizens of the U.S. However, given that the vast majority of migrant farmworkers are immigrants to the United States, this generalization will be made.⁸ Furthermore, some migrant farmworkers' temporary residencies are more permanent than others. Some stay in one location for years at a time, while others follow typical migration streams through multiple states over the course of one season. In such cases, the term "migrant farmworker" applies to both.

Eye Health

Eye health is a broad term summarizing subjective, self-reported eye symptoms and objective diagnoses of eye disease. In the following study, eye health was assessed only subjectively, through self-reported symptoms. In this study the term includes symptoms of difficulty with near or far vision, eye pain, burning, itching, aching, or injury.

Visual Impairment

Visual impairment is a term referring to difficulty seeing at a close distance or a long distance even while wearing their current glasses, if applicable. Typically, visual impairment is

measured through visual acuity testing with the use of eye charts. However, in this study, visual impairment was only assessed using subjective self-reporting of difficulty of vision at near or far.⁹

Access to Eye Care

Access to eye care refers to the ability of a person to find, travel to, pay for, communicate with, and follow-up with an eye care provider when needed. It also includes the ability to find, pay for, and use appropriate eye treatments and protections. In the following survey, access to eye care was assessed through self-reported insurance, insurance for eye care, last eye exam by a doctor, reason for lack of eye exam in the last year, affordability of glasses, and ownership and use of protective eyewear.

Unauthorized Migrant Farmworker

Legal authorization of migrant farmworkers in the United States requires having an H2A, or agricultural working visa, for a specific amount of time. Those migrant farmworkers who are not citizens and do not have an H2A visa are considered “unauthorized” and are at risk for deportation.¹

Chapter 2: Literature Review

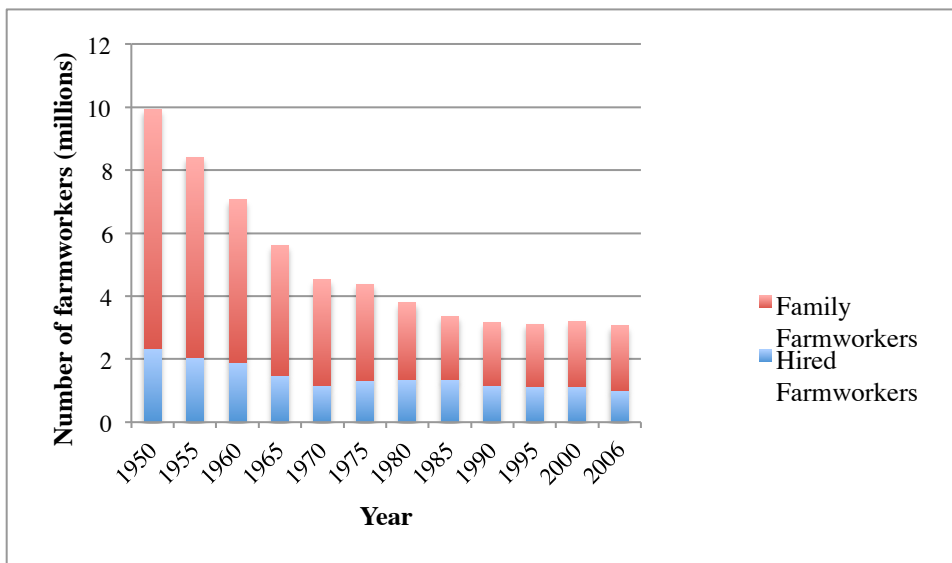
The following review will provide background and relevant literature that will first describe the history of the migrant farmworker and their significant role in the United States agriculture industry. The analysis will proceed to enumerate the current population size of migrant farmworkers in the United States, their geographic distribution, and the different migrant farmworker migration patterns. Next, this section will profile the demographic and socioeconomic status of migrant farmworkers in the United States, with a particular focus on poverty among migrant farmworkers and the legal authorization to work in the United States. The literature review will proceed to discuss what is known about migrant farmworkers' general health, their occupational and demographic risk factors for injury and disease, and their ability to access the United States healthcare system. To follow, the demographic, socioeconomic, and health issues of migrant workers in Georgia will be compared to the United States. Migrant farmworker eye health, eye safety, access to eye care and relevant predictors will be discussed. In particular, we will focus on the validity of existing data and knowledge gaps in current literature to demonstrate the importance of subsequent study.

Overview of the US Agriculture Industry and Hired Farmworkers

In 2015, the U.S. agriculture industry is expected to produce \$435.2 billion in both crop and livestock industries. The crop industry represents a substantial portion of the overall industry, contributing \$166.9 billion in 2013, or about 1% of the US GDP.¹⁰ The hired farmworker workforce contributes substantially to this production, and reliance of the agricultural industry on hired farmworkers has increased in recent decades. Since the 1950s, technological innovations have increased the marginal productivity of each farmworker. The U.S. Census of Agriculture, surveys farm owners regarding the total number of family members

and hired farmworkers. According to data from the Census from 1950 to 2002, the average farm acreage doubled, while the number of hired farmworkers steadily declined to a reported 1,063,000 farmworkers in 2012. Nevertheless, while the total number of hired farmworkers decreased, their proportion in the farm workforce increased. The proportion of hired farmworkers to total farmworkers increased from 23.4% to 33.0% from 1950 to 2006, representing less reliance on family members and increased reliance on externally-hired labor (Figure 1).^{1,11}

Figure 1: Distribution of Hired Farmworkers to Family Farmworkers in the US (1950-2006)¹



Based on Figure 1 from <http://www.ers.usda.gov/publications/err-economic-research-report/err60.aspx> [Access Date December 1, 2015]¹

Half of farm work positions are permanently hired farmworkers, while 199,000 are part time positions and 288,000 are contracted on a temporary basis. These positions are highly seasonal, growing by roughly 70-75% from January to July, based on the harvest of different crops.¹² Given the temporal fluctuations in farmworker job availability, many farmworkers are mobile or “migrant,” traveling from farm to farm and state to state in search of jobs. Historically, migrant farmworkers followed well-established migrant streams, or paths of migration, from the

Southeastern US to the Northeast, from the Southwest to the Midwest, and up the Western coast, to follow crop production cycles. However, recent profiling of migrant farmworkers has revealed that only 12% follow the migrant stream in a single season.¹ Many others work part time in two or three states, depending on the availability of contract work and the preferences of contractors who serve as the hiring contact between farmers and farmworkers.

History of Immigrant Farmworkers

The use of foreign immigrants for hired farm work is historically rooted in labor practices beginning in World War II. In 1942, the Bracero Program, named for the Spanish word for “manual laborer,” was implemented as a series of laws and diplomatic agreements hiring temporary contract farmworkers from poor, rural towns in Mexico to alleviate post-war farmworker shortages. Congress eliminated the policy in 1964, following an increase in concern about undocumented immigrants, and the discovery of abusive labor practices. Despite stricter enforcement of immigration laws the 1980s, the low cost and ample supply of immigrant farmworkers, both documented and undocumented, has implicitly institutionalized this labor practice.^{1, 13}

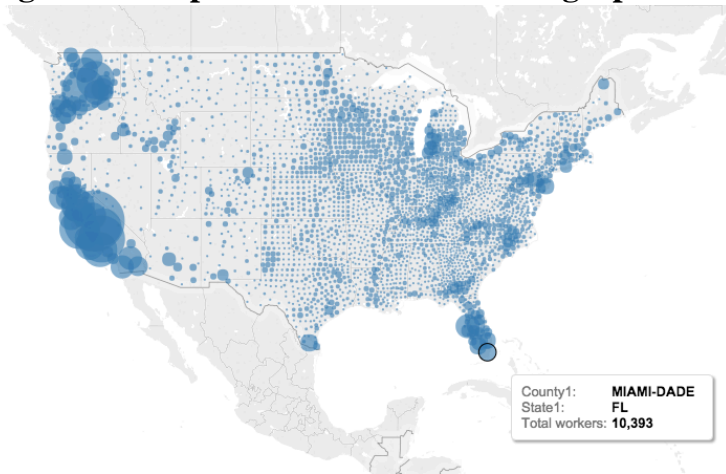
Undocumented immigrant farm labor has been one of the most economically beneficial changes to the farming industry. A report from the University of Wisconsin determined that in just one year in that state, migrant farmworkers contributed roughly \$15 million in added income, helped to create 500 new jobs, and lead to \$8.7 million in additional tax revenue.¹⁴ Additionally, undocumented farmworkers significantly reduce the costs of production. Overall, labor represents the third largest cost of the agriculture industry, and has been a growing proportion of overall costs since the 1980s. Horticulture, fruit, nut, and vegetable farming, is particularly meticulous work. As such, mechanization has been limited, making horticulture

highly labor intensive. Horticultural farmers need a large supply of workers. The supply of workers with H2A visas, or temporary agricultural work visas, issued by the United States is limited: in 2010, only 55,921 H2A visas were issued.¹⁵ In addition, while some migrant farmworkers have also gained permanent residency through amnesty programs, these workers are often older and more expensive to hire.¹⁶ Undocumented workers work for significantly lower wages and are not subject to minimum wage. Thus, facing a shortage of new, young workers and minimum wage increases, farmers have come to rely on an increasing number of undocumented immigrants, to ensure that agricultural produce remains affordable to the general American public. Only approximate estimates of authorization status exist. Both farmers and unauthorized farmworkers are incentivized to lie about authorization status to avoid the penalty of law. The National Agricultural Worker Survey (NAWS) 2007-2009, found that that 48% of hired farmworkers self-report being unauthorized to be in the United States.¹⁵ Thus, the term “migrant farmworker” has come to signify more than the migratory patterns of workers within the United States; “migrant farmworker” has come to also connote the undocumented, immigrant farmworker.

Geography and Migration Patterns of Migrant Farmworkers in the United States

The Southwest represents the largest and fastest growing distribution of migrant farmworkers in the United States. Among these states, California has the largest number of migrant farmworkers, reporting farming labor expenses more than three times the labor expenses of Florida, the state with the second largest number of migrant farmworkers. As migrant farmworkers continue to move to the Southwest, the Southeast and Midwest have seen a slight decline in the number of migrant farmworkers.¹ The geographic distribution of migrant crop workers is shown in **Figure 2**.

Figure 2: Crop Worker Estimated Geographic Distribution¹⁷



The National Center for Farmworker Health map is interactive in its original form at <http://www.ncfh.org/population-estimates.html> [Access Date December 1, 2015]. The map shows population estimates for each circular symbol. The population estimate for Miami-Dade, 10,393 workers, is highlighted as an example.¹⁷

As migrant farmworkers are seasonal farmworkers the geographic distribution of migrant farmworkers can vary throughout the crop season. These geographic distributions vary according to the migration patterns of the five different classes of migrant farmworkers. Some migrant farmworkers are more permanent and are considered “settled,” if they have migrated, legally or illegally, to the United States but remain in one farm location. Approximately half or 53% of migrant farmworkers fall under this category. The second category, made up of 7% of migrant farmworkers, are the “U.S. shuttlers.” These are migrant farmworkers who migrate between a more permanent U.S. home and another location within the U.S. The third category is the “international shuttler,” which is comprised of the 14% of migrant farmworkers. These farmworkers shuttle between their home country and another location, and in doing so, cross an international border. “Follow-the-crop” migrants, who travel to multiple states and even internationally based on crop-production seasons, comprise just over one-tenth of migrant workers. The last category, the “newcomer” are those migrant farmworkers in their first farming season in the U.S., for who a pattern has not been identified.¹ Among all migrant farmworkers,

29% have spent more than 20 years in the U.S. Another quarter has spent 10-19 years in the U.S. Thus, over half of all migrant farmworkers has been in the United States for over a decade.¹⁸ This group of long-term migrants represents “settled,” “U.S. shuttlers,” and “U.S. follow-the-crop” farmworkers.¹

Sociodemographic Characteristics of Migrant Farmworkers

In general, migrant farmworkers are younger, male, and have less education than traditional wage and salary laborers in the United States. The median age of the migrant farmworker is 34 years old, compared with 40 years old in traditional wage and salary earners. Roughly 80% of migrant farmworkers are male, compared to just over half of all wage and salary earners in the United States. Over 90% of all migrant farmworkers are Hispanic, with 90.3% coming from Mexico.¹ About 45%, of migrant farmworkers from Mexico are from three western central states, Guanajuato, Jalisco, and Michoacán. These states traditionally send the greatest number of migrant farmworkers to the United States, and are thus, considered “sending states.”¹⁸ Contrasting traditional beliefs, the majority of migrant farmworkers are married with families, with 70.7% having been married at least once and 46.7% having children under 18 years of age.¹ Many migrant farmworkers bring their families as they migrate. One study found that 33.9% to 70.0% of migrant farmworkers are accompanied by their family. An average of 1.8 non-farmworkers live in each household of accompanied migrant farmworkers. Of the children accompanying migrant farmworkers, most are school-aged children, with a third aged 5-12 years old.⁸

The average education level attained by migrant farmworkers is also lower than the average for wage and salary workers. Hispanic farmworkers have an average of nine years of education, meaning that the average migrant farmworker has not attended years of high school.

This reflects that a majority migrant farmworkers come from low-income, low-education communities in Mexico and the rest of Latin America.¹ In light of their limited education, few migrant farmworkers come to the United States with the ability to speak English. English-speaking ability is largely also dependent on time spent in the United States; of all migrant farmworkers surveyed, 35% noted that they could not speak English at all, whereas 30% said that they could speak English well.¹⁸ A different study suggested roughly 70% of all migrant farmworkers do not speak English at all.

Legal Authorization Status

Legal status, largely referring to having an H2A visa to legally work in agriculture, remains an important issue for migrant farmworkers. For migrant farmworkers, legal status ensures set minimum wage and great security of protection by federal regulations. Furthermore, legal status requires that farmers give benefits to migrant farmworkers such as transportation, housing, worker's disability compensation insurance, and access to kitchens or meals. In those who are not authorized to stay in the US, fear of legal ramifications and deportation can hinder their ability to access everyday goods and resources.

Obtaining an H2A visa is difficult, however. Farmers must apply for an H2A visa on the worker's behalf at least 45 days in advance of hiring. Farmers must prove they have a need for non-citizen labor because there are no citizens to fill the position. Applying for H2A visas also requires farmers to fill out time-consuming and detailed paperwork. Finally, though over 60,000 applications are filed annually, the Department of Labor has granted just over 50,000 visas each year. Authorization can be obtained through a few other amnesty programs, like the Special Agricultural Workers (SAW) Program initiated with the Immigration control and Reform Act of 1986.¹ The SAW Program gave permanent resident status to roughly 1.3 million migrant

farmworkers if they had worked in agriculture for more than 90 days in each of the three years before 1986.¹⁶ However, this subset of workers given amnesty is aging. Given the demand for new, young hired farmworkers exceeds the supply of H2A workers and the supply of SAWs, many farmers find it easier and cheaper to hire those who are unauthorized.¹

Employment and Economic Status

Migrant farmworkers find employment throughout the year either through referrals from friends or family or through a contractor who makes arrangements with various farms. About 70% of migrant farmworkers reported finding their current position through a friend or family member. About 12% reported using a contractor to establish the position. Through this system, most migrant farmworkers end up working with various different crops throughout the year or over several years. A third of migrant farmworkers are employed to work with fruit and nuts. Of the remaining farmworkers, 23% work with vegetables, 20% work with garden-type crops, 16% work in field-based crops, and the rest work with many miscellaneous types of agriculture.¹⁸

Given the seasonal and contractual nature of their work, migrant farmworkers are twice as likely as general wage and salary-earners in the U.S. to be unemployed. Migrant farmworkers experience 9.7% unemployment, compared to U.S. citizen farmworkers who have an unemployment rate of 7.7%. Wage and salary workers have an overall unemployment rate of 4.5%. Among migrant farmworkers surveyed about their unemployment, 47.2% reported being unemployed because they were laid off, whereas 31.4% reported having had their job end as the contract ended. These unemployment rates reflect employment instability of farm work over the course of a year. Migrant farmworkers are more likely to be laid off from temporary jobs, as opposed to stable full-time positions.¹ Unemployment is also more likely to be short-term as seasonal work can often be found within the year.

In addition to higher rates of unemployment, average incomes for migrant farmworkers, both authorized and unauthorized, are lower than U.S. citizen farmworkers. The median weekly salary of migrant farmworkers in 2006 was \$318, compared to \$462 among citizen farmworkers. Median hourly wage for migrants was \$7.50 in 2006 compared to \$10.00 an hour for citizen farmworkers. These migrant farmworker wages are deflated by the inclusion of unauthorized migrant farmworkers, who cannot unionize and who do not have a protected minimum wage.¹ Annual incomes for migrant farmworker are difficult to assess, but estimates suggest that an individual migrant farmworker earns a yearly average income of \$12,500 to \$14,999. The average migrant farmworker family makes just \$17,500 to \$19,999 in one year.¹⁸

Lack of stable employment and lower wages both contribute to a substantial amount of poverty among migrant farmworkers. Migrant farmworkers, both authorized and unauthorized, experience more than double the rate of poverty among citizen hired and seasonal farmworkers. Compared with 9.7% and 8.7% of male and female citizen farmworkers, respectively, over one-quarter of male and female migrant farmworkers are considered impoverished. Meanwhile, employment benefits and insurance are minimal. Only one in ten migrant farmworkers reported receiving having employment-based health insurance of any kind.¹ This percentage is halved when surveying the subset of migrant farmworkers who are employed seasonally. Similarly low rates of worker's compensation and unemployment insurance were noted, with only 39% of all migrant farmworkers, authorized and unauthorized, reporting that they have at least unemployment insurance.¹⁸ As legal status is needed for unemployment insurance, less than 5% of unauthorized workers claim to have some sort of unemployment insurance.¹

Compounding such poverty, housing benefits are truly limited, with many reports of substandard housing for a majority of immigrants. Migrant camps, or housing established as a

condition of employment of H2A laborers, are state and federally regulated. However, many studies have documented poor compliance with regulations. One study in North Carolina found that 89% of migrant housing or migrant camps were in violation of the Migrant Housing Act of North Carolina. Among the camps surveyed, all had exterior violations and 93% had interior violations. Over 20% of the camps were considered “severely substandard.” Conditions associated with increased housing violations included houses sampled later in the agricultural season, houses without H2A residents, and houses with 11 or more migrant farmworkers.¹⁹ Another study in California cited that 2% of migrant farmworkers thought that their housing conditions were “not meant for human habitation such as outdoors, cars, or trailers on private property.”²⁰ These studies suggest that the cause of substandard housing is the lack of enforcement of regulations, especially since most inspections of houses occur before the farming season and before the camps become occupied.¹⁹

As half of farmworkers are authorized and many children of migrant farmworkers are citizens, documented migrant farmworkers and hired farmworkers in general are more likely to receive social services than general U.S. wage and salary earners. Medicaid and food stamp utilization among children of migrant farmworkers are two times higher than the general population. Authorized migrant and hired farmworkers are more likely to receive disability and unemployment compensation than the general wage and salary population. These data do not capture the undocumented migrant farmworkers who comprise half of all migrant farmworkers. Though little data exists regarding social services in the undocumented, social service utilization is likely very rare as most would not qualify.¹

Migrant Farmworkers in Georgia

Georgia's agriculture industry has increased in production value in recently years, having made \$14.1 billion in 2014.²¹ Georgia is the primary producer of peanuts, pecans, and blueberries in the United States. It also is a large producer of cotton, with over 2,600 farms growing cotton in 2012.²²

Traditionally considered in the "Eastern" migrant stream from Florida to the Northeast, Georgia has long relied on migrant farmworkers. Depending on the time and season, an estimated 88,677 migrant and seasonal farmworkers work in Georgia. This estimation includes authorized and unauthorized immigrants and citizen hired farmworkers. Another 29,442 household and family members accompany the migrant and seasonal workers.⁸ In Lowndes County, with a total population of roughly 110,000, where the following study takes place, there are an estimated 1,798 migrant and seasonal farmworkers.^{8,23}

Very few studies have characterized demographic and socioeconomic data on migrant farmworkers in Georgia. However, limited data suggests the migrant population in South Georgia is similar to other states with large migrant farmer population. One study, surveying 100 farmworkers in South Georgia, reported a mean age of workers of 33 years old. A majority of 87% of workers were male, and most (93%) were from Mexico, with 70% of workers speaking only Spanish. Workers had mean education of 5.5 years. 60% of the workers were found to be non-permanent to the U.S., with 42% of workers having only 0-3 agricultural seasons total.

Health of Migrant Farmworkers

Poverty, poor housing conditions, and occupational hazards place migrant farmworkers at increased risk for injury and undetected health conditions. Agricultural work is one of the most hazardous occupations in the United States.^{24,25} The California Agricultural Worker Health

Survey (CAWHS) conducted in 1999 was one of the largest and most comprehensive studies of farmworker health to date. The study included a household-administered survey of 970 and physical and laboratory examinations of 632 migrant farmworkers (without regard for legal status), and serves as the “benchmark” study in migrant farmworker health. The study assessed both chronic conditions and behavioral risk factors.

In assessing chronic health conditions, the CAWHS found migrant farmworkers to have higher rates of overweight than the typical U.S. population. Among 20-34 year-olds, or 40% of the sample population, the prevalence of overweight in men and women was 76% and 72%, respectively.²⁴ These rates are higher than the corresponding populations in the United States in 1999, with the CDC reporting men overweight at 58% and women overweight at 51.5%.^{24,26} Migrant farmworkers who follow-the-crop or shuttle are more likely to be obese than those migrant farmworkers who are more settled.²⁷ Of male and female participants respectively, 27% and 4% had hypertension. Among males and females respectively, 17% and 4% had high cholesterol. Of male and female migrant farmworkers 5% and 3% had diabetes.²⁴ The prevalence of these chronic conditions are comparable to rates among 20-34 year olds in the United States, and are particularly comparable to Mexican and Hispanic Americans.²⁸⁻³⁰ Other important conditions found prevalent among migrant farmworkers were dermatitis, tooth decay and other dental problems, and mental illness, with significantly higher rates of depression among women than men.

Given their occupational hazards of working with heavy equipment, exposure to pesticides and other chemicals, and often performing such tasks without appropriate equipment and appropriate training, rates of injury among migrant farmworkers are high.²⁴ The most important indicator of occupational hazard is the number of fatalities. Agriculture in general has

not seen the same decreases in fatality that other industries have experienced between 1996 and 2006 after increasing federal safety regulations.¹ The agriculture, fishing, and forestry sector, though employing only 2% of the U.S. population, represented 13% of all occupational-related fatalities.² In particular, foreign-born workers experience a increased risk of fatality disproportionate to there increase in population.^{1,2}

Occupational injury is another important indicator of occupational hazard. CAWHS determined rates of injury by measuring the percentage of farmworkers who had ever filed for a workers compensation claim. The survey reported 27% of men had filed for workers compensation, while 11% of women had filed for workers compensation.²⁴ A study of musculoskeletal injury among migrant farmworkers in the Northeast estimated an annual incidence of 1,260 cases or 30.27 injuries per 10,000 workers-weeks. Primarily these injuries involved muscle spraining and straining secondary to heavy lifting.³¹ Other occupational injuries can include pesticide exposure, which occurred in 0.9% and 0.6% of migrant farmworkers, authorized and unauthorized, respectively. Though this reported frequency is small, it may partially reflect lack of recognition or reporting of pesticide exposure. Underreporting of pesticide exposure limits our knowledge of both the short-term and long-term consequences of pesticide exposure among migrant farmworkers. It is possible that these incidents are associated with lack of appropriate safety training regarding pesticides. Among unauthorized migrant farmworkers, 65.1% reported receiving pesticide training in the last year, but 87.8% reported having handled pesticides in the last year. Likewise, 77.2% of authorized migrant farmworkers reported training, while 92.7% reported having used pesticides.¹

Health of Migrant Farmworkers in Georgia

Assessments of migrant farmworker health in Georgia also seem to support data from other states and regions. A chart review of 1688 South Georgia farmworkers confirmed that musculoskeletal problems, such as back pain, comprise 23.1% of diagnoses made in farmworkers attending migrant clinics. Diagnoses of skin problems made up 12.6% of diagnoses. The third most common type of diagnoses, comprising 7.2% of all diagnoses made, were eye problems.³²

Healthcare Access among Migrant Farmworkers

Migrant farmworkers have limited access to the healthcare system. Roughly two-thirds of migrant farmworkers have accessed healthcare in the United States within the last two-years. Another 8% have reported using healthcare services in another country, likely their country of origin, in the last two years. Most workers (41%) used a private provider, whereas one-third used a federally-qualified health center, 14% went to a dentist, and 11% presented to the hospital.³³ Despite this utilization, 38% and 23% of unauthorized and authorized migrant farmworkers reported having never visited a doctor or clinic in the United States.²⁴ Many migrants are healthy and young, many may not need to attend a clinic during their stay in the U.S. Nevertheless, many report avoiding doctors and hospitals even when ill or injured in light of significant barriers to care.

Many factors prevent migrant farmworkers from accessing the healthcare system for illness or injury. Cost is cited as the main reason why migrant farmworkers find difficulty accessing healthcare; 59% and 73% of migrant farmworkers, unauthorized and authorized respectively, cite that healthcare is “too expensive.” While migrant farmworkers may have access to health benefits if they experience occupational injury or illness, few have general health insurance to help mitigate the cost of health care. If injured on the job, 67% of migrant

farmworkers report having health benefits or some compensation by their employer. Also, 36.8% of unauthorized and 46.9% of authorized workers report being able to get workers' compensation. In contrast, only 4.5% and 11.8% of unauthorized and authorized migrant farmworkers report that their employer will compensate for injuries and illness off the job. Meanwhile, 9.8% and 29.4% of unauthorized and authorized migrant farmworkers carry general health insurance, with 11% and 31.5% of their respective spouses having insurance. The children of migrant farmworkers have slightly more access than their parents, as many are citizens of the U.S., many children qualify for Medicaid and other state-run programs. Of all migrant farmworker children, a third to a half of these children have health insurance.¹ Nevertheless, without insurance or other health benefits, 46% of migrant farmworkers pay for their healthcare entirely out of pocket. Given their substantial economic disparity, adult migrant farmworkers face a substantial obstacle to affording appropriate care.³³

The second most common for not going to the doctor includes the language barrier that prevents adequate communication and precludes migrant farmworkers from feeling comfortable with the care they receive. Of authorized and unauthorized workers, 38% and 20% respectively cite this as their primary reason for not attending a clinic. Other reasons include not knowing where available services are located, receiving poor or biased treatment, lack of transportation, feeling unwelcome or a lack of understanding at the doctor's, and fear of losing their job if they go to the clinic.¹ This last reason, fear of losing their job, is a result of not wanting to miss work because the opportunity cost is too high and the unwillingness of farmers lose the labor if they do not view the illness as significant.

Eye Health and Safety Among Migrant Farmworkers

Few studies have assessed the eye health and safety of migrant farmworkers; however, existing studies have found ocular disease and ocular injury are significant health issues among migrant farmworkers. In a survey of 100 Hispanic migrant farmworkers 18 years and older in Georgia, Luque et al. reported that 12% had any ocular problems.³² One study of 79 migrant farmworkers attending a clinic for dermatologic conditions found that 21.3% of migrant farmworkers also reported their vision as being fair or poor. While 11% reported difficulty in far distance vision, 19.5% reported difficulty with near vision. Meanwhile, only 5.1% in the total population reported wearing corrective glasses or contact lenses. Workers also reported eye pain (21.5%), redness (26.6%), and itching (25.5%).⁵ In a different study of 179 migrant farmworkers in North Carolina, eye pain and redness was reported by 40% of farmworkers.³⁴ Migrant farm workers are exposed to a variety of eye irritants, like pesticides, wind, and dust that could cause these complaints.³⁵

In addition to acute complaints, given their occupational, environmental, and perhaps genetic predisposition, Latino migrant farmworkers have been found to have a higher prevalence of pterygia. In one study of 304 migrant farmworkers in North Carolina, 23.3% were found to have a pterygium in at least one eye. As a measurement of severity and risk for visual impairment, the study examined whether each pterygium crossed the limbus. Of those studied, 4.4% had a pterygium which crossed the limbus in one eye only, while 7.1% had pterygia which crossed the limbus in both eyes. Possibly secondary to the small sample size, presence of pterygia in this sample was found to be significantly associated with age, but education, nationality, authorization status, self-reported general health, and number of seasons worked in agriculture were not found to be significant.⁴

Injury is also common among migrant farmworkers. Agricultural work has the highest risk of occupational eye injury compared to other labor sectors. The annual incidence of occupational eye injury is 8.7 in 10,000 agricultural workers, which is much higher than the rate of 3.8 in 10,000 among all U.S. workers.³⁶ National regulations require use of protective eyewear among agricultural workers exposed to pesticides and manufacturing; however, there is little enforcement of these regulations.^{35,37-39} Therefore, migrant farmworkers do not use these protective measures.³⁸ Among workers who worked closely with pesticides in Georgia, only 18.8% reported wearing safety glasses. Of all migrant farmworkers surveyed, only 22% used safety glasses.³² These rates of safety glasses are higher than the 1.6 to 8.3% of migrant farmworkers in North Carolina who reported having ever worn eye protection.^{34,39} 60.7% reported not wearing safety eyewear because they were uncomfortable or fogged-up in humid weather.⁵ Also, of those having never worn protective eyewear, 37% reported that they did not own protective eyewear.³⁴ Another 92.3% of migrant farmworkers in North Carolina report that employers do not provide protective eyewear, and 70% are never trained in appropriate technique to prevent eye injury.³⁹

Access to Eye Care Among Migrant Farmworkers

There is a paucity of data regarding migrant farmworkers' ability to access eye care. The study in North Carolina of 79 farmworkers revealed that only 27% had received eye care in the previous year. Meanwhile, 38% had never had their eyes examined. 22.8% reported that access to eye care was a problem for them, with cost, transportation, and lack of familiarity with an eye doctor reported as the most common reasons for poor access.⁵

Gaps in Research

There is a paucity of data on ocular health, safety, and access to care among migrant farmworkers in the United States. Of the few studies found to be dedicated to ocular health and safety among migrant farmworkers, four sample migrant farmworkers in North Carolina.^{4,5,32,34,39} The largest study, Verma et al. was a random sample of 300 migrant farmworkers from camps in North Carolina. This study included a questionnaire adapted from a previous small sample study of farmworkers and was validated previously by only a small number of people. The study also indicates there may have been some social desirability bias, or responses biased by wanting to choose the most socially desirable answer, and bias towards choosing an answer that agreed with the dichotomous statement being presented.³⁹ Taylor et al., the second largest study, while performing a random sample of 296 migrant farmworkers in North Carolina, utilized a questionnaire not mentioned to be previously validated. Furthermore, the study only addresses one aspect of eye disease, the presence and severity of pterygia.⁴ Two other studies also studied small samples migrant farmworkers in North Carolina. One was a semi-random sample of 197 farmworkers in North Carolina, while the other, by the same group, was a convenience sample of 79 migrant farmworkers attending a clinic.^{5,34} This second study of 79 farmworkers is the only study found to report any subjective measure of visual impairment among migrant farmworkers.⁵ Only one study to date has examined eye health and access to care among migrant farmworkers in the state of Georgia. This study, while accounting for those who reported eye problems, those who reported safety glasses use, and frequency of eye diagnoses, did not tease out the prevalence of specific complaints, prevalence of access to care, and predictors of visual impairment and access to care among Georgian migrant farmworkers.³²

To date, no other studies have assessed eye health and safety among Georgia migrant farmworkers. Only one study has examined visual impairment status.⁵ Few studies have

examined predictors of visual difficulty and poor access to care among migrant farmworkers in general. The following study aims to supplement the existing literature with a second study of visual impairment, eye health, and safety among migrant farmworkers in Georgia and with a deeper examination of independent predictors of visual impairment and access to care among migrant farmworkers in general.

Chapter 3: Manuscript

Introduction

Despite the increasing epidemiologic literature examining Hispanics in the United States, very little is known about the state of eye health, safety, and access to eye care among Hispanics in more rural communities.⁴⁰⁻⁴⁷ Indeed, there is a paucity of data regarding visual impairment, eye health, and access to care among the 1 to 3 million migrant farmworkers living and working in the United States.¹

The term “migrant farmworker,” as used in the following study, refers to foreign-born, immigrant farmworkers who are legally authorized or unauthorized to be in the United States, who establish a temporary residency for the purposes of employment on a farm.⁸ This migrant farmworker population supports the United States the farming industry, an industry estimated to contribute over \$166 billion annually.¹⁰ Over 90% of migrant farmworkers are Hispanic, with 90.3% originating from Mexico. The median age of a migrant farmworker is 34 years old, and 86% are male. Roughly half of all hired farmworkers are legally authorized to be in the United States. Migrant farmworkers experience significantly higher rates of occupational-related injury

and illness.^{1,2} With exposure to wind, dust, ultraviolet light, migrant farmworkers have increased risk for chronic eye disease, especially surface disease like pterygia.⁴ As few migrant farmworkers wear protective eyewear, they are at risk for occupational injury and acute ocular problems like chemical conjunctivitis and photokeratitis.^{34,39} With a poverty rate double that of non-migrant, citizen farmworkers, and only 35% of legally authorized migrant farmworkers having Medicaid insurance, access to health care and eye care is limited.^{1,7} Thus, in addition to occupational-induced ocular disease, it is likely that migrant farmworkers have a significant amount of uncorrected refractive error, and those 40 years and older have a significant amount of undetected age-related eye disease.

A limited number of small, cross-sectional studies, mostly set in North Carolina, have examined occupational eye hazards, ocular health, and access to eye care among migrant farmworkers.^{4,5,32,34,39} Few have examined visual impairment among migrant farmworkers, or have assessed in depth the migrant farmworkers' access to eye care. Furthermore, there is limited investigation into the predictive risk factors for visual impairment and limited access to eye exams.

In order to robustly describe the status of eye health and access to eye care among Hispanics in the United States, additional epidemiologic information is needed regarding the status of eye health and access to eye care among migrant farmworkers in the United States. The following study uses a cross-sectional survey of migrant farmworkers 18 years and older living in South Georgia to (1) analyze the prevalence of visual impairment, eye irritation, eye injury and access to eye care; (2) determine independent predictors associated with moderate-to-severe visual impairment; and (3) identify independent predictors of receiving an eye exam in the last year. By supplementing existing epidemiologic data and delineating the risk factors that predict

visual impairment and access to eye exams among migrant farmworkers, we hope to provide information to efficiently target preventative and treatment resources to the migrant farmworker population.

Materials and Methods

We used a custom questionnaire for this study that incorporated a selection of nationally-validated survey questions from the Behavioral Risk Factor Surveillance System (BRFSS) Vision Module, the National Health Interview Survey (NHIS), and the National Eye Institute Visual Function Questionnaire-25 (NEI VFQ-25).⁴⁸⁻⁵¹ We designed some additional questions to assess eye health, safety, and access to eye care among migrant farmworkers in southern Georgia. Data was collected in June 2014, during an annual primary care mobile clinic for migrant farmworkers.

Study Population

The study population consisted of 542 self-identified migrant farmworkers, 18 years or older, attending a mobile primary care clinic in Lowndes County, Georgia. Surveys were administered at 7 different farmworker campsites and at the Lake Park Migrant Clinic, according to the location of the mobile primary care clinic. Eligible patients attending the clinic were informed of the survey and invited to participate. Informed consent was obtained for each participant prior to administration of the survey.

This research adhered to guidelines set forth by the Declaration of Helsinki. Prior to data collection, all portions of the study were reviewed by Emory University's Institutional Review Board (IRB00073949) and determined to meet criteria for exemption, as it consisted of anonymous, de-identified surveys.

Data Collection

The questionnaire was composed of 21 questions total (**Appendix 1**). It included 14 questions from the BRFSS, one item from NHIS, one item from NEI VFQ-25, and five customized migrant farmworker-specific questions. The BRFSS is a random telephone survey of non-institutionalized persons 18 years and older. The survey is given in each state on an annual basis. In addition to the core questions of the annual BRFSS survey, states can choose to add additional modules, including the Visual Impairment and Access to Care Module (Vision Module), which has nine questions assessing eye health and care in respondents aged 40 years and older.⁵² The NHIS is an in-person household survey distributed continuously throughout the year to assess health and access to care.⁵³ The NEI VFQ-25 survey is a publicly available, validated, 26-question survey that accompanies the measure self-reported vision health and access to eye care. Many of its questions are overlap with questions from the BRFSS.⁵⁰ Customized farmworker-specific questions were designed based on literature review for previous health surveys given to migrant farmworkers.^{4,5,39}

The survey was developed in English and then translated into Spanish using a professional translation service. Data was collected with interview administration of the survey by investigators and program coordinators fluent in Spanish or with the assistance of a trained Spanish interpreter.

Demographic Indicators

Three questions regarding demographic characteristics were deemed relevant and incorporated from the BRFSS into the study questionnaire. These questions included age, which was later grouped into 18-39, 40-65, ≥65 for analysis, gender, and education level (dichotomized into completed high school vs. did not complete high school). Study-specific customized

questions included country of origin (Mexico, vs. non-Mexico), primary language (Spanish vs. non-Spanish), and seasons worked in agriculture (0-5 years, ≥ 6 years).

Ocular Health Risk Indicators

Four BRFSS core module questions were used to assess candidate ocular health risk factors. These included questions about general health (later dichotomized into excellent/very good vs. good/fair/poor), previous history of smoking, current smoker (current smoker vs. non-smoker), and history of diabetes. One BRFSS Vision Module question assessed eye injury, asking, “have you EVER had an eye injury that occurred at your place of work that caused you to miss at least one day of work?” As migrant farmworkers’ have substantial occupational exposure, eye irritation and pain was thought to be an important variable to incorporate into the survey. Thus, a question from NEI VFQ-25 was used: “how much pain or discomfort have you had in and around your eyes (for example, burning, itching, or aching)?” For analysis, responses were dichotomized into severe/very severe pain vs. none/mild/moderate pain. Migrant farmworker-specific questions regarding eye safety included the questions: “do you own sunglasses or protective eyewear?” and “how often do you wear sunglasses or protective eyewear when working in agriculture?” Use of protective eyewear was dichotomized into sometimes/usually/always vs. rarely/never for analysis.

Access to Eye Care Indicators

Of the BRFSS Vision Module’s nine questions, four were used to assess access to eye care and two were used to assess visual impairment. These included insurance and eye care insurance, time of last eye exam, and reason for no exam within the last two years (“Do you have any kind of health care coverage, including health insurance, prepaid plans such as Health Maintenance Organizations, or government plans such as Medicare or Medicaid?” “Do you have

any kind of health insurance coverage for eye care?” “When was the last time you had your eyes examined by any doctor or eye care provider?” “What is the main reason you have not visited an eye care professional in the past 12 months?”). The three BRFSS Vision Module questions that were excluded from the questionnaire required knowledge of previous diagnosis of cataract, glaucoma, and age-related macular degeneration. These were deemed irrelevant in a young population where a large majority likely had never had an eye exam.

Primary Outcomes

Primary outcomes included any moderate-to-severe visual impairment and last eye exam within one year. The visual impairment variable was derived from two BRFSS Vision Module questions: “How much difficulty, if any, would you have in recognizing a friend across the street (while wearing contacts or glasses)? and “how much difficulty, if any, do you have reading print in newspaper, magazine, recipe, menu, or numbers on the telephone (while wearing contacts or glasses)?” Responses used a five-point scale difficulty for both near and far vision. In analysis, a dichotomous variable was created, assigning near and/or far visual difficulty (moderate, severe, unable) a value of 1 and no or little difficulty a value of 0. Vision was considered moderate-to-severe if near and/or far vision were considered moderate-severe. Time of last eye exam was administered as a five-point scale, including within the last month, year, two years, two or more years ago, or never. In analysis, last eye exam was also dichotomized (≤ 1 year vs. > 1 year).

Statistical Analysis

Descriptive statistics were performed for demographic questions, risk factors for eye disease, eye injury, use and availability of ocular protection, and access to eye care. Continuous variables were expressed as mean \pm standard deviation (SD). Results were expressed as crude frequency percentages for categorical variables. Bivariate analysis using the chi-square test and

Fisher chi-square for categorical variables and t-test for means was done to determine demographic and ocular health and safety characteristics associated with moderate-to-severe visual impairment and eye exam within the last year. The significant, independent predictors of moderate-to-severe visual impairment and eye exam within the last year were identified using forward stepwise selection. The final regression model consisted of only significant predictors at an alpha <0.05 adjusted for covariates. A receiver operating characteristic (ROC) curve was produced for each logistic regression model to determine area-under-the-curve (AUC) as a representative statistic of predictive power. All statistical analyses were conducted at the 0.05 significance level and were performed using SAS version 9.4 (SAS Institute Inc., Cary, NC, USA).

Results

Study cohort

Of the 542 migrant farmworkers attending the mobile clinic, a final sample population size of 162 agreed to participate. The baseline demographics of the sample population are reported in **Table 1**. The sample consisted of 132 males and 30 female farmworkers. Mean age of the migrant farmworkers was 32.2±10.5 years, with 92.2% of migrant farmworkers originating from Mexico. Overall, 92.2% of migrant farmworkers spoke Spanish as their primary language. The other 7.8% spoke Creole, and other languages including indigenous languages. 26.0% of migrant farmworkers completed 12 years of education, or the equivalent of a high school education. More than half (58.6%) had worked in agriculture for greater than 5 seasons.

Ocular health and safety

In our sample population, 40.3% reported good-to-excellent general health. 8.7% reported having a history of diabetes. 35.5% of migrant farmworkers have ever smoked and 25.2% are current smokers. 7.1% of migrant farmworkers report severe or very severe eye pain or irritation. Meanwhile, 20.8% own protective eyewear and use protective eyewear. 7.8% report having a previous eye injury that caused them to miss at least one day of work.

Prevalence of Visual Difficulty Stratified by Age-Group

Table 2 reveals the prevalence of visual difficulty among the different age groupings. Among the sample, 12.3% reported moderate-to-severe visual difficulty. The prevalence of moderate-to-severe visual impairment in migrant farmworkers was 6.7%, 31.3%, and 50.0% among those 18-39 years, 40-64 years, and greater than 65 years respectively. The overall prevalence of any vision impairment, including those with “a little” visual difficulty was 37.6%. Prevalence of any visual impairment was 30.9%, 59.4%, and 100% in age groups 18-39, 40-64, and 65 and older. Of those 40 and older 66.7% and 32.4% reported any visual impairment and moderate-to-severe visual impairment, respectively.

Stratification of Risk Factors by Level of Visual Impairment

Table 1 additionally reveals the descriptive statistics of ocular risk factors as stratified by no-to-mild visual difficulty and moderate-to-severe visual difficulty. Compared to those with no-to-mild visual difficulty, those with moderate-to-severe visual difficulty were older and had severe or very severe eye pain (each $p < 0.001$). On initial univariate analysis, those with moderate-to-severe visual difficulty were less likely to have completed high school, were more likely to own protective eyewear, but were less likely to speak Spanish or to afford glasses when needed, compared to those with no-to-mild visual difficulty. However, these represent unadjusted associations, and are not representative of independent risk factors included in the

adjusted predictive regression model, as seen in **Table 3**. Independent predictors of any moderate-to-severe visual impairment included severe and very severe eye pain (odds ratio [OR] 12.6; confidence interval [CI] 2.3-68.5; $p < 0.01$). Age was also an independent predictor of any moderate-to-severe visual impairment. Those with moderate-to-severe visual impairment were more likely to be older than 18-39 years (40-64 years OR 12.1; CI 2.7-54.7; and ≥ 65 years OR 41.6; CI 1.9-914.5; $p < 0.01$). In addition, current smoking status was an independent predictor of any moderate-to-severe visual impairment (OR 7.6; CI 1.6-36.8; $p = 0.02$). AUC for the regression model of visual impairment was 0.82.

Access to Eye Care

As seen in Table 1, one-fifth, or 19.9% of migrant farmworkers who needed glasses in the last year were unable to get them because they were unaffordable. Although 21.2% had some type of general health insurance, only 3.4% had any insurance coverage for eye care. Only 16.7% of farmworkers had an eye exam within the last year, whereas 47.2% have never had an eye exam. **Table 4** demonstrates the prevalence of eye exam within the last year and no previous eye exam by age, diabetes status, and any moderate-severe visual impairment. Of those ≥ 65 years, with any moderate-to-severe vision impairment, or a history of diabetes, only 33.3%, 15.8% and 33.3% had their eye examined within the last year, respectively. Of those with any moderate-to-severe vision impairment, or a history of diabetes, 57.9% and 33.3% of patients had never had an eye exam, respectively.

Stratification of Risk Factors by History of Eye Exam within the Last Year

Table 5 presents the descriptive statistics of ocular risk factors as stratified by eye exam within the last year and no eye exam within the last year. Compared to those without an eye exam within the last year, migrant farmworkers who had received an eye exam in the previous

year were more likely to have completed a high school education ($p<0.01$). Those who had an eye exam within the last year were also more likely to own protection; however, this association is unadjusted and is not representative of independent risk factors included in the adjusted predictive regression model, as seen in **Table 6**. Independent predictors of receiving an eye exam within the last year included completion of high school (OR 4.7; CI 1.6-13.2; $p<0.01$) and moderate-to-sever far vision impairment (OR 0.2; CI 0.04-0.9; $p=0.04$). AUC for the regression model of eye exam within the last year was 0.68. The most common reasons for not having received an eye exam within the last two years was having had no reason to go (47.2%), cost or insurance (23.0%), and not wanting to miss work (13.5%).

Discussion

The Hispanic population accounts for the largest ethnic minority in the United States. Two large studies of Mexican Americans in Arizona and Latinos in Los Angeles have provided the foundational epidemiology of ophthalmic disease and access to eye care in this population.^{41,42,54} Nevertheless, few studies have examined eye health and access to care among Hispanics in rural areas. Specifically, very little is known about the 1-3 million migrant farmworkers living and working in the United States.^{1,4,5,34,39} Our analysis is the first to use nationally-validated survey questions to assess eye health and eye care utilization among migrant farmworkers. It is also the first study to determine risk indicators of visual-impairment and eye examinations in migrant farmworkers.

Visual Impairment among Migrant Farmworkers

Our data from 162 migrant farmworkers in rural Georgia suggests that the prevalence of visual impairment was 37.6%, with a prevalence of self-reported moderate-to-severe visual impairment of 12.3%. Migrant farmworkers, in general, are a young population, and in our study

have an average age of 32.2 years. Our study reveals that 6.7% and 30.9% of those under 40 years old report moderate-to-severe and any visual impairment, respectively. Few studies have been performed to analyze the prevalence of visual impairment and blindness among those under the age of 40. One study of objective visual acuity data by the National Health and Nutrition Examination Survey (NHANES) 2005-2008 suggested that the prevalence of vision loss is 1.3% (0.69%-1.87%).^{55,56} Nevertheless, subjective reports of visual impairment and objective measures of visual acuity loss may not correspond. Future research with supplementary visual acuity data is necessary to establish true comparison.

Among migrant farmworkers 40 years and older, the prevalence of moderate-to-severe visual impairment was 32.4%. Among migrant farmworkers 65 years and older, the prevalence of moderate-to-severe visual impairment was 50.0%. Compared to a prevalence range of 5.4% to 16% among BRFSS Vision Module 2006-2009 respondents 65 years and older in Tennessee to Georgia, respectively. Only 16.1% of Hispanic respondents to the BRFSS Vision Module 2006-2009 reported moderate-to-severe vision loss.⁵⁷ The prevalence of any visual impairment among migrant farmworkers 40 and older was 66.7%. In U.S. respondents to the BRFSS Vision Module 2005, 14.3% to 20.5% reported any visual impairment.⁵⁸ Therefore, our data suggest that the prevalence of visual problems among migrant farmworkers aged 40 and older may be higher than the general population and the general Hispanic population in the United States. The only other study of self-reported visual impairment among migrant farmworkers found 11% reported difficulty in far distance vision, 19.5% reported difficulty with near vision, but does not specify the level of impairment. Thus, it is difficult to draw parallel comparisons with the current study.³⁴

The independent risk indicators of moderate-to-severe self-reported visual impairment included severe or very severe eye irritation or discomfort, age, and current smoking ($P_s < 0.05$) (**Table 3**). Eye irritation and current smoking status may be associated with visual impairment through mechanisms related to ocular surface disease.⁵⁹ Given that migrant farmworkers have chronic ocular exposure to wind, dust, and chemicals, subsequent irritation and ocular surface disease could help explain the higher prevalence of self-reported visual impairment among migrant farmworkers compared to the general or Hispanic U.S. populations. Age has frequently been found a risk factor for visual impairment in the general and Latino population.^{40,60} In addition to age, the LALES study of Latinos additionally found diabetes to be a risk indicator of visual impairment. This association may be partly explained because Hispanics have been shown to be at high risk for this diabetes and diabetic retinopathy.⁶¹ Our study did not find diabetes to be a significant indicator. This may be due to the fact that migrant farmworkers are a young population and thus, have less risk for diabetic retinopathy. In addition, diabetes may be under-diagnosed in migrant farmworkers and thereby underreported by our population. The LALES study also found female gender and completion of less than a high school education to be independent predictors. Of demographic and health risk factors that we did not explore, the LALES group found that history of eye disease, unemployment, and being separated or widowed as independent indicators ($P_s < 0.05$).⁶⁰ It is possible that that in our study, risk indicators like those found in the LALES study could have been predictors with a larger sample size and with supplementary visual acuity data.

Access to Eye Care among Migrant Farmworkers

Substantial disparities in access to eye care exist among migrant farmworkers and the general and Hispanic U.S. populations. These limitations are particularly accentuated among

those at high risk for eye disease who are recommended to receive an exam within one year. This high-risk group includes those with moderate-to-severe visual impairment, those with diabetes, or those 65 years and older.⁶² Of migrant farmworkers with any moderate-to-severe vision impairment, 15.8% had their eyes examined within the last year. Comparatively, 58% (95% CI 57%-59%) of U.S. BRFSS survey respondents with moderate-to-severe visual impairment received an eye exam within the last year. Of Hispanic BRFSS respondents with moderate-to-severe visual impairment, 61% (95% CI 57%-65%) received an eye exam in the last year.⁶³ Of those with a history of diabetes, 33.3% of migrant farmworkers versus 60% (95% CI 47.8%-53.9%) of 2002 NHIS survey respondents in the U.S. received an eye exam within the last year. Finally, among those 65 years and older, 33.3% of migrant farmworkers and 56.3% (95% CI 45.1%-50.7%) of NHIS survey respondents received an eye exam in the last year.⁶⁴ High-risk migrant farmworkers even have a lower prevalence of eye exams as compared to those living in rural areas where provider density and transportation remain significant issues. In rural Arkansas, for example, 62.6% and 66.8% of residents aged 65 and older or with diabetes had seen an eye doctor within the last year.⁶⁵ Therefore, migrant farmworkers appear to have large disparities in access to care as compared to the general population, Hispanics, and rural populations.

The independent risk indicators of having had an eye exam within the last year include moderate-to-severe vision impairment and completion of at least a high school education ($P_s < 0.05$) (**Table 6**). These risk indicators are similar to previous studies of access to eye care. Using U.S. NHIS data on access to eye care, Zhang et al. found that individuals 18 years and older who had completed less than a high school education were significantly less likely to have visited an eye doctor, compared to those with at least a high school education.⁶⁶ In a different

study of NHIS data, the association between education and ocular healthcare utilization was especially strong among Hispanic respondents.⁶⁷ The association of at least a high school education with more recent eye exam may indicate a relationship between education and an increased ability of educated migrant farmworkers to navigate the healthcare system. Similar to our findings of an association between moderate-to-severe vision loss and eye exam in the last year, Zhang et al. found self-report of eye problems was significantly associated with eye healthcare utilization. Among the factors found to be predictive by Zhang et al. that were not found to be predictors in our study were having health insurance, being female, high income, and having diabetes ($P_s < 0.01$).⁶⁶ While insurance status or eye insurance status was not found to be predictive in our model, 23% of the farmworkers responded that cost and insurance was the primary reason for not seeking care. 78.8% of migrant farmworkers do not have any type of insurance. 96.6% of migrant farmworkers do not have eye insurance. Lack of eye insurance among farmworkers is higher than the general (46.2% to 55.0%) or Hispanic (63.2%) U.S. population, according to the BRFSS Vision module in 2005.⁵⁸ Income and insurance status may be important predictive risk factors for poor access to care, and should be further explored in future studies.

Eye Safety

Given their occupational and environmental exposure, eye safety is a great concern for migrant farmworkers. In our study, 7.8% of migrant farmworkers reported having a previous eye injury that caused them to miss at least one day of work. This rate of eye injury is consistent with the 13.5% of men and 2.6% of women who reported previous injury in BRFSS 2005-2007 surveys.⁶⁸ Only 20.8% of farmworkers owned protective eyewear and only 26.9% used protective eyewear at least sometimes. The rate of protective eyewear use in our study is higher

than those previously reported in migrant farmworker studies (8.3%).³⁹ This may be because we incorporate those migrant farmworkers who “sometimes” use eyewear. Other studies of migrant farmworkers have suggested that despite high rates of eye injury, irritation, and chronic surface disease, there are several barriers to farmworkers using protective eyewear. Such barriers include lack of training in preventing eye injury, protective eyewear fogging up and inhibiting work, and lack of ownership of protective eyewear.^{5,39} Our data suggest that there is still a need for improved eye injury and irritation education and prevention.

Limitations of our Study

Our results should be interpreted in light of the limitations of our study. Our study was small, cross-sectional in nature, and represents a non-random sample from a single state. Workers sampled were those presenting to a primary care clinic who agreed to complete the survey. As a result of this design, it is possible that our sample selected for those with health and/or ocular complaints who were seeking clinical care. Additionally, the questionnaire depended on self-reported demographic and health information. While the questionnaire was based on validated and reliable national surveys, and while questions were clear and comprehensive, responses may have been subject to recall bias. Some risk indicators for visual impairment and access to care previously found important for Hispanics, were not identified in this study. Research with a larger sample size may also illuminate additional risk indicators. Furthermore, variability with which migrant farmworkers are paid, assessing income level was found to be too difficult to include. Future research should include income as a demographic factor to more fully assess predictors and interpret associations. Finally, given our analysis of risk indicators is one of predictive modeling, we cannot quantify the exposure-disease relationship of associations without more in depth exploration of interactions and confounding.

Furthermore, predictive indicators should not be interpreted as causal. However, such analysis allows us to identify possible associative risk indicators of visual impairment and access to care, which can be future explored in future research.

Implications and Future Directions for Research

Research regarding migrant farmworker visual impairment and eye disease is imperative to more fully understanding the ophthalmic epidemiology of Hispanics in the U.S. Moreover, understanding the risk factors for visual impairment and poor access to care can help determine high-risk subgroups of Hispanic populations and help distribute health resources appropriately. Future research is needed to determine if objective, acuity-measured vision loss is, indeed, more prevalent among migrant farmworkers of all ages. Further research using objective examination would also help determine the prevalence of various eye diseases within the migrant farmworker population. Larger, randomized studies would also help to clarify exposure-disease relationships among risk indicators and outcomes discussed in this study.

Visual impairment substantially impacts health-related quality of life and diminishes economic productivity. Moderate-to-severe self-reported visual impairment has been associated with more frequent physical and mental unhealthy days.⁶⁹ The total annual economic burden of vision loss among those 40 years and less, an age group that includes the majority of migrant farmworkers, is an estimated \$27.5 billion. Given that the United States agriculture industry depends heavily on migrant farmworkers' productivity contributions, untreated eye disease and visual impairment in this population is likely highly costly.¹⁴ High rates of visual impairment, little access to care, and lack of adequate eye safety indicates a need for targeted detection, treatment, and prevention education in this population.

Tables and Figures

Table 1. Distribution of Demographic, Ocular Health, and Access to Care Risk Factors by Visual Impairment in Migrant Farmworkers

Risk Factor	n	Total [% or mean (SD)]*	Moderate-Severe Visual Impairment	No-Mild Visual Impairment	P**
All	162	100%	19 (12.3%)	135 (87.7%)	
Demographic Indicators					
Age [mean (SD)] years	162	32.2 (10.5)	40.4 (12.6)	30.5 (8.8)	<0.0001
Age (categorical)					<0.001
18-39 years	120	77.9%	8 (42.1%)	112 (83.0%)	
40-64 years	32	20.8%	10 (52.6%)	22 (16.3%)	
65+ years	2	1.3%	1 (5.3%)	1 (0.7%)	
Gender (male)	127	82.5%	15 (79.0%)	112 (83.0%)	0.78
Country of origin (Mexico)	142	92.2%	16 (84.2%)	126 (93.3%)	0.17
Primary Language (Spanish)	142	92.2%	15 (79.0%)	127 (94.1%)	0.04
Education (Completed high school)	40	26.0%	0 (0%)	40 (29.6%)	<0.01
Seasons worked in agriculture (>5 seasons)	89	58.6%	8 (44.4%)	81 (60.5%)	0.20
Ocular Health Risk Indicators					
History of excellent/very good health	62	40.3%	4 (21.1%)	58 (43.0%)	0.06
Diabetes	6	8.7%	1 (9.1%)	5 (8.6%)	0.66
Ever smoker	54	35.5%	7 (36.8%)	47 (35.3%)	0.90
Current smoker (Every day, some days)	38	25.2%	6 (31.6%)	32 (24.2%)	0.49
Eye irritation or discomfort (Severe or very severe)	11	7.1%	5 (26.3%)	6 (4.4%)	<0.001
Own protective eyewear	32	20.8%	8 (42.1%)	24 (17.8%)	0.01
Use protective eyewear (always, usually, or sometimes)	31	19.1%	6 (31.6%)	25 (18.5%)	0.18
History of previous eye injury	12	7.8%	1 (5.3%)	11 (8.2%)	0.81
Access to Eye Care Risk Indicators					
Unaffordability of glasses	30	19.9%	9 (47.4%)	21 (15.9%)	<0.01
General health insurance	32	21.2%	5 (26.3%)	27 (20.5%)	0.56
Insurance for eye care	5	3.4%	1 (5.3%)	4 (3.1%)	0.50
Eye exam within the last year	25	16.7%	3 (15.8%)	22 (16.7%)	0.64
Never had an eye exam	72	47.2%	11 (57.9%)	61 (46.2%)	0.34

* For certain variables, missing data resulted in a total variable n<162. Total percentage was calculated using crude frequency of the variable divided by the total count of non-missing data for that variable.

**Using Mantel Haenszel Chi-square analysis and two sample t-test

Table 2. Prevalence of Visual Impairment by Age Group

Visual Impairment Status	18-39 years	40-64 years	≥65 years	Total
No Visual Impairment*	69.2%	40.6%	0.0%	62.3%
"A Little" Visual Impairment*	24.2%	28.1%	50.0%	25.3%
Moderate-to-Severe Visual Impairment*	6.7%	31.3%	50.0%	12.3%
Moderate-to-Severe Near Visual Impairment* [§]	2.4%	26.5%	33.3%	8.1%
Moderate-to-Severe Far Visual Impairment [§]	5.0%	8.8%	0.0%	5.8%

* Significant difference between age groups with p<0.001 found among those with no vision impairment and any moderate-to-severe vision impairment by Fisher Exact Chi-Square.

[§] Addition of moderate-to-severe near vision and far vision frequencies do not add up to 100% secondary to missing data excluded from the moderate-to-severe visual impairment variable.

Table 3. Independent Predictors of Moderate-to-Severe Visual Impairment among Migrant Farmworkers Based on Stepwise Logistic Regression Analysis (n=131)*

Step	Predictor Variable	Adjusted Odds Ratio (95% Confidence Interval)	P
1	Eye irritation or discomfort (severe or very severe)	12.6 (2.3-68.5)	<0.01
2	Age (categorical)		<0.01
	18-39	Reference Group	
	40-64	12.1 (2.7-54.7)	
	65+	41.6 (1.9-914.5)	
3	Current smoker	7.6 (1.6-36.8)	0.02

* AUC value of 0.82

Table 4. Prevalence of Last Eye Exam History by Age Group, Visual Impairment, and Diabetes Status

	18-39 years	40-64 years	≥65 years	Any Moderate-to-Severe Visual Impairment	Diabetes	Total
Eye Exam within the Last Year	16.7%	13.9%	33.3%	15.8%	33.3%	16.4%
Never Had an Eye Exam	45.0%	58.3%	0.0%	57.9%	33.3%	47.2%

Table 5. Distribution of Demographic, Ocular Health, and Access to Care Risk Factors Stratified by Eye Exam within the Last Year in Migrant Farmworkers

Risk Factor	n	Eye Exam within the last year	Last Eye Exam more than 1 year ago	P**
All	159	26	133	
Demographic Indicators				
Age [mean (SD)]	159	32.5 (11.2)	32.2 (10.5)	0.88
Age (categorical)				0.67
18-39 years	120	20 (76.9%)	100 (75.2%)	
40-64 years	36	5 (19.2%)	31 (23.3%)	
65+ years	3	1 (3.9%)	2 (1.5%)	
Gender (male)	129	19 (73.1%)	110 (82.7%)	0.28
Country of origin (Mexico)	146	25 (96.2%)	121 (91.0%)	0.34
Primary Language (Spanish)	146	24 (92.3%)	122 (91.0%)	0.59
Education (Completed high school)	40	12 (46.2%)	28 (21.1%)	<0.01
Seasons worked in agriculture (>5 seasons)	91	8 (30.8%)	58 (44.3%)	0.20
Ocular Health Risk Indicators				
History of excellent/very good health	62	12 (46.1%)	50 (37.9%)	0.43
Diabetes	6	2 (28.6%)	4 (6.2%)	0.1
Ever smoker	53	9 (36%)	44 (33.3%)	0.8
Current smoker (every day or some days)	38	6 (25%)	32 (24.2%)	0.94
Eye irritation or discomfort (severe or very severe)	11	1 (3.9%)	10 (7.5%)	0.87
Own protective eyewear	32	9 (34.6%)	23 (17.3%)	0.04
Use protective eyewear (always, usually, or sometimes)	31	7 (26.9%)	24 (18.1%)	0.29
History of previous eye injury	13	4 (15.4%)	9 (6.8%)	0.14
Moderate-severe far vision difficulty	9	3 (12.0%)	6 (4.7%)	0.17
Moderate-severe near vision difficulty	13	1 (96.2%)	12 (84.0%)	0.91
Access to Eye Care Risk Indicators				
Unaffordability of glasses	32	4 (15.4%)	28 (21.7%)	0.33
General health insurance	33	8 (32%)	25 (19.1%)	0.15
Insurance for eye care	5	2 (7.7%)	3 (2.4%)	0.21

* For certain variables, missing data resulted in variable n<162.

**Using Chi-square analysis and two sample t-test

Table 6. Independent Predictors of Eye Exam in the Last Year among Migrant Farmworkers Based on Stepwise Logistic Regression Analysis (n=131)*

Step	Predictor Variable	Adjusted Odds Ratio (95% Confidence Interval)	P
1	High school education (completed at least 12 years)	4.7 (1.6-13.2)	<0.01
2	Moderate-severe far vision impairment	0.2 (0.04-0.9)	0.04

*AUC value of 0.68

References

1. Kandel W. *Profile of Hired Farmworkers, A 2008 Update*. Washington, D.C.: United States Department of Agriculture Economic Research Service; July 2008 2008. 60.
2. Loh KR, Scott. Foreign-born workers and on-the-job fatalities by industry, 1996-2001. *Mon. Labor Rev.* 2004.
3. Shipp EM, Cooper SP, Burau KD, Bolin JN. Pesticide safety training and access to field sanitation among migrant farmworker mothers from Starr County, Texas. *Journal of agricultural safety and health.* 2005;11(1):51-60.
4. Taylor SL, Coates ML, Vallejos Q, et al. Pterygium among Latino migrant farmworkers in North Carolina. *Arch. Environ. Occup. Health.* 2006;61(1):27-32.
5. Quandt SA, Feldman SR, Vallejos QM, et al. Vision problems, eye care history, and ocular protection among migrant farmworkers. *Arch. Environ. Occup. Health.* 2008;63(1):13-16.
6. Villarejo D, McCurdy SA. The California Agricultural Workers Health Survey. *Journal of agricultural safety and health.* 2008;14(2):135-146.
7. Gibbard S. Migratory & Seasonal Farmworkers Population Estimates. 2012; <http://www.ncfh.org/population-estimates.html>.
8. Larson AC. *Migrant and Seasonal Farmworker Enumeration Profiles Study Georgia*. Cordele, GA: Georgia Department of Community Health;2008.
9. Glossary. 2013; <http://georgia.preventblindness.org/glossary>.
10. Ag and Food Statistics: Charting the Essentials. 2014; <http://ers.usda.gov/data-products/ag-and-food-statistics-charting-the-essentials/ag-and-food-sectors-and-the-economy.aspx>, 2015.
11. *Census of Agriculture 2007*: . United States Department of Agriculture;2007.
12. Farm Labor: Background. 2014; <http://www.ers.usda.gov/topics/farm-economy/farm-labor/background.aspx#demographic>, 2015.
13. Massey DS, Durand, Jorge, and Malone, Massey, Nolan J. . *Beyond Smoke and Mirrors: Mexican Immigration in an Era of Economic Integration*. New York: Russell Sage Foundation; 2002.
14. Slesinger DPD, Steven. *Economic Impact of Migrant Workers on Wisconsin's Economy*. Madison, WI: Center for Demography and Ecology;2003. CDE Working Paper No. 2002-06.
15. Farmworker Health Factsheet. 2012; http://www.ncfh.org/uploads/3/8/6/8/38685499/fs-facts_about_farmworkers.pdf, 2015.

16. Bean FD, Edmonston, Barry , and Passel, Jeffrey S *Undocumented Migration to the United States: IRCA and the Experience of the 1980s*. Santa Monica: RAND Corporation;1990.
17. Bogue HO. Migratory & Seasonal Farmworker Population Estimates. 2012; <http://www.ncfh.org/population-estimates.html>, 2015.
18. Demographics. *Farmworker Health Factsheet* 2012; <http://www.ncfh.org/fact-sheets--research.html>.
19. Vallejos QM, Quandt SA, Grzywacz JG, et al. Migrant farmworkers' housing conditions across an agricultural season in North Carolina. *Am. J. Ind. Med.* 2011;54(7):533-544.
20. *The County of Riverside 2006 Coachella Valley Farm Worker Survey: Final Report*. Institute for Urban Research and Development;2006.
21. *2014 Farm Gate Value Report*. Athens: The University of Georgia College of Agricultural & Environmental Sciences;2014.
22. Agriculture- Georgia's \$72 Billion Industry. 2013; http://www.gfb.org/aboutus/georgia_agriculture.html, 2015.
23. QuickFacts Beta: Lowndes County, Georgia. 2010; <http://www.census.gov/quickfacts/table/PST045214/13185,00>.
24. Villarejo D, McCurdy SA, Bade B, Samuels S, Lighthall D, Williams D, 3rd. The health of California's immigrant hired farmworkers. *Am. J. Ind. Med.* 2010;53(4):387-397.
25. Villarejo D. The health of U.S. hired farm workers. *Annu. Rev. Public Health.* 2003;24:175-193.
26. Ogden CL, Carroll MD, Curtin LR, McDowell MA, Tabak CJ, Flegal KM. Prevalence of overweight and obesity in the United States, 1999-2004. *JAMA.* 2006;295(13):1549-1555.
27. Castaneda SF, Rosenbaum RP, Holscher JT, Madanat H, Talavera GA. Cardiovascular disease risk factors among Latino migrant and seasonal farmworkers. *Journal of agromedicine.* 2015;20(2):95-104.
28. High Blood Pressure Facts. 2015; <http://www.cdc.gov/bloodpressure/facts.htm>.
29. Vital signs: prevalence, treatment, and control of high levels of low-density lipoprotein cholesterol--United States, 1999-2002 and 2005-200. *MMWR Morb. Mortal. Wkly. Rep.* 2011;60(4):109-114.
30. *National Diabetes Statistics Report, 2014: Estimates of Diabetes and Its Burden in the United States*. National Center for Chronic Disease Prevention and Health Promotion;2014.
31. Scribani M, Wyckoff S, Jenkins P, Bauer H, Earle-Richardson G. Migrant and seasonal crop worker injury and illness across the northeast. *Am. J. Ind. Med.* 2013;56(8):845-855.
32. Luque JS, Reyes-Ortiz C, Marella P, et al. Mobile farm clinic outreach to address health conditions among Latino migrant farmworkers in Georgia. *Journal of agromedicine.* 2012;17(4):386-397.
33. Farmworkers' Health Factsheet: Data from the National Agricultural Workers Survey. 2015; <http://www.ncfh.org/fact-sheets--research.html>.
34. Quandt SA, Elmore RC, Arcury TA, Norton D. Eye symptoms and use of eye protection among seasonal and migrant farmworkers. *South. Med. J.* 2001;94(6):603-607.
35. Forst L, Noth IM, Lacey S, et al. Barriers and benefits of protective eyewear use by Latino farm workers. *Journal of agromedicine.* 2006;11(2):11-17.

36. *Incidence rates for national occupational injuries and illnesses involving days away from work per 10,000 full-time workers by industry and selected parts of the body.* Bureau of Labor Statistics;2005.
37. *Personal Protective Equipment Vol 1910.* United States Department of Labor: Occupational Safety and Health Administration; 2011.
38. Islam SS, Doyle EJ, Velilla A, Martin CJ, Ducatman AM. Epidemiology of compensable work-related ocular injuries and illnesses: incidence and risk factors. *J. Occup. Environ. Med.* 2000;42(6):575-581.
39. Verma A, Schulz MR, Quandt SA, et al. Eye health and safety among Latino farmworkers. *Journal of agromedicine.* 2011;16(2):143-152.
40. Varma R, Mohanty SA, Deneen J, Wu J, Azen SP. Burden and predictors of undetected eye disease in Mexican-Americans: the Los Angeles Latino Eye Study. *Med. Care.* 2008;46(5):497-506.
41. Varma R, Paz SH, Azen SP, et al. The Los Angeles Latino Eye Study: design, methods, and baseline data. *Ophthalmology.* 2004;111(6):1121-1131.
42. Munoz B, West SK, Rodriguez J, et al. Blindness, visual impairment and the problem of uncorrected refractive error in a Mexican-American population: Proyecto VER. *Invest. Ophthalmol. Vis. Sci.* 2002;43(3):608-614.
43. Broman AT, Hafiz G, Munoz B, et al. Cataract and barriers to cataract surgery in a US Hispanic population: Proyecto VER. *Arch. Ophthalmol.* 2005;123(9):1231-1236.
44. Rodriguez J, Sanchez R, Munoz B, et al. Causes of blindness and visual impairment in a population-based sample of U.S. Hispanics. *Ophthalmology.* 2002;109(4):737-743.
45. Broman AT, Munoz B, Rodriguez J, et al. The impact of visual impairment and eye disease on vision-related quality of life in a Mexican-American population: proyecto VER. *Invest. Ophthalmol. Vis. Sci.* 2002;43(11):3393-3398.
46. West SK, Munoz B, Klein R, et al. Risk factors for Type II diabetes and diabetic retinopathy in a mexican-american population: Proyecto VER. *Am. J. Ophthalmol.* 2002;134(3):390-398.
47. Yonekawa Y, Varma R, Choudhury F, Torres M, Azen SP. Risk factors for four-year incident visual impairment and blindness: the Los Angeles Latino Eye Study. *Ophthalmology.* 2011;118(9):1790-1797.
48. Centers for Disease Control and Prevention (CDC). Behavioral Risk Factor Surveillance System Survey Questionnaire. Atlanta GUSDoHaHS, Centers for Disease Control and Prevention, 2010.
49. National Health Interview Survey. *National Center for Health Statistics.* Maryland: Centers for Disease Control and Prevention, United States Department of Health and Human Services; 2014.
50. National Eye Institute Visual Function Questionnaire (VFQ-25). RAND Health; 2000.
51. Mangione CM, Lee PP, Gutierrez PR, Spritzer K, Berry S, Hays RD. Development of the 25-item National Eye Institute Visual Function Questionnaire. *Arch. Ophthalmol.* 2001;119(7):1050-1058.
52. Behavioral Risk Factor Surveillance System (BRFSS). *Vision Health Initiative (VHI)* 2009; http://www.cdc.gov/visionhealth/data/sources_brfss.htm.
53. National Center for Health Statistics. Survey Description, National Health Interview Survey, 2013. Hyattsville, Maryland. 2014.

54. Facts for Features: Hispanic Heritage Month 2014: Sept. 15–Oct. 15. 2014; <http://www.census.gov/newsroom/facts-for-features/2014/cb14-ff22.html>.
55. Vitale S, Cotch MF, Sperduto RD. Prevalence of visual impairment in the United States. *JAMA*. 2006;295(18):2158-2163.
56. Wittenborn JS, Zhang X, Feagan CW, et al. The economic burden of vision loss and eye disorders among the United States population younger than 40 years. *Ophthalmology*. 2013;120(9):1728-1735.
57. *The State of Vision, Aging, and Public Health in America*. Atlanta: Centers for Disease Control and Prevention;2011.
58. Bailey RN, Indian RW, Zhang X, Geiss LS, Duenas MR, Saaddine JB. Visual impairment and eye care among older adults - five States, 2005. *MMWR Morb. Mortal. Wkly. Rep.* 2006;55(49):1321-1325.
59. Satici A, Bitiren M, Ozardali I, Vural H, Kilic A, Guzey M. The effects of chronic smoking on the ocular surface and tear characteristics: a clinical, histological and biochemical study. *Acta Ophthalmol. Scand.* 2003;81(6):583-587.
60. Varma R, Ying-Lai M, Klein R, Azen SP. Prevalence and risk indicators of visual impairment and blindness in Latinos: the Los Angeles Latino Eye Study. *Ophthalmology*. 2004;111(6):1132-1140.
61. Varma R, Torres M, Pena F, Klein R, Azen SP. Prevalence of diabetic retinopathy in adult Latinos: the Los Angeles Latino eye study. *Ophthalmology*. 2004;111(7):1298-1306.
62. *Frequency of Ocular Examinations - 2015*. San Fransisco: American Academy of Ophthalmology Hoskins Center for Quality Eye Care;2015.
63. Chou CF, Barker LE, Crews JE, et al. Disparities in eye care utilization among the United States adults with visual impairment: findings from the behavioral risk factor surveillance system 2006-2009. *Am. J. Ophthalmol.* 2012;154(6 Suppl):S45-52.e41.
64. Zhang X, Saaddine JB, Lee PP, et al. Eye care in the United States: do we deliver to high-risk people who can benefit most from it? *Arch. Ophthalmol.* 2007;125(3):411-418.
65. Kilmer G, Bynum L, Balamurugan A. Access to and use of eye care services in rural arkansas. *J. Rural Health.* 2010;26(1):30-35.
66. Zhang X, Cotch MF, Ryskulova A, et al. Vision health disparities in the United States by race/ethnicity, education, and economic status: findings from two nationally representative surveys. *Am. J. Ophthalmol.* 2012;154(6 Suppl):S53-62.e51.
67. Lee DJ, Lam BL, Arora S, et al. Reported eye care utilization and health insurance status among US adults. *Arch. Ophthalmol.* 2009;127(3):303-310.
68. Luo H, Beckles GL, Fang X, Crews JE, Saaddine JB, Zhang X. Socioeconomic status and lifetime risk for workplace eye injury reported by a us population aged 50 years and over. *Ophthalmic Epidemiol.* 2012;19(2):103-110.
69. Crews JE, Chou CF, Zhang X, Zack MM, Saaddine JB. Health-related quality of life among people aged ≥ 65 years with self-reported visual impairment: findings from the 2006-2010 behavioral risk factor surveillance system. *Ophthalmic Epidemiol.* 2014;21(5):287-296.
70. Zambelli-Weiner A, Crews JE, Friedman DS. Disparities in adult vision health in the United States. *Am. J. Ophthalmol.* 2012;154(6 Suppl):S23-30.e21.
71. Costs. *Costs of Vision Problems* 2013; <http://costsofvision.preventblindness.org/costs#tr1>.

72. The Affordable Care Act and Farmworkers: Access to Healthcare. 2015; <https://www.farmworkerjustice.org/content/access-healthcare-0>. Accessed November 24, 2015.
73. Vision. *Healthy People 2020* 2015; <http://www.healthypeople.gov/2020/topics-objectives/topic/vision/objectives>.

Chapter 4: Conclusions and Recommendations

An estimated 54 million Hispanics live in the United States, constituting 17% of the US total population. This number is expected to increase to 128.8 million Hispanics, or 31% of the U.S. population, by 2060.⁵⁴ Despite the growth of the Hispanic community in the United States, disparities remain in eye health and access to eye care. The two largest epidemiologic studies of eye disease in Hispanic populations, the Los Angeles Latino Eye Study (LALES) and Proyecto VER, have revealed high rates of visual impairment, diabetic retinopathy, and cataract.^{40-44,60,70} However, much remains to be discovered about the epidemiology of eye disease in more rural Hispanic populations. Much remains to be determined, for example, about the epidemiology of visual impairment, eye disease, and access to care among migrant farmworkers in the United States. The present study was an attempt to give further insight into the eye health and needs of this large, marginalized Hispanic population.

The Impact of Visual Impairment among Migrant Farmworkers and Recommendations

The present study determined that 12.3% of migrant farmworkers less than 40 years old report self-reported moderate-to-severe visual impairment. Large national surveys like the BRFSS Vision Module do not assess those under 40 years, and, thus, do not allow for parallel

comparison. Nevertheless, our prevalence for this age group suggests that a portion of migrant farmworkers, the majority of whom are under 40 years, are impacted by vision loss. In migrant farmworkers 40 years and older, rates of moderate-to-severe vision loss (32.4%) were higher than the Hispanic (16.1%) and general U.S. population (5.4% to 16%) 40 years and older.⁵⁷ The primary etiologies of such reported visual impairment are unknown. Our study determined that severe and very severe eye pain, age, and current smoking are significant predictive indicators of moderate-to-severe visual impairment among migrant farmworkers. With significant exposure to wind, pesticides, and dust in agricultural work, it is possible that a substantial portion of this visual impairment is secondary to ocular surface disease, both acute and chronic, leading to pain and visual impairment.³⁸ Current smoking may be an indication of eye irritation and surface disease leading to visual impairment as well.⁵⁹ Age has been commonly associated with visual impairment as it is associated with a number of age-related eye diseases.^{40,60}

As visual impairment and blindness are associated with poorer mental and physical health and reduced quality of life, vision loss represents a substantial burden to migrant farmworkers.⁶⁹ In addition, visual impairment and blindness generate sizable economic costs. The annual total economic cost of eye disorders and vision loss in the United States by age category, \$22.2 billion, \$33.8 billion, and \$77.3 billion are the costs incurred by visually impaired persons aged 18-39, 40-64, and 65 and older, respectively.⁷¹ Thus, even farmworkers younger than 40 years with vision impairment may generate significant economic productivity loss.

In light of the burden of visual impairment prevalence among migrant farmworkers and its impact on quality of life and economic production, we must continue to explore and address the underlying factors of vision loss in this population. Additional research is needed to objectively classify vision loss with visual acuity data. Also, research must be done using full

eye examination of migrant farmworkers to identify the underlying diagnostic causes of vision loss. Doing so will help establish true prevalence and incidence rates of eye disease in this population. By further understanding the causes of vision loss, farm owners, local providers and health policymakers can appropriately target prevention, screening, and treatment resources. For example, further understanding the association of ocular surface disease and injury with visual impairment, a greater effort can be made to educate migrant farmworkers on the use of protective eyewear. Pesticide exposure training can be improved and artificial tears distributed to those with irritation symptoms. If current smoking status is a risk indicator for vision loss, efforts can be made to improve smoking cessation counseling. Increased screening and examination efforts can be made among migrant farmworkers at high risk, including those with diabetes, moderate-to-severe visual difficulty, and those 65 years and older.

The Impact of Access to Care among Migrant Farmworkers

Our study also determined that migrant farmworkers at high-risk, those with diabetes, those 65 and older, and those with visual impairment, have fewer eye exams than the general and Hispanic U.S. population. The primary reasons farmworkers cited for not visiting an eye doctor within the last two years, beyond not having an eye complaint, were cost and insurance. As migrant farmworkers have twice the rate of poverty as the general U.S. population, the cost of an eye examination can be a huge barrier.¹ Migrant farmworkers also have substantially lower rates of insurance and eye insurance than the general and Hispanic U.S. population.⁵⁸ The significant predictors of having an eye exam in the last year is moderate-to-severe visual impairment and having a high school education or greater. These results suggest that while cost and insurance

are the most significant barriers, it is possible that having a high school education may allow farmworkers to better navigate the healthcare system and find low cost eye care resources.

Inadequate access to care can compound high rates of visual impairment. Poor access to care can lead to increased rates of undetected eye disease and uncorrected refractive error among immigrants and in particular, Hispanic immigrants. The LALES study found that 63% of Latinos had eye disease that was previously undetected.⁴⁰ In the Proyecto VER study, 73% of visual impairment among Mexican Americans was found to be a result of uncorrected refractive error.⁴² In both studies, those who were less acculturated had lower detection of eye disease. Migrant farmworkers, often a newly immigrated, transient and rurally isolated population, are less acculturated and less integrated into the healthcare system. Those migrant farmworkers who are undocumented have even less access; inability to obtain insurance and fear of deportation restrict their contact with the healthcare system.¹ Therefore, migrant farmworkers' may have high rates of visual impairment because of their environmental and occupational risks, but also because of poor access to care: they may have a significant amount of undetected eye disease, such as correctable refractive error.

Given the importance of access to eye care in this high-risk population with high rates of visual impairment, more efforts must be made to overcome barriers to care. Migrant farmworkers with H-2A status may be qualified for health insurance under the Affordable Care Act.⁷² However, few farmworkers are aware of this new law or the new options it allows. More of an effort must be made to educate such farmworkers about their insurance options. Furthermore, given that higher education may reduce the barrier to care, additional efforts must be made in reaching low education migrant farmworkers. Local health providers must be involved in determining appropriate pathways of eye care for authorized and unauthorized

migrant farmworkers, and educating migrant farmworkers about how to access local providers and resources. Finally, we must educate farmworkers regarding who is at high-risk for eye disease and the consequences of such disease. This education may help farmworkers self-identify if they are at high-risk and increase the chance that they will seek care.

Final Words

In light of the social and economic significance of visual impairment and blindness, Healthy People 2020, a national objective to improve health in America by the year 2020, established reduction of visual impairment, blindness, and occupational eye injury as primary objectives.⁷³ Addressing the Healthy People 2020 objectives comprehensively will require a focus on addressing disparities in eye health and access to eye care. As the literature increasingly focuses on visual impairment, eye disease, and access to ophthalmologic care among Hispanics in the U.S., there is additional need to focus on more rural and marginalized Hispanic subgroups. The 1 to 3 million migrant farmworkers in the U.S. represent a large Hispanic subgroup that experiences significant ocular risk and even more restricted access to eye care.¹ To achieve our national objectives for health and eye health, we must increase our focus on migrant farmworkers. We must work to identify the ophthalmologic needs of migrant farmworkers, and we must work to equitably expand their ophthalmologic care.

Appendices

Appendix 1:

2014 Survey of Eye Health of South Georgia Migrant Farmworkers

Emory University School of Medicine

Primary Investigator: Dr. Danny Haddad, MD, Dept. of Ophthalmology

Co-Investigator: Rebecca Russ, MD/MPH Candidate

Please contact Rebecca Russ 303-918-7222 with questions.

- **Thank you for offering to participate in this study.**
- **I am going to ask you a few questions about your vision health and about your ability to visit an eye doctor. The survey should take around 5 to 10 minutes, but is often under 5 minutes.**
- **I will not ask for your name, address, or other personal information that can identify you. You do not have to answer any question you do not want to, and you can end the interview at any time. Any information you give me will be confidential.**
- If you have any questions, I will provide a telephone number for you to call to get more information. *See phone number above.*

1. What is your age?

_____ (age in years)

- 7 Don't /Not Sure
- 9 Refused

2. What is your gender?

- 1 Male
- 2 Female

3. In what country were you born?

- 1 Mexico
- 2 Guatemala
- 3 Honduras
- 4 Haiti
- 5 Other: _____

4. What is your primary language?

- 1 English
- 2 Spanish

- 3 Creole
- 4 Indigenous language
- 5 Other: _____

5. How many seasons have you worked in agriculture? If patient can give an exact number, please fill in below. Otherwise, choose one of the following categories.

Seasons: _____

OR choose from

- 1 0-5 seasons
- 2 6-10 seasons
- 3 10-15 seasons
- 4 15-20 seasons
- 5 20+ seasons

6. What is the highest grade or year of school you completed?

- 1 Never attended school or only attended kindergarten
- 2 Grades 1 through 8 (Elementary)
- 3 Grades 9 through 11 (Some high school)
- 4 Grade 12 or GED (High school graduate)
- 5 College 1 year to 3 years (Some college or technical school)
- 6 College 4 years or more (College graduate)

- 9 Refused

7. Would you say that in general your health is---

- 1 Excellent
- 2 Very good
- 3 Good
- 4 Fair
- 5 Poor

- 7 Don't know/Not Sure
- 9 Refused

8. Have you smoked at least 100 cigarettes in your ENTIRE LIFE?

- 1 Yes
- 2 No

- 7 Don't Know
- 8 Not ascertained
- 9 Don't know

9. Do you NOW smoke cigarettes every day, some days or not at all?

- 1 Every day
- 2 Some days
- 3 Not at all

- 7 Don't know
- 8 Not ascertained
- 9 Refused

10. Have you ever been told by a doctor that you have diabetes or high blood sugar? (A doctor may have told you this after they stuck your finger to measure the sugar level in your blood.)
DIABETE2

(If "Yes" and respondent is female, ask: "Was this only when you were pregnant?")

- 1 Yes
- 2 Yes, but female told only during pregnancy
- 3 No
- 4 No, pre-diabetes or borderline diabetes

- 7 Don't know / Not sure
- 9 Refused

I would like to ask you questions about how much difficulty, if any, you have doing certain activities. If you usually wear glasses or contact lenses, please rate your ability to do them WHILE wearing glasses or contact lenses.

11. How much difficulty, if any, would you have in recognizing a friend across the street (while wearing contacts or glasses)?

- 1 No difficulty
- 2 A little difficulty
- 3 Moderate difficulty
- 4 Extreme difficulty
- 5 Unable to do because of eyesight

- 6 Unable to do for other reasons
- 7 Don't know/ Not sure
- 8 Not applicable (Blind)
- 9 Refused

12. How much difficulty, if any, do you have reading print in newspaper, magazine, recipe, menu, or numbers on the telephone (while wearing contacts or glasses)? Would you say—?

- 1 No difficulty
- 2 A little difficulty
- 3 Moderate difficulty
- 4 Extreme difficulty
- 5 Unable to do because of eyesight

- 6 Unable to do for other reasons
- 7 Don't know / Not sure
- 8 Not applicable (Blind)
- 9 Refused

13. How much pain or discomfort have you had in and around your eyes (for example, burning, itching, or aching)? Would you say it is:

- 1 None
- 2 Mild
- 3 Moderate
- 4 Severe
- 5 Very severe

- 7 Don't know/Not sure
- 8 Not ascertained
- 9 Refused

14. Have you EVER had an eye injury that occurred at your place of work that caused you to miss at least one day of work?

- 1 Yes
- 2 No

- 7 Don't know/Not sure
- 8 Not ascertained
- 9 Refused

15. Do you have any kind of health care coverage, including health insurance, prepaid plans such as HMOs (Health Maintenance Organizations), or government plans such as Medicare or Medicaid?

- 1 Yes
- 2 No

- 7 Don't Know/Not Sure
- 9 Refused

16. Do you have any kind of health insurance coverage for eye care?

- 1 Yes
- 2 No

- 7 Don't know / Not sure
- 9 Refused

17. When was the last time you had your eyes examined by any doctor or eye care provider?

- 1 Within the past month (anytime less than 1 month ago)
- 2 Within the past year (1 month but less than 12 months ago)
- 3 Within the past 2 years (1 year but less than 2 years ago)
- 4 2 or more years ago
- 5 Never

- 7 Don't know / Not sure
- 8 Not applicable (Blind)
- 9 Refused

18. If answered 3, 4, 5, 7, 8, 9 read question below. If answered 1 or 2, skip next question.

What is the main reason you have not visited an eye care professional in the past 12 months? I am going to list several options that may apply to you. Pick the one that describes the MAIN reason.

- 1 Cost/insurance
- 2 Do not want to miss work
- 3 The doctor does not speak my primary language
- 4 Do not have/know an eye doctor
- 5 Cannot get to the office/clinic (too far away, no transportation)
- 6 Could not get an appointment
- 7 No reason to go (no problem)
- 8 Have not thought of it

- 7 Don't know / Not sure
- 8 Not Applicable
- 9 Refused

19. DURING THE PAST 12 MONTHS, was there any time when you needed glasses, but didn't get them because you couldn't afford them?

- 1 Yes
- 2 No

- 7 Don't know
- 8 Not ascertained
- 9 Refused

20. Do you own sunglasses or protective eyewear?

- 1 Yes
- 2 No

- 7 Don't Know
- 9 Refused

21. How often do you wear sunglasses or protective eyewear when working in agriculture?

- 1 Always
- 2 Usually
- 3 Sometimes
- 4 Rarely
- 5 Never