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Agriculture is one of the most dangerous industries in the United States. Everyone who works in agriculture is exposed to environmental risk factors that can result in occupational eye injury and illness. These risks are particularly high for migrant and seasonal farmworkers. Vision problems increase the risk of occupational injuries in farmworkers. Workers rely on distance vision when driving cars, vans, and farm equipment. They rely on close vision to read pesticide labels and avoid branches and other hazards when picking orchard crops. Few farmworkers utilize healthcare in the US due to their immigration status, low income, lack of health insurance, and the limited number of migrant facilities.

The overall goals of this project are to: (1) assess the prevalence of visual impairment in Latino farmworkers in North Carolina and (2) assess the use of ocular protection and examine farmworker knowledge, perceptions, and risk beliefs about eye health and safety.

Interviews and standardized vision examinations were conducted with 300 Latino farmworkers. About 75% of farmworkers reported never having had their eyes checked. For distance vision, 3.4% had vision problems in the right eye, 3.1% in the left eye, and 1.3% with both eyes. For near vision, 10% had vision problems in the right eye, 10.3% in the left eye, and 6.9% in both eyes. Visual impairment was most common among farmworkers aged 40 years and older. Farmworkers reported difficulty watching TV

(19.7%) and doing work requiring near vision (25%). Responses to vision tasks did not accurately predict vision problems identified by examinations; sensitivities for each question were 60% or less. Farmworkers need routine vision exams to identify problems and reduce the risk of occupational injury.

Farmworkers reported low rates of eye protection use (8.3%) in this study. Majority (92.3%) of farmworkers in our study report that growers or contractors they work for do not provide eye protection despite the Occupational Safety and Health Standards. Approximately 70% of the farmworkers in this study reported that they are not well trained in preventing eye injuries and 81% of the workers believe that their chances of getting an eye injury at work on any given day are extremely low. Self-efficacy was apparent in issues related to risky behavior. While farmworkers indicated that they could recognize when their co-workers took risks, many farmworkers themselves chose to take risks to the eyes in order to save time or get more work done. Understanding farmworker knowledge, perceptions, and risk beliefs about eye health and safety are important when designing interventions and promoting the use of eye protection.

The results of this research are built upon previous studies focused on eye health and provide vital information for defining the need for screening, designing interventions, and implementing programs that are targeted to reduce eye conditions in such a vulnerable, medically underserved population.

VISUAL IMPAIRMENT AND EYE HEALTH AND SAFETY AMONG LATINO FARMWORKERS

by

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Approved by

_____
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To my mother, father, and sister:

~ A warmhearted thank you for your unconditional love, encouragement, and support during each chapter of my life. I am honored to have you as my family. Your presence has given me the motivation and drive to succeed in all aspects of life.

APPROVAL PAGE

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CHAPTER I

INTRODUCTION

Agriculture is one of the most dangerous industries in the United States. Everyone who works in agriculture is exposed to a significant number of environmental risk factors (i.e., weather, mechanical devices, chemicals, animals, plants and crops, organic and inorganic dust) that can result in occupational eye injury and illness.[1, 2] Vision problems increase the risk of occupational injuries in farmworkers. Workers rely on distance vision when driving cars, vans, and farm equipment. They rely on close vision to read pesticide labels and avoid branches and other hazards when picking orchard crops. Visual impairment and undetected eye diseases are widely acknowledged among the general population. Latinos are the largest minority group in the United States and are more likely than other groups to suffer from visual impairment;[3] however, documentation among Latino farmworkers is scarce.

Although all agricultural workers are exposed to environmental risks for occupational eye injury and illness, these risks are especially great among migrant and seasonal farmworkers. Very few farmworkers utilize healthcare in the US due to their immigration status, low income, lack of health insurance, and the limited number of migrant facilities.[4] In addition, most migrant health facilities do not have an ophthalmologist or a qualified provider, and therefore may face difficulty

offering diagnosis and treatment options for eye conditions. Over 90% of US farmworkers are Latino, with most of these being immigrants from Mexico.[5] Data from the National Agricultural Worker Survey (NAWS) estimates that approximately 50% of farmworkers are working without legal documents.[5]

The overall goal of this project is to assess the prevalence of visual impairment and eye health and safety in Latino farmworkers in North Carolina. While existing research has focused on eye injury and risk factors associated with those injuries, additional research is necessary to determine the levels of visual impairment in this population. This research documents the levels of visual impairment and assesses behaviors and knowledge that place them at risk for injuries to the eye. To accomplish these goals this project used a cross-sectional survey design to:

1. Assess the prevalence of visual impairment among Latino farmworkers in North Carolina.
2. Assess the use of ocular protection and examine farmworker knowledge, perceptions, and risk beliefs about eye health and safety

Research shows that Latino farmworkers are at an increased risk for numerous health problems (i.e., atopic skin conditions, infectious diseases, asthma); however, further efforts are necessary to document visual impairment.[6, 7] The results of this research are built upon previous studies focused on eye injuries and will provides vital information for defining the need for screening, designing interventions, and implementing programs that are targeted to reduce eye conditions in such a vulnerable, medically underserved population. This study provides feedback on the feasibility of

measuring visual acuity and self-reported eye conditions in the field and creates the foundation for future comprehensive studies. The study also provides an insight to farmworker eye health and safety and documents the need for interventions that promote the use of eye protection and farmworker safety.

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CHAPTER II

REVIEW OF LITERATURE

Who Are Farmworkers?

A *migrant farmworker* is an individual whose principal employment is in agriculture on a seasonal basis, and who, for purposes of employment, establishes a temporary home. The migration may be from farm to farm, within a state, interstate, or international. A *seasonal farmworker* is an individual whose principal employment is in agriculture on a seasonal basis and who does not migrate.[1]

Although difficult to enumerate, over one-million migrant and seasonal farmworkers and their dependents work in the United States.[2, 3] North Carolina ranks fifth in the size of its farmworker population, with approximately 100,000 farmworkers.[4] However, this number is considered low by many in the state. Four-of-five farmworkers were born in Mexico or Central America, and over 90% are Latino.[5] One-quarter of farmworkers are US citizens, 21% are legal permanent residents, and the remaining 53% are in the country without authorization.[5] A small proportion, nationally, are immigrants who come to the US annually with H2A visas, which authorize nonimmigrant aliens to work in agricultural employment in the US for a specified period. Over 60% of farmworkers live in poverty, 50% earn less than $7,500 annually, and the majority face barriers (i.e. language, culture, immigration status, availability, health insurance) in accessing healthcare services.[6-8]

Scope of Eye Conditions

Studies among farmworkers that measure refractive error using eye charts are extremely scarce. Currently, the majority of the literature relies on self-reported instruments to measure visual impairment.[9-11] Quandt et al (2008) found that 22% of migrant farmworkers in North Carolina reported fair or poor eyesight and up to 20% reported difficulty seeing in specific situations (i.e., recognizing a friend across the street, conducting specific tasks).[11] Retzlaff and Hopewell (1996) surveyed providers from migrant health clinics who administered visual screening tests using an eye chart and found that refractive error was a common eye problem.[12] These results suggest that further population-based basic vision screenings beyond current self-reported questionnaires and clinic screenings are necessary among farmworkers.

Farmworkers are at risk for a variety of occupational health problems such as pesticide-related illness,[13-15] musculoskeletal conditions,[16, 17] inflammatory skin diseases,[18, 19] and eye symptoms or injuries.[10, 11, 20-24] While the prevalence of self-reported eye symptoms or injuries has been documented, no studies have assessed the association between workplace risk factors or behavior and visual impairment and self-reported eye conditions.

Workplace eye injuries occur at an annual rate of 3.8/10,000 US workers. Agriculture workers experience the greatest risk for eye injury and illness at a rate of 8.7/10,000 workers;[25] however, statistics for Latino migrant farmworkers are underreported. The most common reported eye conditions among farmworkers are pain, redness, itching, blurred vision, poor visual acuity, pterygium, and allergic conjunctivitis.

A recent analysis in North Carolina found that 41% of farmworkers reported eye pain or burning after working in the fields all day; 43% redness; 25% itching; and 22% blurred vision.[11] Similarly, in the California Agricultural Workers Health Survey, 23% reported irritated itchy eyes and 12%, blurred vision.[24] In the Migrant Clinicians Network, 42% of providers surveyed reported that conjunctivitis was the most frequent eye condition presented among farmworkers.[12] In addition, Latinos have been documented to have age-related illnesses including hypertension, type II diabetes, and pterygium, all of which increase the risk for visual impairment.[23, 26] In California, Villarejo & Baron (1999) reported that a common complaint among farmworkers was pterygium.[17] Furthermore, telemedicine examinations in North Carolina revealed that 23% of workers in a large, population-based sample presented with pterygium.[23]

Risk Factors for Eye Conditions

Latino farmworkers are disproportionately more likely to suffer from eye conditions due to predisposing risk factors, harsh working conditions, environmental exposures, and lack of ocular protection.[10, 11, 21, 23, 26] Airborne soil and particulates that result of farming practices create environmental conditions that pose a risk to eye health. Exposure to allergens such as pollen has the ability to cause allergic reactions or abrasions to the eyes.[21, 27] Similar symptoms of irritated eyes also result from exposure to pesticide residues on crops, as well as from pesticide mixing, loading, other application tasks, and drift.[17, 21, 28] In addition, living in housing located next to fields sprayed with pesticides provides a mechanism for continuous exposure.[29, 30] Sunlight is also considered to be a continuous risk exposure that is detrimental to eye health.[21, 31] Farmworkers spend

a significant amount of time outdoors in extreme ultraviolet light. Short-term ocular conditions as a result of exposure to intense ultraviolet light include eye irritation and eye sensitivity, while long term conditions include cataract formation, retinal damage, and pterygium development.[23]

Additionally, farmworkers are sometimes exposed to aging equipment that lacks protective physical barriers. Case reports have documented failure of hydraulic lines on tractors resulting in workers being sprayed in the eyes with hydraulic fluid or other chemicals. Farmworkers use grinding wheels to sharpen tools, which can results in corneal abrasions from foreign bodies invading the eye.[21] Abrasions to the eye have also been documented due to thorns, stalks, vines, and bushes. The prevalence of eye abrasions is elevated due to failure to use ocular protection.[17, 21] For example, Quandt et al. (2008) documented that self-reported use of eye protection among farmworkers in North Carolina was extremely low: 9% wore eye protection in the past 7 days; 9%, safety goggles or safety glasses; 9%, sunglasses; and 4%, face shields.[11]

Interventions

Work-related eye injuries may be prevented with adequate protective eyewear. The main barriers for farmworkers not wearing ocular protection include perception of risk and effectiveness of eyewear to reduce risk, comfort, appearance, and impact on visual acuity.[11, 32] To date, all interventions among farmworkers have focused on preventing eye injuries by promoting the use of ocular protection and by using health education.[32-34] However, no interventions have targeted screening of visual impairment in

order to reduce the risk of workplace injury among farmworkers and improve overall quality of life.

Summary

Latino farmworkers are exposed to several occupational and environmental hazards that can lead to a variety of eye conditions ranging from discomfort to severe visual impairment. This study will expand on existing data by documenting the prevalence of visual impairment beyond the inherent limitations of self-reported questionnaires. Self-reported data sources limit the understanding of the extent visual impairment among farmworkers and its possible link to eye injuries. These limitations will be overcome by quantifying visual impairment by administering vision screenings.

Current interventions are focused on reducing eye injury by promoting the use of ocular protection through health education interventions. Providing epidemiological data to identify the scope of visual impairment is necessary in order to develop more effective interventions. For example, farmworkers can wear ocular protection to protect their eyes from injury, but if they suffer from visual impairment, they may be at increased risk for other occupational injuries.

By accomplishing the specific aims of this study, the prevalence and severity of visual impairment and eye health and safety are better understood. Eye health among farmworkers is an extremely important issue. However, very little research has been conducted in this population that measures visual acuity, and knowledge, risk, perceptions, and behaviors regarding eye health and safety. This project allows for the foundational development and validation of measures for future studies. Furthermore,

findings from this project will provide feasibility for measuring visual impairment in the field and lead to future studies that will provide information for translating research to practice in order to lessen the burden of eye problems and improve the overall health among farmworkers.

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CHAPTER III

VISION EXAMINATIONS AND SELF-REPORTED VISION AMONG MIGRANT FARMWORKERS

Introduction

Migrant farmworkers are exposed to a variety of environmental risk factors including chemicals, mechanical devices, plants, crops, dust, and exposure to sunlight that can result in occupational eye injuries and illnesses.[1, 2] Vision problems have the potential to enhance the risk of occupational injuries in farmworkers. Workers rely on distance vision when driving cars, vans, and farm equipment. They rely on near vision to read directions and warnings on pesticide labels and avoid branches or other hazards when picking crops. Migrant farmworkers need to be able to see clearly with both distance and near vision in order to minimize the risk of injuring themselves or their coworkers.

The majority of farmworkers in the southeastern United States are Latino. Latinos are the largest minority group in the United States and are more likely than other groups to suffer from visual impairment.[3] In addition, Latinos have been documented to have age-related illnesses including hypertension, type II diabetes, and pterygium, all of which increase the risk for visual impairment.[3, 4] Although visual impairment is acknowledged among the general Latino population, documentation among Latino migrant farmworkers is scarce.

Studies have relied on self-reported information to measure visual impairment among farmworkers.[5-7] A study in North Carolina found that 22% of farmworkers reported fair or poor eyesight and up to 20% reported difficulty seeing in specific situations (i.e., recognizing a friend across the street, conducting specifics tasks that require near vision).[7] Although self-reported data have been useful in documenting the prevalence of visual impairment among farmworkers, they fail to document the extent of clinically relevant vision problems. Studies among farmworkers that measure refractive error using standardized eye charts are rare. A survey of providers from migrant health clinics who administered visual screening tests using an eye chart found that refractive error was a common eye problem in migrant farmworkers.[8] While visual screening tests in migrant health clinics can be beneficial, very few farmworkers use healthcare in the US due to their immigration status, low income, lack of health insurance, and the limited number of migrant facilities.[9, 10] Further population-based vision screenings beyond current self-reported questionnaires and clinic screenings are necessary among farmworkers. No studies have attempted to implement vision screenings at farmworker residential sites. The objectives of this analysis are to describe farmworker visual health using self-report and standardized vision exam data, and to compare the results of self-report and standardized vision exam data.

Methods

Data are from a cross-sectional study of self-reported visual impairment and a standardized vision examination administered among migrant farmworkers in eastern North Carolina. Data collection was completed from June through August, 2009.

Sample

Participant recruitment and selection involved two steps: (1) identifying and selecting camps, and (2) identifying and selecting workers within camps. Farmworkers residential sites chosen for this study were located in three eastern North Carolina counties: Harnett, Johnston, and Sampson. As residential sites are widely distributed and not always occupied every year, we used an approach similar to that described in previous studies of green tobacco sickness and occupational skin disease.[11-13] The North Carolina Farmworkers Project serves all of the camps in the region and maintains a list of the camps, which was provided to the study team. Camps from the list were selected in random order. If a randomly selected camp was not being used, interviewers went to the next site on the randomized list.

A census was completed at all the selected camps in which farmworkers gave preliminary consent to participate. Farmworkers at each camp were recruited from the census list; up to six participants were recruited at each camp. The overall sample size included 300 farmworkers recruited from 52 campsites. Although migrant farmworkers begin arriving in North Carolina as early as April, the greatest numbers are present in eastern North Carolina from June through August. Therefore, we recruited migrant farmworkers during these months. Farmworkers at 62 camps were asked to participate in the study; workers at eight camps declined to participate and growers refused to allow study personnel to recruit at two camps. At the 52 camps included in the sample, 157 individuals refused to participate, for a participation rate of 66% (300/457).

Data Collection

Data collection included an interviewer-administered questionnaire and the administration of a visual impairment screening using the Snellen Tumbling E Charts for nearsightedness and farsightedness. The questionnaire and the visual impairment screening protocol were developed in English and translated into Spanish by a native Spanish speaker familiar with Mexican Spanish and farmworker vocabulary. Five farmworkers were recruited to pretest the questionnaire and protocol for the vision screening. Modifications to the questionnaire and protocol were made based on farmworker feedback. The questionnaire included items addressing demographic and background conditions and eye health. Questions on eye health focused on self-assessment of overall vision, distance vision, and near vision. Farmworkers were asked to rate their eyesight using both eyes. The five response categories were very good, good, moderate, bad, or very bad. They were also asked how much difficulty they had: (1) recognizing a friend across the street, (2) watching television, (3) reading print, and (4) doing work or hobbies that require near vision. The five response categories were none, mild, moderate, severe, or extreme and cannot do. The self-reported assessment questions pertaining to recognizing a friend across the street and difficulty watching television were used to assess distance vision; while questions about reading print and doing work or hobbies that require near vision were used to assess near vision.

Interviewers were trained to perform the visual impairment screening tests using the Snellen Tumbling E Charts for nearsightedness and farsightedness. These Snellen E charts were chosen due to the advantageous design including: contrast relation between

the letter width and between letter spacing, and contrast relation between letter height and between row spacing. This chart also ensures that the only variable in the screening for each letter size is the letter size itself and it eliminates the variable effect of crowding and use of various random letters.[14] Due to the Snellen E Chart's exact size, color, and contrast, original standardized charts used in the clinical setting were used to ensure accuracy of the eye screening. Appropriate measures were taken to make sure that the eye charts were well lit. Eye charts were not placed near locations or objects that would lead to distractions, light reflections, glare, or visual obstruction.

Interviewers were trained thoroughly in the examination protocol in order to make certain that results of the examinations were accurate (See Appendix A). Interviewers participated in a one-day training program conducted by investigators and project coordinators. Particular attention was directed towards eye chart screening as well as recording and interpreting the results. Interviewers demonstrated mastery of all examination protocol by the end of the training and participated in the pilot testing of the examination protocol in the field prior to the study. Project coordinators experienced in administering eye examinations supervised the interviewers in the field to make sure standardized examination protocols were followed and that results were accurately obtained and interpreted.

Values for distance visual impairment are normal vision (20/10 to 20/40), impaired vision (> 20/40 to 20/100), and legally blind (> 20/100); while values for near visual impairment are normal vision (20/10 to 20/40), impaired vision (> 20/40 to < 20/200), and legally blind (≥ 20/200).[15, 16] The vision examination protocol included

instructions to perform a corrected and uncorrected vision exam if the migrant farmworker brought corrective lenses.

Analysis

Descriptive statistics were calculated for the sample demographic characteristics and the results of the standardized uncorrected visual screening test for distance and near vision. In order to ensure that responses to the self-reported vision assessment questions were solely based on interpretations without corrective lenses, eleven farmworkers who reported that they wore corrective lenses for either distance or near vision were excluded from the analysis. Self-reported uncorrected eyesight results are described by counts and frequencies. Bivariate analyses comparing standardized vision screening with self-reported overall vision, self-reported distance, and self-reported near vision were conducted using cross-tabulations. For self-reported overall vision, the categories very good, good, and moderate were combined, and bad to very bad were combined to form two groups for the cross-tabulations. Similarly, for self-reported distance and near vision assessment questions, the categories very good, good, and moderate were combined, and severe and extreme or cannot do were combined. Sensitivities and specificities were calculated in order to examine how well self-reported vision assessment can predict actual vision measured by a standardized vision examination.

Results

The sample consisted of 275 males and 14 females (Table 1). Approximately two-thirds (69.2%) were between 18 and 39 years of age; the remainder were forty years or older (M=34.6, SD=10.2). About half (53.3%) had received no more than six years of

education and majority of the workers (99.7%) spoke Spanish. Almost two-thirds (63.3%) of the farmworkers were in the US on an H-2A temporary worker visa. The remaining workers had some other documentation status (36.6%). Over half (58.5%) of the farmworkers interviewed had worked five or more years in US agriculture. Two hundred and fifteen (74.4%) of the farmworkers had never had their eyes checked by a professional, and an additional 49 (17%) had not had their eyes checked in one or more years. Only 25 (8.7%) farmworkers had had their eyes checked in the past year. Of the 215 farmworkers who had never had their eyes checked, 152 (70.7%) never thought about having their eyes checked; 31 (11.4%) stated that cost or lack of insurance was a barrier; and 25 (11.6%) reported that they did not have or know an eye doctor, could not get to a healthcare site due to long distances or transportation, or had no reason to have their eyes checked. The remaining seven (3.3%) farmworkers reported some other reason for not having their eyes checked such as lack of time or because the doctor spoke English.

When tested with the standardized Snellen Tumbling E distance vision test using both eyes, 4 (1.4%) farmworkers were identified with impaired vision and 1 (0.3%) farmworker with legal blindness (Table 2). Distance vision tests on individual eyes revealed more visual impairment than the distance test using both eyes. In the right eye distance vision test, 7 (2.4%) farmworkers were identified with impaired vision and 3 (1.0%) farmworkers with legal blindness. In the left eye distance vision test, 6 (2.1%) farmworkers were identified with impaired vision and 3 (1.0%) farmworkers with legal blindness.

When tested with the standardized Tumbling E near vision test using both eyes, 19 (6.6%) farmworkers were identified with impaired vision and 1 (0.3%) farmworker with legal blindness. Near vision tests on individual eyes revealed more visual impairment than the near vision test using both eyes. In the right eye near vision test, 27 (9.3%) farmworkers were identified with impaired vision and 2 (0.7%) farmworkers with legal blindness. In the left eye near vision test, 29 (10.0%) farmworkers were identified with impaired vision and 1 (0.3%) farmworker with legal blindness.

Impaired vision and legal blindness varied by age. For distance vision using the right eye, 9 of 89 (10.1%) farmworkers aged 40 and older and 1 of 200 (0.5%) aged 18 to 39 years old were visually impaired or legally blind. For distance vision using the left eye, 6 of 89 (6.7%) farmworkers aged 40 and older and 3 of 200 (1.5%) aged 18 to 39 years old were visually impaired or legally blind. Distance vision results using both eyes found that 4 of 89 (4.5%) farmworkers aged 40 and older and 1 of 200 (0.5%) aged 18 to 39 years old were visually impaired or legally blind. For near vision using the right eye, 26 of 89 (29.2%) farmworkers aged 40 and older and 3 of 200 (1.5%) aged 18 to 39 years old were visually impaired or legally blind. For near vision using the left eye, 26 of 89 (29.2%) farmworkers aged 40 and older and 4 of 200 (2.0%) aged 18 to 39 years old were visually impaired or legally blind. Near vision results using both eyes found that 19 of 89 (21.3%) farmworkers aged 40 and older and 1 of 200 (0.5%) aged 18 to 39 years old were visually impaired or legally blind.

For overall self-reported eyesight, 21 (7.3%) reported it to be very good; 84 (29.1%), good; 170 (58.8%), moderate; 10 (3.5%), bad; and 4 (1.4%) very bad (Table 3).

For self-reported distance vision tasks, 17 (5.9%) farmworkers reported mild to extreme difficulty recognizing a friend across the street; and 57 (19.7%) reported difficulty watching television. Approximately a quarter of farmworkers reported mild to extreme difficulty with each near vision task. Sixty-nine (23.8%) of farmworkers had difficulty reading fine print, and 72 (25%) had trouble doing work or hobbies requiring up close vision.

Five farmworkers were identified as visually impaired or legally blind by the administered distance vision exam, but only 3 of those farmworkers identified themselves as having bad to very bad vision for a sensitivity of 60% (Table 4). Two hundred and eighty-four farmworkers were identified as having normal or better distance vision by exam, and 273 of those farmworkers self-identified themselves as having very good to moderate vision (specificity = 96.1%). Twenty farmworkers were identified as visually impaired or legally blind by the administered near vision exam, but only 4 of those farmworkers self-identified themselves as having bad to very bad vision (sensitivity = 20%). Two hundred and sixty-nine farmworkers were identified as having normal or better near vision by exam, and 259 of those farmworkers self-identified themselves as having very good to moderate vision (specificity = 96.3%).

Both self-reported distance vision questions about difficulty watching television and difficulty recognizing a friend across the street had sensitivities of 0% when compared to the administered distance vision test (Table 5). In both these cases, none out of the 5 farmworkers who were identified as visually impaired or legally blind by the administered distance vision exam self-identified as having a vision problem of any kind.

The specificities for both distance vision questions of difficulty watching television and difficulty recognizing a friend across the street were 100% and 99.6%, respectively. Almost all of the farmworkers who were identified as having normal or better vision by the administered distance vision exam self-identified themselves for both distance vision questions as having very good to moderate vision.

Similarly, when compared to the administered near vision test, both self-reported near vision questions about difficulty reading print and difficulty doing work or hobbies that require up close vision had a low sensitivities of 10%. For both assessment questions, of the 20 farmworkers who were identified as visually impaired or legally blind by the near vision test, 2 farmworkers self-identified themselves as having bad to very bad vision. The specificities for difficulty reading print and difficulty doing work or hobbies were 99.6% and 100%, respectively. Almost all farmworkers who were identified as having normal or better vision by the administered near vision exam also self-identified for both near vision questions as having very good to moderate vision.

Conclusion

Many immigrant Latino communities in the United States experience barriers to health services utilization.[9, 10, 17-19] Similar barriers to health service utilization are also recognized among Latino migrant farmworkers.[2, 9, 20] Such barriers include language and cultural differences, lack of healthcare insurance, financial strains, lack of availability of services, lack of transportation, immigration status, and different interpretations of health and illness that would prevent utilizing healthcare.[9, 20] Farmworkers access health services only when absolutely necessary (i.e., in case of an emergency), and the

overwhelming majority have never visited a medical clinic or doctor for health screenings such as a vision examination. Results from the California Agricultural Worker Health Survey (CAWHS) indicate that two-thirds of all agricultural workers have never had their eyes checked.[2] Findings from our study indicate that 74.4% of farmworkers have never had an eye examination; which is similar to the rate obtained by the CAWHS (66%). In our sample, the most common reasons for farmworkers not having their eyes checked are that they never thought about the importance of having an examination or that they felt that they had no reason to have their eyes checked because they experienced no eye problems. Cost of healthcare and lack of insurance were also major barriers that prevented farmworkers from having their eyes checked.

Latinos are the fastest growing and largest minority group in the United States. Latinos are documented to have higher rates of type II diabetes and hypertension and as a result are more likely to experience visual impairment than other groups.[21, 22] A few studies have addressed visual impairment among the Latino population;[22, 23] however, visual impairment studies among Latino migrant farmworkers are more scarce and limited to self-reported data as opposed to standardized vision screening.[6, 7, 23] Results from this study expand on existing data for Latino migrant farmworkers by documenting the prevalence of visual impairment beyond the inherent limitations of self-reported questionnaires by utilizing standardized vision exams at farmworker campsites.

Findings from the vision examinations indicate that a number of farmworkers experience visual impairment and blindness that place them at risk for occupational injury or further vision problems if their vision remains uncorrected. The results from the

standardized vision screening indicate that the prevalence of vision problems is four times greater for near vision than distance vision when using both eyes. Similarly, when farmworkers were tested for visual impairment in each individual eye, more farmworkers had impaired vision with their near vision when compared to the distance vision results. In our study, age-specific visual impairment and blindness was most common among individuals aged 40 years and older. According to a national study, the overall rate of visual impairment and blindness in US adults aged 40 years and older is 4.3%.[24] Our rate for distance vision using both eyes (4.5%) in Latino farmworkers aged 40 years and older is similar to the overall national rate of visual impairment and blindness in US adults aged 40 years and older; while our rate for near vision using both eyes (21.3%) for the same age group is higher than the overall national rate for visual impairment and blindness. Rates from our study for distance and near visual impairment and blindness among those who are older are also higher than rates reported in a Latino population-based study. The Los Angeles Latino Eye Study reported that 0.9% of Latinos aged 40 and older had visual impairment or blindness.[22]

Studies have documented that visual acuity with two eyes is different than visual acuity with one; however variations exist in regards to which measure is most useful to define visual impairment.[23, 25-27] While binocular visual acuity is the most accepted measure of a person's vision, monocular visual acuity is commonly used in the clinical and research settings.[23] Many studies and national agencies vary on the criteria of defining visual impairment in terms using either results from the better-seeing eye or binocular acuity using both eyes. Regardless of how visual impairment is defined, in our

study, farmworkers have problems with acuity when tested with individual eyes as well as both eyes. While vision examination results are better using both eyes, it was important to identify farmworkers that have visual impairments in individual eyes, as this could be an indication for further deterioration of overall vision in the future; especially since farmworkers do not utilize healthcare on a regular basis. Farmworkers need visual precision in order to avoid occupational injury when performing tasks such as cutting crops with sharp blades, sharpening tools, and driving farm machinery. It is necessary for farmworkers to obtain a routine vision exam in order to avoid future complication with their vision and to reduce the risk of occupational injury.

This study adds to the current literature by comparing results from the standardized vision exams that are rarely conducted on a farmworking population to self-reported assessment questionnaires about farmworker vision that are more commonly used in surveys of farmworker health. In our study, many farmworkers reported mild to extreme difficulty performing specific tasks that require either distance or near vision. In terms of self-reported assessment of distance vision, the rate of difficulty watching television (19.7%) is slightly higher than that obtained by Quandt et al. (2008) (13.0%). The results of the self-reported near vision assessment also indicate that a larger percentage of farmworkers experience a problem with reading print (23.8%) and performing tasks requiring up close vision (25%) than that obtained by Quandt et al. (2008) (19.5% and 9.0%, respectively). Farmworkers who have difficulty performing up close tasks are at risk of injuring themselves while performing day-to-day occupational activities.

Assessment questions about overall vision and self-reported ability to perform various tasks that require either distance or near vision are not very accurate in identifying visual impairment. None of the questions had a sensitivity exceeding 60% and many of the sensitivities were close to 0%, indicating that migrant farmworkers who have a visual impairment may not be able to recognize that a problem exists unless they receive an eye examination. Migrant farmworkers who test as having normal vision by the administered exams are more accurate in self-identifying themselves as having no vision problems. Self-reported questionnaires appear to be valid in situations when farmworkers do not have vision problems. Most farmworkers do not seek healthcare and their vision status is not usually known; therefore, relying solely on self-reported data to identify vision problems is likely to overlook the majority of visual impairment cases among migrant farmworkers. Farmworkers are at an increased risk for injuring themselves as well as those they work around because they are unable to correctly identify vision problems and their lack of access to healthcare for necessary screenings.

A major strength of this study is that it is among the first to obtain standardized measured visual impairment data from farmworkers at residential sites. In addition, by being one of the only studies to compare self-reported vision assessment questions to measured visual impairment data among farmworkers, this study addresses recommendations made by Quandt et al. (2008) to determine whether farmworkers accurately perceive vision problems.[7] Despite the strengths of the study, results should be considered with limitations. While eye chart examinations can aid in measuring visual impairment at various distances, it is not a complete eye examination. Eye chart exams

do not always help a provider in deciding whether corrective lenses are necessary for visual impairment; additional tests are usually necessary. Furthermore, eye charts do not measure problems with peripheral vision, depth perception, or the ability to perceive contrasts; all of which could potentially increase the risk of occupational injuries among farmworkers. In addition, vision charts do not consider other eye health conditions possible among farmworkers such as eye fluid pressure, dryness, or whether the retinas are damaged.

Regardless of the limitations, the results from the standardized vision examinations as well as the self-reported vision assessment questions indicate that farmworkers have various levels of visual impairment, and they do not obtain routine eye examinations. While vision exams at farmworker residential sites provided an opportunity for workers to become more aware of the importance of a vision screening, future studies are necessary in order to assess comprehensive eye health beyond the scope of standardized vision exams.

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TABLES

Table 1: Personal Characteristics of Farmworkers.

Personal Characteristics	Total	
	N (289)	%
Gender		
Male	275	95.2
Female	14	4.8
Age		
18 to 29 years	91	31.5
30 to 39 years	109	37.7
40 years and older	89	30.8
Educational attainment		
0 to 6 years	154	53.3
7 to 9 years	112	38.8
10 or more years	23	8.0
Language spoken[1]		
English	34	11.8
Spanish	288	99.7
Indigenous language	58	20.1
Years worked in US agriculture		
1 to 4 years	120	41.5
5 to 9 years	94	32.5
10 or more years	75	26.0
H-2A visa		
Yes	183	63.3
No	103	35.6
Other	3	1.0
Last time eyes were checked		
Never	215	74.4
5 or more years ago	23	8.0
1 to 4 years ago	26	9.0
Less than a year ago	25	8.7
Reason for not checking eyes[2]		
Cost or insurance	31	14.4
Do not have or know an eye doctor	6	2.8
Transportation or distance	2	0.9
No reason to go	17	7.9
Have not thought about it	152	70.7
Other	7	3.3

[1] Some people speak more than one language, so totals do not equal 289 and 100%.

[2] Frequencies and percentages are based on farmworkers who responded "never" to the question "last time their eyes were checked" (n=215).

Table 2: Uncorrected Visual Screening Results for Distance and Near Vision. N=289

Variable	Right Eye		Left Eye		Both Eyes	
	N	%	N	%	N	%
Distance Vision Test[1]						
Normal vision	279	96.5	280	96.9	284	98.3
Impaired vision	7	2.4	6	2.1	4	1.4
Legally blind	3	1.0	3	1.0	1	0.3
Near Vision Test [2]						
Normal vision	260	90.0	259	89.6	269	93.1
Impaired vision	27	9.3	29	10.0	19	6.6
Legally blind	2	0.7	1	0.3	1	0.3

[1]Distance vision ranges are: 20/10 to 20/40 = normal vision, >20/40 to 20/100 = impaired vision, and >20/100 = legally blind

[2]Near vision ranges are: 20/10 to 20/40 = normal vision, >20/40 to <20/200 = impaired vision, and ≥20/200 = legally blind

Table 3: Self-reported Uncorrected Eye Sight Among Farmworkers. N=289		
Variable	N	%
Overall self-reported eyesight		
Very Good	21	7.3
Good	84	29.1
Moderate	170	58.8
Bad	10	3.5
Very Bad	4	1.4
Difficulty recognizing a friend across the street		
None	272	94.1
Mild	10	3.5
Moderate	6	2.1
Severe	1	0.3
Extreme or can not do	-	-
Difficult watching television		
None	232	80.3
Mild	43	14.9
Moderate	14	4.8
Severe	-	-
Extreme or can not do	-	-
Difficulty reading fine print		
None	220	76.1
Mild	52	18.0
Moderate	14	4.8
Severe	-	-
Extreme or can not do	3	1.0
Difficulty doing work or hobbies requiring up close vision		
None	217	75.1
Mild	58	20.1
Moderate	12	4.2
Severe	-	-
Extreme or can not do	2	0.7

Table 4: Self-reported Overall Vision versus Administered Distance and Near Vision Tests (N=289)

	Administered Vision Test with Both Eyes		
	Distance Vision		
Overall how would you rate your eyesight using both eyes...	Impaired / Blind	Normal	Total
Bad to Very Bad	3	11	14
Very good to Moderate	2	273	275
Total	5	284	289
	Near Vision		
Bad to Very Bad	4	10	14
Very good to Moderate	16	259	275
Total	20	269	289

Table 5: Self-reported Distance & Near Vision Assessment versus Administered Distance & Near Vision Test (N=289)

	Administered Vision Test with Both Eyes		
	Distance Vision		
Self-reported Distance and Near Vision Questions	Impaired / Blind	Normal	Total
Because of your eye sight, how much difficulty do you have in watching television			
Severe or Extreme / Can't Do	0	0	0
None to Moderate	5	284	289
Total	5	284	289
Because of your eye sight, how much difficulty do you have recognizing a friend across the street			
Severe or Extreme / Can't Do	0	1	1
None to Moderate	5	283	288
Total	5	284	289
	Near Vision		
Because of you eye sight, how much difficulty do you have reading print			
Severe or Extreme / Can't Do	2	1	3
None to Moderate	18	268	286
Total	20	269	289
Because of your eye sight, how much difficulty do you have doing work or hobbies that require you to see up close			
Severe or Extreme / Can't Do	2	0	2
None to Moderate	18	269	287
Total	20	269	289

CHAPTER IV

EYE HEALTH AND SAFETY AMONG LATINO FARMWORKERS

Introduction

Latino farmworkers are more likely to suffer eye injuries and illnesses due to environmental exposures and harsh working conditions when compared to all other industries.[1-4] Sunlight is considered to be a continuous risk exposure that is detrimental to eye health.[1, 5] Farmworkers spend a significant amount of time outdoors in extreme ultraviolet light. Short-term conditions as a result of exposure to intense ultraviolet light include eye irritation and eye sensitivity, while long-term conditions include cataract formation, retinal damage, and pterygium development.[4] Exposure to allergens such as pollen may cause allergic reactions or abrasions to the eyes.[1, 6] Abrasions to the eye have also been documented due to thorns, stalks, vines, and bushes. Eye irritation also results from exposure to agricultural pesticides.[1, 7, 8] Airborne soil and particulates that result from farming practices create environmental conditions that pose a risk to eye health. In addition, living in housing located next to fields sprayed with pesticides provides a mechanism for continuous exposure.[2, 10] Additionally, farmworkers are sometimes exposed to aging equipment that lacks protective physical barriers. Case reports have documented failure of hydraulic lines on tractors resulting in workers being sprayed in the eyes with hydraulic fluid or other chemicals. Farmworkers use grinding wheels to

sharpen tools, which can results in corneal abrasions from foreign bodies invading the eye.[1]

Another important contributor to eye injuries and illnesses among farmworkers is the failure to use eye protection.[1, 7] According to the U.S. Occupational Safety and Health Administration, 90% of eye injuries and symptoms can be prevented by proper use of eye protection.[11] Studies among Latino farmworkers have documented that self-reported use of eye protection is extremely low.[2, 3, 12, 13] The specific aims of this analysis are to describe eye protection use among migrant farmworkers and to determine farmworker knowledge, perceptions, and risk beliefs about eye health and safety.

Methods

Data are from a cross-sectional study of visual impairment and eye health and safety among migrant farmworkers in eastern North Carolina. Data collection was completed from June through August, 2009.

Sample

Participant recruitment and selection involved two steps: (1) identifying and selecting camps, and (2) identifying and selecting workers within camps. Farmworkers residential sites chosen for this study were located in three eastern North Carolina counties: Harnett, Johnston, and Sampson. As residential sites are widely distributed and not always occupied every year, we used an approach similar to that described in previous studies of green tobacco sickness and occupational skin disease.[14, 15, 16] The North Carolina Farmworkers Project serves all of the camps in the region and maintains a list of the camps, which was provided to the study team. Camps from the list were

selected in random order. If a randomly selected camp was not being used, interviewers went to the next site on the randomized list.

A census was completed at all the selected camps in which farmworkers gave preliminary consent to participate. Farmworkers at each camp were recruited from the census list; up to six participants were recruited at each camp. The overall sample size included 300 farmworkers recruited from 52 campsites. Although migrant farmworkers begin arriving in North Carolina as early as April, the greatest numbers are present in eastern North Carolina from June through August. Therefore, we recruited migrant farmworkers during these months. Farmworkers at 62 camps were asked to participate in the study; workers at eight camps declined to participate and growers refused to allow study personnel to recruit at two camps. At the 52 camps included in the sample, 157 individuals refused to participate, for a participation rate of 66% (300/457).

Data Collection

Data collection included an interviewer-administered questionnaire. Interviewers were involved in a one-day program conducted by investigators and project coordinators. The program included a thorough review of camp and participant selection, recruitment procedures, and interview data collection procedures. The questionnaire was developed in English and translated into Spanish by a native Spanish speaker familiar with Mexican Spanish and farmworker vocabulary. Five farmworkers were recruited to pretest the questionnaire. Modifications to the questionnaire were made based on farmworker feedback.

The questionnaire included items addressing demographic and background conditions, use of eye protection, factors discouraging use of eye protection, knowledge about eye health and safety, and perceptions and risk beliefs about eye health and safety. In order to assess eye protection use, farmworkers were asked whether or not they wear sunglasses, face shields, protective glasses, goggles, or other devices to protect their eyes. Responses to the types of eye protection worn were summed to create a dichotomous variable for eye protection use. A score of zero indicated that a farmworker did not wear any form of eye protection and a score of one or more was recoded to indicate that a farmworker wore at least one form of eye protection.

Seven questions were used to assess knowledge about eye health and safety and eight questions were used to assess perceptions and risk beliefs about eye health and safety. Measures for knowledge about eye health and safety were adopted from a previous study on the effectiveness of community health workers for promoting use of safety eyewear by Latino farmworkers.[12] Similarly, individual items around perception and risk belief about eye health and safety were adopted from previous conducted studies among Latino farmworkers in the Midwest and in Florida.[12, 13, 17] Reponses to the knowledge, perception, and risk belief questions were dichotomized into "disagree" and "agree."

All participants provided signed informed consent before data collection began. The Wake Forest University Health Sciences Institutional Review Board approved protocol and consent forms.

Results

The sample consisted of 285 males and 15 females (Table 1). Approximately one-third (31.3%) were between 18 and 29 years of age; the remainder were thirty years or older (M=35.0, SD=10.5). More than half (53.7%) completed no more than six years of education and a majority of the workers (99.7%) spoke Spanish. Over half (58.0%) of the farmworkers interviewed worked five or more years in US agriculture and almost two-third (63.0%) were in the US on a H-2A temporary worker visa. The remaining workers had some other documentation status (37.0%).

In all, 275 (91.7%) of the participants reported never wearing eye protection of any kind. Of workers reporting the use of eye protection, 14 (4.7% of total sample) wore sunglasses, 1 (0.3%) wore a face shield, 12 (4.0%) wore protective glasses, and 8 (2.7%) wore goggles (Table 2). Farmworkers reported several factors that prevented them from wearing eye protection. Almost half (141; 47.0%) reported that eye protection was uncomfortable, 102 (34.0%) reported that eye protection fogs up while sweating, 31 (10.3%) reported that eye protection fell off the face easily, 156 (52.0%) reported that eye protection prevented seeing well enough to do the job, 18 (6.0%) reported that they did not like the way it looked, 14 (4.7%) reported that their co-workers would make fun of them for wearing eye protection, and 20 (6.7%) reported some other reason for not wearing eye protection. Most (92.3%) of the farmworkers indicated that the growers did not provide eye protection and 97.3% reported that they would wear eye protection if it were made mandatory by growers. Of the 275 farmworkers who did not wear eye protection, only 13 (4.7%) were provided eye protection by the growers or contractor.

For the 25 cases in which eye protection was worn, 10 (40.0%) stated that they received eye protection from their employer. Those who had eye protection provided by the grower or contractor were 13.4 times more likely (95% CI 5.1, 35.6; p-value=0.01) to wear eye protection than those who did not have eye protection provided to them by their grower or contractor. When demographic covariates such as age, education, and years in agriculture were included in a multivariate logistic regression model, the association still remained significant with a slight increase in the odds ratio; therefore, the unadjusted odds ratio and CI are reported.

Over two thirds (69.3%) of the farmworkers indicated that they are not well trained in preventing eye injuries (Table 3). Approximately one quarter (23.7%) disagreed with the statement that rays of sunlight can cause cataracts. A majority (91.7%) reported that if they get something in their eyes, such as a piece of wood, they should immediately wash it with clean water; and 98.0% reported that if the eyes are splashed with chemicals, the first thing that should be done is wash the eyes out with water. Almost all farmworkers (97.3%) believe that wind, dust, and chemicals could cause eye problems. Fourteen percent disagreed with the statement "if I lost my safety glasses but need to do a job that is hazardous to my eyes it is important to get another pair before doing that job." Most (93.7%) of the farmworkers are aware that proper safety eyewear can be purchased at stores.

Among the farmworkers, 74.7% believe that eye injuries are always avoidable or preventable when working in agriculture; and 81.0% believe that their chances of getting an eye injury at work on any given day are very low (Table 4). Almost half (49.7%) of

farmworkers see their co-workers doing something that is risky for their eyes and 46.3% of farmworkers take risks to the eyes in order to save time or get more work done. A majority (86%) agreed that safety glasses protect the eyes when working in agriculture. Approximately three-fourth (74.0%) thought it important to wear safety glasses all the time while working in agriculture, but about half (48.7%) also stated that there are many jobs in agriculture where a worker does not need to wear safety glasses. In 13.7% of the cases, farmworkers indicated that eye protection would make them look funny.

Conclusion

Agriculture is one of the most dangerous industries in the United States. Among agricultural workers in the US, workplace injuries to the eye occur at an annual rate of 8.7/10,000 workers; which is greater than the workplace eye injury rate of 3.8/10,000 US workers in all other industries.[18] Latino migrant farmworkers are among the most economically deprived groups of individuals in the US[19] and they are exposed to a significant number of occupational and environmental risk factors (i.e., weather, mechanical devices, chemicals, animals, plants and crops, organic and inorganic dust) that can result in eye injuries and illnesses.[1,4-10]

Farmworkers report low rates of eye protection use despite their routine exposure to occupational and environmental hazards. The rate for eye protection use (8.3%) in this study is somewhat greater then that reported by Quandt et al (2008) (1.6%) and Forst et al (2004) by observation (0.6%) as a baseline measure for an eye protection intervention. However, it is still extremely low. The most common reasons that farmworkers indicate for not wearing eye protection are that the protection prevents them from seeing well

enough to do the job, they are uncomfortable, and they fog up while sweating. These reasons for not using eye protection are similar to those reported in previous studies.[2, 3, 13]

In addition to personal discouraging factors that prevent farmworkers from wearing eye protection, many growers or contractors do not provide their workers with protective eye equipment. A majority (92.3%) of farmworkers in our study report that the grower or contractor they work for does not provide eye protection. The Occupational Safety and Health Standards (OSHA 1910.133(a)) mandate that employers provide eye protection to employees whenever they are performing tasks that have a likelihood of risk for injury to the eyes and that it is a requirement for employees to use the protective equipment provided.[20] In addition to not providing protective equipment, it also appears that many growers and contractors do not mandate the use of protective eyewear. Almost all (97.3%) of the farmworkers indicate that they would wear eye protection if their employers mandate it. While farmworkers state they would use eye protection if it is enforced, many still report not using it and provide justification for not wearing it. This inconsistency suggests that some participants gave socially acceptable responses about their willingness to use eye protection if this use was made mandatory. Also, findings from our study indicate that in situations where employers provided eye protection, farmworkers were much more likely to wear eye protection then were workers who did not receive eye protection. Employer mandates regarding distribution of eye protection to farmworkers as well as mandating farmworker use of eye protection must be enforced in order to prevent eye injuries.

Farmworkers' knowledge about eye health and safety is limited. A majority of the farmworkers reported that they are not trained in preventing eye injuries. When farmworkers are asked about getting something in their eyes such as a piece of wood or splashing chemicals in their eyes, the majority agreed that they should immediately wash their eyes out with water. While immediately rinsing the eyes out with water prior to seeking medical attention is the appropriate step when splashing the eyes with a chemical, it is not necessarily the appropriate step to take after getting something in the eyes such as a piece of wood. Foreign objects in the eye should not be removed until medical attention is sought in order to avoid damage to the eyes. For example, attempting to rinse a foreign object out of the eye with water can result in rubbing; which can lead to scratching or further penetration of the object into the eye.[21] Also, in terms of acquisition of proper safety eyewear, a majority of the farmworkers in our study are aware that eye protection can be purchased in stores. While safety eyewear is available in stores, farmworkers may not be able to purchase it due to barriers they face, such as low income, lack of transportation, and isolation of farmworker residential sites from nearby stores.[19, 22]

Farmworker perception and risk beliefs about eye health and safety can also increase their risk for eye injuries. In our study, approximately a quarter (25.3%) of farmworkers believe that eye injuries are always avoidable or preventable when working in agriculture, but over three quarters (81.0%) believe that the chances of getting an eye injury at work on a given day are very low. Therefore, a majority of the farmworkers reported that they do not use eye protection and are not well trained in preventing eye

injuries. Forst et al. (2006) found that inconsistencies in these results are because farmworkers feel that not all job tasks are equally as risky as others and, therefore, farmworkers may not always use eye protection and feel less susceptible to eye injuries. Approximately half the farmworkers in this study indicated that many tasks in agriculture do not require eye protection. We recommend that audits of tasks in agricultural be performed that would make growers, contractors, and farmworkers aware of the hazards associated with each task. This might help to ensure that the appropriate safety eyewear is provided and used. Such audits are believed to make mandates regarding eye protection more acceptable because only tasks that are determined to be dangerous would require eye protection as opposed to mandating eye protection for all tasks.[13]

A lack of self-efficacy was apparent as regards avoiding risky behavior. For example, even though several farmworkers could recognize risky behaviors to the eyes among their co-workers, many farmworkers themselves chose to take risks to the eyes in order to save time or get more work done. Situations in which farmworkers receive pay based on production of crop rather than pay based on the number of hours worked may influence farmworkers to chose not to wear safety eyewear in order to save time and get more work done.[13]

The results of this study should be interpreted in light of their limitations. Questions about knowledge, perception, and risk beliefs on eye health and safety were adopted from a previously study conducted on Latino farmworkers.[12] Perhaps the dichotomized style of questions used for this group was not the best option because many farmworkers seemed to overwhelmingly agree with the statements provided in the

questionnaire. Farmworkers seemed to provide the most socially acceptable answer and also responded inconsistently to various questions that were related. For example, most of the farmworkers reported that they do not wear eye protection and provided many reason for not wearing it; however, a majority would agree with the statement that it is important to wear safety glasses all the time while working in agriculture. Also, farmworkers needed to be reminded that there are no "correct" answers to the questions. For example, questions pertaining to washing their eye out with water if they are splashed with chemicals or if they got a piece of wood in the eye do not have a "correct" answer. Farmworkers responded by agreeing that they should wash their eyes in every situation because it seems to be the most socially acceptable and logical answer when the correct response should vary depending on the type of chemical or object exposed in the eye. This suggests that additional studies and interventions are necessary to educate farmworkers about eye health and safety.

Understanding the knowledge levels, perceptions, and risk beliefs of eye health and safety are important in designing successful interventions and promoting the use of eye protection among farmworkers. Results from this study should be expanded to develop appropriate interventions to improve farmworker knowledge and perceptions, increase eye protection behavior, and reduce farmworker risk, as well as increase grower and contractor provision of eye protection. Farmworkers, growers, and contractors need to become aware of the dangers in working in agriculture and the appropriate precautionary measures that need to be taken to prevent eye injuries.

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TABLES

Table 1: Personal Characteristics of Farmworkers.

Personal Characteristics	Total	
	N (300)	%
Gender		
Male	285	95.0
Female	15	5.0
Age		
18 to 29 years	94	31.3
30 to 39 years	110	36.7
40 years and older	96	32.0
Educational attainment		
0 to 6 years	161	53.7
7 to 9 years	115	38.3
10 or more years	24	8.0
Language spoken[1]		
English	35	11.7
Spanish	299	99.7
Indigenous language	61	20.0
Years worked in US agriculture		
1 to 4 years	126	42.0
5 to 9 years	97	32.3
10 or more years	77	25.7
H-2A visa		
Yes	189	63.0
No	108	36.0
Not needed (US citizen)	3	1.0

[1] Some people speak more than one language, so totals do not equal 300 and 100%.

Table 2: Self-reported Use of Ocular Protection and Factors Preventing Ocular Protection Among Farmworkers.

Variables	Total	
	N (300)	%
Wear eye protection of any kind		
No	275	91.7
Yes	25	8.3
Type of eye protection worn[1]		
Sunglasses	14	4.7
Face shield	1	0.3
Protective glasses	12	4.0
Goggles	8	2.7
Factors preventing eye protection to be worn[2]		
Uncomfortable	141	47.0
Fogs when you sweat	102	34.0
Falls off	31	10.3
Prevents seeing well enough to do the job	156	52.0
Do not like the way it looks	18	6.0
Co-workers or friends would make fun them	14	4.7
Other reason	20	6.7
Eye protection provided by growers or contractors		
No	277	92.3
Yes	23	7.7
Would you wear protection if it was made mandatory by growers		
No	8	2.7
Yes	292	97.3

[1] Some farmworkers wore more than one type of eye protection therefore the frequency sum is higher than the farmworkers who reported wearing eye protection

[2] Many farmworkers reported more than one reason for not wearing eye protection therefore the frequency sum is higher than the farmworkers who reported not wearing eye protection

Table 3: Knowledge About Eye Health and Safety

Variables	Total	
	N (300)	%
I am well trained in preventing eye injuries		
Disagree	208	69.3
Agree	92	30.7
The rays of sun can cause cataracts		
Disagree	71	23.7
Agree	229	76.3
If I get something in my eye, like a piece of wood, I should immediately wash it with clean water		
Disagree	25	8.3
Agree	275	91.7
If I splash my eyes with chemicals, the first thing I should do is wash my eyes out with water		
Disagree	6	2.0
Agree	294	98.0
Wind, dust, and chemicals can cause eye problems		
Disagree	8	2.7
Agree	292	97.3
If I lost my safety glasses but need to do a job that is hazardous to my eyes it is important to get another pair before doing that job		
Disagree	42	14.0
Agree	258	86.0
Proper safety eye wear can be purchased at stores		
Disagree	19	6.3
Agree	281	93.7

Table 4: Perceptions and Risk Beliefs About Eye Health and Safety

Variables	Total	
	N (300)	%
Eye injuries are always avoidable or preventable when working in agriculture		
Disagree	76	25.3
Agree	224	74.7
My chance of getting an eye injury at work on any given day is very low		
Disagree	57	19.0
Agree	243	81.0
I often see my co-workers doing something that is risky for their eyes		
Disagree	151	50.3
Agree	149	49.7
I often take risks to my eyes in order to save time or to get more work done		
Disagree	161	53.7
Agree	139	46.3
Safety glasses protect the eyes when working in agriculture		
Disagree	42	14.0
Agree	258	86.0
It is important to wear safety glasses all the time while working in agriculture		
Disagree	78	26.0
Agree	222	74.0
There are many jobs in agriculture where a worker does not need to wear safety glasses		
Disagree	154	51.3
Agree	146	48.7
I think that eye protection would make me look funny		
Disagree	259	86.3
Agree	41	13.7

EPILOGUE

Finding from this study suggest that farmworkers are at risk for occupation injuries as a result of visual impairment. Majority of the farmworkers in the study have never had their eyes checked because they never thought about having them checked, cost of insurance, no reason to go, lack of transportation, or they do not have or know an eye doctor. Due to the lack of eye care visits, if impairment exists, almost all of the farmworkers perform occupational tasks with uncorrected vision. Many farmworkers reported difficulty performing specific tasks that require distance and near vision. When comparing eye examination results to self-reported vision results, responses to vision tasks did not accurately predict vision problems identified by exams. In situations where farmworkers tested to have normal vision, they were accurately able to self-report normal vision; however, in situations where farmworkers tested to have impaired vision, most farmworkers were not able to self-report that they had trouble with vision. These findings suggest that farmworkers need routine vision exams to identify problems and the reduce risk of occupational injury.

Farmworkers are also at risk for occupational injury due to the lack of ocular protection use, lack of knowledge about eye health and safety, and inaccurate perceptions and risk beliefs related to eye health and safety. Findings from the study indicate that majority of the farmworkers interviewed do not wear eye protection of any kind while performing agricultural tasks. Factors that prevented eye protection from being worn

include visual obstruction, an uncomfortable feeling, fogging up when sweating, and falling off the face. Growers or contractors not providing eye protection, despite the Occupational Safety and Health Standards, also reinforced lack of eye protection use. Farmworkers' knowledge about eye health and safety is also limited. Majority of the farmworkers reported that they are not well trained in preventing eye injuries and as a result may not take appropriate measures to protect their eyes or care for their eyes in the event of an eye injury. Farmworker perception and risk beliefs about eye health and safety also increase the risk for eye injuries. A quarter of farmworkers in this study believe that eye injuries are always avoidable or preventable and over three-quarters believe that their chances of getting an eye injury at work are low; therefore farmworkers may not use eye protection.

Findings from this study should be expanded to develop more comprehensive eye examinations that test for other eye conditions as well as develop appropriate interventions to improve farmworkers knowledge and perceptions about eye health and safety. Documentation of the lack of ocular protection use by farmworkers should encourage future health education studies targeted at encouraging use of eye protection in order to reduce the risk of eye injuries.

Strengths and Limitations

Strengths

This study has several innovations and strengths. This is among the first projects that measure visual impairment among farmworkers in a population-based sample. Existing studies have relied on self-reports or have queried only health services related to

vision. This study provides one of the first estimates of visual impairment in a farmworker population by using standardized vision screening techniques at farmworker campsites. Vision has never been widely considered as an impediment to safety behavior or as causal in unintentional injuries involving farmworkers. This study provides evidence that farmworkers do not visit eye professions to have their eyes checked and they are documented to have problems with their vision; which increase their risk for occupational injuries.

This study provides preliminary data on two important areas for development of future research. First, it provides preliminary data for visual impairment through standardized vision examinations and self-reported assessments. Second, it provides experience for assessing the feasibility of conducting field assessments of vision among farmworkers. Both types of data are essential before moving to a larger study of a broader population of farmworkers and/or more sophisticated measurement of vision and eye problems.

Limitations

1. While the Tumbling E eye chart allowed for the measurement of visual impairment at various distances, it was not a complete eye exam. Eye examinations do not always aid in determining whether or not corrective lenses are necessary for visual impairment. In order to assess for the need for corrective lenses, additional eye examinations using appropriate ophthalmologic equipment are necessary. Also, eye charts do not measure problems with peripheral vision, depth perception, and ability

to perceive contrasts. Clinical eye conditions such as eye fluid eye pressure, dryness, and whether or not the retinas are damaged were not examined in this study.

2. Questions about knowledge, perception, and risk belief on eye health and safety were dichotomized. Perhaps a dichotomization of questions was not the best approach because farmworkers seemed to overwhelmingly agree with majority of the statements suggesting that they were providing socially desirable responses to the interviewers. Also, the questions about knowledge, perception, and risk beliefs have not been previously evaluated for reliability and scaling. A qualitative assessment may have been a better technique to assess farmworker knowledge, perceptions, and risk beliefs about eye health and safety.

Future Work

Detailed eye and vision examinations beyond visual impairment testing are necessary among farmworkers in order to prevent the risk of eye problems and occupational injuries. Many eye and vision problems do not have signs or symptoms and can be difficult to detect if a routine eye examination is not conducted. Future studies need to focus on detailed eye examinations that include a patient history, visual acuity tests, visual function tests, refraction tests, eye focusing tests, eye movement assessments, and eye pressure analysis. Patient histories can document any symptoms a farmworker may be experiencing, any general health problems that may result in eye conditions, and any occupational conditions that may affect the eyes. Ophthalmologist and optometrists must conduct visual impairment tests with medical instruments as opposed to the eye chart to accurately document visual impairment among farmworkers. Also, providers

should assess various aspects of visual function in farmworkers such as depth perception, color vision, eye muscle movement, peripheral vision, and pupil response to light.

Problems with visual functioning can result in occupational injuries on the jobsite. For example, if farmworkers have trouble with depth perception, they may not be able to accurately judge distances to branches they cut and as a result may injure themselves with sharp blades. Farmworker peripheral vision is also important while farmworkers drive farm equipment. The lack of peripheral vision while driving farm machinery or cutting crops can endanger farmworkers on the jobsite. Also, vision examinations using an eye chart do not necessarily aid in determining whether or not a farmworker needs corrective lenses. Health professionals must provide farmworkers refraction testing to determine the appropriate lens power needed to account for any refractive error such as nearsightedness and farsightedness. Furthermore, astigmatisms can result in farmworkers seeing objects less sharply and clearly; posing a risk of injury in the occupational environment. Advanced vision testing can also determine how well the eyes move, work, and focus together. Measurement of eye pressures is also necessary during an eye examination in order to rule out glaucoma or other health problems. In addition, external eye examinations must be conducted to rule out conditions such as pterygium and conjunctivitis; both of which have been documented to be common among farmworkers.

This study found that farmworker knowledge, perceptions, and risk beliefs pose a threat to their eye health and safety. In additional to not seeking eye care, farmworkers do not wear ocular protection; which enhances their risk for eye problems and injuries. Findings from this study reveal that farmworker knowledge about preventing eye injuries

is limited. Future studies need to focus on training health educators to train farmworkers about eye protection use and educate them to improve knowledge about work-related injuries and ways to prevent eye injuries. While previous studies have been successful in implementing health education sessions among farmworkers, assessment of the effectiveness of eye protection use over time has not been documented well. Additional studies are necessary to collect repeated measures data over the course of one or several agricultural seasons. Also, additional surveillance efforts are necessary to document eye injuries over time in order to assess whether interventions targeting eye protection use are effective. Additionally, advocacy efforts targeting growers and contractors are necessary in order to encourage them to provide and mandate eye protection among farmworkers. The findings from this study provide a foundation for future comprehensive studies and advocacy efforts focusing on farmworker eye health and safety.

APPENXIX A. EYE EXAMINATION PROTOCOL

Eye Examination Protocol

Materials you will need:

- Snellen E distance vision chart (large long chart)
- Snellen E near vision chart with 16 inch cord attached (small chart)
- Disposable occluders (eye patches/covers)
- Measuring tape (20 feet long)
- Ruler/meter stick
- Lamp for vision tests
- Table
- Eye chart stand
- Eye chart clips and tape
- Pointer
- Extension cord for lamp
- Enlarged copy of the Snellen E near vision chart
- Piece of card stock

DISTANCE VISION TEST

Preparation:

1. Pick an exam location where the eye chart will be placed (make sure there is no glare or distracting objects in general area)

2. Set up the stand and clip the distance vision eye chart to the stand

3. Measure 20 feet in a straight line from the eye chart

4. Place ruler on the floor 20 feet away from the eye chart

5. Set up the lamp near the eye chart so that the entire chart is lit up equally (make sure that the lamp is not in the way of the participants taking the eye test). Note

to interviewer: Take care to stand on the side of the eye chart opposite of the lamp, so as to not obstruct the lighting of the eye chart.

6. It will be necessary for two interviewers to administer the distance vision test. Prior to each exam, decide who will be responsible for directing the eye exam (Interviewer #1) and who will be responsible for recording data (Interviewer #2). Interviewers may alternate roles between participants.

7. The interviewer directing (Interviewer #1) the distance vision test will need to stand next to the eye chart and explain the instructions to the participant. This interviewer will also point to each letter once the exam begins.

8. The second interviewer (Interviewer #2) will stand next to the participant 20 feet away from the distance vision chart and double check the participant's responses for accuracy. This interviewer will also record the participant's vision score on the data form and vision reporting form.

Distance Eye Exam

1. Interviewer #2: Ask the participants whether or not they are wearing contacts or if they wear glasses. If participants are wearing contacts or glasses ask them to remove them for the first test. Document on the data form whether or not they wear glasses or contact lenses before the start of the exam.

2. Interviewer #1: Test the participant to make sure he/she is able to state which direction the Es are pointing with both eyes uncovered standing near the eye chart. Give the participant examples of Es that are pointing in the each direction (up, down, left and right) to ensure that participant is able to identify each before beginning.

3. Interviewer #1: Adjust the eye chart so that the line 20/30 on the eye chart is eye level with the participant.

4. Interviewer #2: Position the participant at the 20 foot ruler that is marking the floor. The participant's heels should be aligned with the ruler.

5. Interviewer #2: Give the participant an occlude to cover the eye.

6. Interviewer #1: Explain the eye exam to the participant. (You will point to the letter on the different lines of the chart one at a time. The participant will tell you which direction the "E" is pointing.)

7. Interviewer #1: Make sure that you are standing beside the eye chart in a way that you can point to the "E's" without blocking the participant's view. Use a pointer to point to the letters.

8. Interviewer #1: Perform the following eye tests:
    - Without glasses or contacts:
        1. Right eye test with left eye covered
        2. Left eye test with right eye covered
        3. Both eyes uncovered

    - With glasses or contacts (if they wear them)
        1. Right eye test with left eye covered
        2. Left eye test with right eye covered
        3. Both eyes uncovered

9. Interviewer #1: Point at the largest letter and have the participant state the direction of the letter. If the participant answers correctly, start the eye exam at line 5 (under the green line). If the participant can read the starting line successfully (if he or she gets all the E's correct or misses only one E), keep moving down to the next line until the participant misses two E's on a line. Once the participant misses two E's, stop the test. Interviewer #1 will look to the left of the eye chart and locate the acuity number for the line on which the participant missed two E's or more. This line is considered to be failed by the participant so interviewer #2 will record the acuity number for the line above, which was read successfully.

    Note to Interviewers: In the event that the participant answers incorrectly for two or more E's on the starting line (line 5), Interviewer #1 will move up one line above the green line to test the vision. If the participant passes the first line above the green line, stop the test and record this line for the vision score. If the participant misses two or more E's, keep moving up a line until the participant is successful in passing a line. Once the participant successfully completes a line, stop the test.

10. Interviewer #2 will record the results for each test (6 total if wear glasses/contacts) that is located to the left of the chart on the data form and on the reporting form for visual acuity.

11. Interviewer #2: Highlight the visual acuity range of the participant on the reporting form for visual acuity.

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NEAR VISION TEST

Preparation:

1. Pick a quiet area that has a table and 2 chairs to perform the exam. If needed, place a table and two chairs in area.

2. Set up the lamp after the participant has taken a seat. Make sure the lamp is situated over the shoulder of the participant and their head does not block the light. Confirm that the vision test is well lit before the start of the near vision test.

3. It will be necessary for two interviewers to administer the near vision test. Prior to each exam, decide who will be responsible for directing the eye exam (Interviewer #1) and who will be responsible for recording data (Interviewer #2).

Near Eye Exam

1. Interviewer #1: Ask the participant to be seated in the chair. The chair should be positioned in an open space. The participant should sit back in the chair with their back straight. Interviewer #1 will take a seat in the chair beside the participant. Interviewer #2 will stand behind the participant with the enlarged copy of the near vision chart to ensure the accuracy of the participant's responses.

2. Once the participant is positioned, Interviewer #1 will show the participant how to hold the vision chart on the sides with both hands and how to move the card stock so it underlines the line he is reading.

3. Interviewer #1: Explain the eye exam to the participant. (They will say the direction of all the "Es" on a specific line one at a time. They will wait until Interviewer #1 says "go ahead" to begin reading a new line.)

4. Interviewer #1: Instruct the participant to remain very still during the exam. If the participant moves during the exam, stop the exam and re-measure the distance. If necessary, re-test the participant's last line to ensure accuracy.

5. Interviewer #1: Perform the following eye tests:

    - Without glasses or contacts:
        1. Right eye test with left eye covered
        2. Left eye test with right eye covered
        3. Both eyes uncovered

    - With glasses or contacts (if they wear them)

4. Right eye test with left eye covered
5. Left eye test with right eye covered
6. Both eyes uncovered

6. Interviewer #1: Adjust the chart to the appropriate distance. Measure 16 inches (the length of the cord attached to the card) from the chart to the eyes of the participant. Make sure there are no kinks or slack in the cord. Please note that this same interviewer will re-measure the distance between each test.

7. Interviewer #1: After it is clear that the participant understands the exam instructions, start the exam at the 20/50 line. Align the card stock under the 20/50 line. This will direct the participant's attention to the line under observation. It is not necessary to point to each line or letter. Interviewer #1 will need to make certain that the participant has the card stock aligned with the correct line before testing each line.

8. If the participant gets the entire line correct or misses only one E direction, you may proceed to the next line until the participant misses two E directions.

9. Interviewer #2: Once the participant misses two Es, stop! Take note of the last successful line where the participant missed one E or less (NOTE: YOU WILL NOT RECORD THE SCORE FOR THE LINE WHERE THE PARTICIPANT MISSED TWO E's). The line with 1 or less errors will be the participant's score. Look to the *right* of the card and record the number in the middle column of the card on the data form and clinic form. (NOTE: There are three columns of numbers on the right side of the chart. <u>ONLY RECORD THE NUMBER IN THE MIDDLE COLUMN.</u>)

10. In the event that the participant is unable to read the 20/50 line without one or less errors, move up one line until the participant is able to read a line with one or less errors. When backtracking occurs, the first successful line and its corresponding number will count as the participant's score.

11. It is very important for the data recorder to correctly identify the participant's score. It will be necessary to use the enlarged copy of the near vision test to follow along with the responses of the participant and identify the score he should receive for the last line he read correctly. This will ensure the accuracy of the participant's row and corresponding vision score. If at any point the score is in question retest.

12. Interviewer #2: Record results for each test (6 total if wear glasses/contacts).

13. Highlight the visual acuity range of the participant on the reporting form for visual acuity.

14. Once the data is recorded on the forms and each test is complete, throw away the used occlude.

DONE!