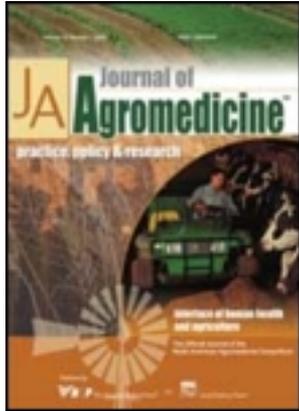


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ABSTRACT. Farmworkers face a variety of risk factors for eye injuries. Measures of eye protection use and of eye safety knowledge and beliefs are based on a survey of 300 Latino farmworkers in North Carolina. Few farmworkers report using eye protection (8.3%); most (92.3%) report that employers do not provide eye protection. Approximately 70% report that they are not trained in preventing eye injuries; 81% believe that their chances of getting an eye injury are low. Many farmworkers choose to take risks in order to save time. Interventions are needed that target farmworker knowledge and beliefs about eye safety.

KEYWORDS. Eye protection, eye safety, knowledge, farmworker, Latino, perception, risk

INTRODUCTION

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 Sunlight is a continuous exposure that is detrimental to eye health.² Farmworkers spend a significant amount of time outdoors in extreme ultraviolet light. Short-term conditions that result from

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exposure to intense ultraviolet light include eye irritation and eye sensitivity, whereas long-term conditions include cataract formation, retinal damage, and pterygium development.³ Exposure to allergens such as pollen may cause allergic reactions or abrasions to the eyes.^{1,4} Abrasions to the eye have also been documented due to thorns, stalks, vines, and bushes. Eye irritation also results from exposure to agricultural pesticides.^{1,5,6} Airborne soil and particulates that result from farming practices create environmental conditions that pose a risk to eye health. Living in housing located next to fields sprayed with pesticides provides a mechanism for exposure.^{7,8} 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.¹ Farmworkers use grinding wheels to sharpen tools, which can result 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.^{1,5} The US Occupational Safety and Health Administration reports that 90% of eye injuries and symptoms can be prevented by proper use of eye protection.⁹ Studies among Latino farmworkers have documented that use of eye protection is extremely low.^{8,10} Although these studies document low eye protection use and reasons for not wearing eye protection, farmworker knowledge, perceptions, and risk beliefs about eye health and safety were not documented. The specific aims of this analysis are first to describe eye protection use among migrant farmworkers and second to determine the knowledge, perceptions, and risk beliefs of farmworkers about eye health and safety. This information is needed to design population appropriate interventions to increase use of eye protection among farmworkers.

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.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.

The project coordinator, who is part of the research staff at Wake Forest University Department of Family and Community Medicine, and the field project manager, who is part of the outreach staff of the North Carolina Farmworkers Project, accompanied the interviewers. The field project manager assisted the interviewers to become familiar with the location of each camp and introduce them to the residents. During the introduction, the interviewers explained the purpose of the study to camp residents as a group. If camp residents reached a group consensus about participating, a census was completed that listed all workers at the camps. Farmworkers at each camp were recruited from the census list; up to six participants were randomly recruited at each camp. The sample 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 in the three study counties primarily worked on planting, cultivating, and harvesting tobacco. 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 completed a 1-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 wore sunglasses, face shields, protective glasses, goggles, or other devices to protect their eyes. A dichotomous variable for eye protection use was created. A value of 0 indicated that a farmworker did not wear any form of eye protection and a value of 1 indicated 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.¹⁴ Similarly, individual items around perception and risk belief about eye health and safety were adopted from previous studies conducted among Latino

farmworkers in the Midwest and Florida.¹⁴⁻¹⁶ Responses to the knowledge, perception, and risk belief questions were dichotomized into “disagree” and “agree.”

Descriptive statistics were calculated for the sample demographic characteristics, self-reported use of ocular protection, factors discouraging use of ocular protection, knowledge about eye health and safety, and perceptions and risk beliefs about eye health and safety. Bivariate analyses using cross-tabulations were conducted between (1) tasks performed by farmworkers and the use of eye protection, (2) type of eye protection worn with specific tasks performed, and (3) whether growers or contractors provided eye protection and the use of eye protection. An odds ratio and 95% confidence interval (CI) was computed to determine the strength of the association between whether or not growers or contractors provided eye protection and farmworker use of eye protection. Demographic covariates such as age, education, and years in agriculture that have been previously shown to be predictors for use of ocular protection were modeled in a multivariate logistic regression model to determine additional associations with ocular protection use.

All participants provided signed informed consent before data collection began. The Wake Forest University Health Sciences Institutional Review Board approved the 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 30 years or older (mean = 35.0, *SD* = 10.5). More than half (53.7%) completed no more than 6 years of education and a majority of the workers (99.7%) spoke Spanish. Over half (58.0%) of the farmworkers worked 5 or more years in US agriculture and almost two third (63.0%) were in the United States on a H-2A temporary worker visa.

In all, 275 (91.7%) of the participants reported never wearing eye protection of any kind. Of workers reporting the use of eye

TABLE 1. Personal Characteristics of Farmworkers

Personal characteristics	Total (N = 300)	
	n	%
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 ^a		
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

^aSome farmworkers speak more than one language, so totals do not equal 300 and 100%.

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). Most farmworkers who wore eye protection used it while performing various tasks in tobacco such as planting, cultivating, harvesting, picking, and priming. The only tasks for which no farmworker wore eye protection was loading, packing, and transporting tobacco.

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 coworkers would make fun of them for wearing eye protection, and 20 (6.7%) reported

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

Variables	Total (N = 300)	
	n	%
Wear eye protection of any kind		
No	275	91.7
Yes	25	8.3
Type of eye protection worn ^a		
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 ^b		
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
Coworkers or friends would make fun of 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

^aSome farmworkers wore more than one type of eye protection, therefore the frequency sum is higher than the farmworkers who reported wearing eye protection.

^bMany 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.

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 had 13.4 times greater odds (95% CI 5.1, 35.6; $p = .01$) of wearing 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 large 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 to 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.

Three quarters (74.7%) of the farmworkers 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 coworkers 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 (86.0%) agreed that safety glasses protect the eyes when working in agriculture. Approximately three fourths (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.

TABLE 3. Knowledge About Eye Health and Safety

Variables	Total (N = 300)	
	n	%
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

DISCUSSION

Agriculture is one of the most dangerous industries in the United States. Among agricultural workers in the United States, 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.¹⁷ Latino migrant farmworkers are among the most economically deprived groups in the United States, 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.^{1-7,18,19}

TABLE 4. Perceptions and Risk Beliefs About Eye Health and Safety

Variables	Total (N = 300)	
	n	%
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 coworkers 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

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 than that reported by Quandt et al.¹⁰ (1.6%) and by Forst et al.¹⁵ (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, it is uncomfortable, and it fogs up when the worker sweats. These reasons for not using eye protection are similar to those reported in previous studies.^{8,10,15}

In addition to personal factors that discourage farmworkers from wearing eye protection, many employers do not provide their workers with protective eye equipment. A majority (92.3%) of farmworkers in our study report that their grower or contractor 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 Despite OSHA mandates, regulations concerning eye safety are not adequately enforced in farm work. Although federal regulations are not always enforced on all farms, some states utilize OSHA-approved state plans to enforce mandates. States that support their own enforcement efforts generally use state funds and focus on farms with the highest injuries and illnesses.²¹ Despite the efforts by some states to protect farmworkers, it is still not guaranteed that all regulations within a state are adequately enforced due to limited finances and the manner in which states select farms for enforcement (i.e., using injury rates as a selection criteria and excluding farms with lower injury rates). If agricultural eye injuries are to be reduced, it is important that states enforce regulations and inspections on all farms regardless of selection criteria such as injury rates. States need to develop laws and regulations that supersede the federal OSHA governance, which is not adequately enforced on many farms, in order to ensure that no farms are excluded from employee protection regulations. State laws in California and Washington, for example, have been shown to be more effective than federal regulations in states that only implement federal OSHA laws pertaining to farmworker protection.²²

In addition to employers not providing protective equipment and the lack of OSHA enforcement, it also appears that many growers and contractors do not mandate the use of protective eyewear. Almost all (97.3%) of the farmworkers in this study indicate that they would wear eye protection if their employers mandated it. Although farmworkers state they would use eye protection if it were enforced, many

report not using eye protection 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 than 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. Although 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.²³ 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. Although 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.^{18,24} Even if farmworkers have access to retail stores, it is not certain whether they would be able to locate the appropriate eye protection necessary to protect the eyes while performing specific occupational tasks. Also, retail stores may not carry a variety of types of eye protection, thus limiting the farmworker's ability to purchase

the appropriate equipment. Even if the correct eye protection were available in retail stores, farmworkers face financial constraints that may prevent them from being able to purchase eye protection at high prices.

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.¹⁵ found that inconsistencies in these results are because farmworkers feel that not all job tasks are as risky as others and, therefore, farmworkers may not always use eye protection and may not feel 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.¹⁵ Audits of agricultural tasks and safety standards should be performed by a multidisciplinary team of individuals that include growers, representatives from local or state farmworker advocacy groups that serve as a liaison for farmworkers, state department of labor, and regional agencies contracted by OSHA to govern farming activities and safety standards. For example, in order to overcome OSHA's lack of enforcement of safety and inspection, in California, OSHA has delegated authority to state agencies in order to regulate and mandate audits and inspections under state laws on all farms within the territorial jurisdiction regardless of size.²²

A lack of self-efficacy for avoiding risky behavior was apparent among the farmworkers. For example, even though several farmworkers could recognize behaviors risky to the eyes among their coworkers, many farmworkers themselves chose to take risks to the eyes in order to maintain a positive relationship with their supervisors and keep their jobs. 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 choose not to wear safety eyewear in order to save time and get more work done.¹⁵

The overall findings from this study suggest a discrepancy between self-reported willingness of farmworkers to wear eye protection and the extent of provision of eye protection by the growers and contractors. This dichotomy can be overcome by implementing behavioral interventions that target employers who do not provide farmworkers eye protection. A comprehensive intervention program should include diverse activities such as increasing employer awareness of various hazards associated with farmwork, improving an employer's ability to aid farmworkers in obtaining appropriate eye protection needed for specific tasks or distributing the correct eye protection, and encouraging employer supervision and enforcement of eye protection use. Although educating employers about the benefits of providing eye protection to farmworkers and implementing behavioral interventions encouraging provisions for eye protection are important tasks, supplemental reinforcements such as regulations are necessary in order for interventions to be effective and sustainable. Enforcement activities regarding eye protection must occur at two levels: the employer level and the farmworker level. It is necessary for state agencies delegated or authorized by OSHA to regulate employers to provide or require eye protection and enforce its use. Employers need to develop strict policies on farms that mandate farmworkers to use eye protection. They must educate all farmworkers on ramifications for failure to comply with mandates and use disciplinary action to deal with noncompliance. It is recommended that behavioral interventions in conjunction with policy efforts be further

evaluated in order to assess the effectiveness of eye protection utilization and enforcement on farms.

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.¹⁴ 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 reasons for not wearing it; however, a majority, 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 in the eye. This suggests that additional studies and interventions are necessary to educate farmworkers about eye health and safety. Another limitation to this study is that the findings may not be generalizable to farmworker groups in different geographic areas where other types of specialized crops are grown. Additional studies are necessary in diverse geographic areas where crops other than tobacco are harvested in order to gain additional insight into eye protection use and knowledge and perceptions about eye health and safety among farmworkers. Collectively, the findings from this study and additional studies can be used to develop appropriate interventions for eye health and safety.

CONCLUSION

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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