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Pterygium Among Latino Migrant Farmworkers in North Carolina

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ABSTRACT. The authors describe the prevalence and severity of pterygium among Latino migrant farmworkers in North Carolina and delineate its risk factors. They selected a sample of 304 farmworkers working in eastern North Carolina in 2005. Digital photographs were taken of each farmworker, including a facial view showing the eyes. Two physicians independently rated each farmworker for the presence and severity of pterygia, with an initial intercoder agreement of 91%. Sixty-eight (23.3%) participants had a pterygium in at least 1 eye; 28 (9.5%) had bilateral pterygia. Age was significantly associated with pterygia (odds ratio = 1.07; 95% confidence interval = 1.03–1.11). Research on the causes of pterygium among farmworkers is needed. In the interim, improvements in farmworkers' preventive behaviors, such as wearing ultraviolet protective lenses and brimmed hats, are reasonable and inexpensive measures.

KEYWORDS: farmworkers, ocular effects, pterygium, ultraviolet exposure

Farmworkers face multiple hazards to their eyes, including traumatic injuries caused by tools, equipment, and plants, and illnesses caused by environmental and infectious agents, such as agricultural chemicals, dust, wind, and allergens.[1–5] Agricultural workers are also exposed to high levels of ultraviolet light, as they spend considerable time outdoors during daylight hours when ultraviolet rays are the strongest.[2,5] Short-term ocular effects of ultraviolet exposure include eye irritation, eye sensitivity, and photokeratitis.[5] Long-term sequelae include cataract formation, retinal damage, and pterygia formation. The population of farmworkers in the United States is estimated to be approximately 4.2 million, most of them Mexican.[6,7] Despite the large number of farmworkers and their exposure to occupational and environmental risk factors for eye injury and illness, little is known about the eye health of this particular population.[3–5] In this study, we are concerned with the prevalence of 1 type of eye disease, pterygium, among Latino farmworkers in North Carolina.

A *pterygium* is an elevated, superficial, external ocular mass that usually forms over the perilimbal conjunctiva and extends onto the corneal surface. Pterygia can vary from small, inactive lesions to large, aggressive, rapidly growing fibrovascular lesions that can distort the corneal topography, and, in advanced cases, can obscure the optical center of the cornea.[8] Pterygia more commonly present on the nasal conjunctiva and may extend onto the nasal cornea, although they can present temporally as well. Pterygia can become inflamed, resulting in redness and ocular irritation, and they can cause significant alteration in visual function in advanced cases. Individuals with pterygia present with a variety of complaints, ranging from no symptoms to significant redness, swelling, itching, irritation, and blurring of vision associated with elevated lesions of the conjunctiva and contiguous cornea in 1 or both eyes. Although a pterygium is a nonmalignant growth of the conjunctiva, it is not a benign condition.[8] It often causes discomfort. It has the potential to become a progressive medical condition. If left untreated,

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pterygia can eventually encroach on the visual axis or induce astigmatism, resulting in mildly to severely impaired vision.[9] The treatment for pterygia that are symptomatic or cause visual impairment is surgical excision. The excision is often accompanied by a conjunctival autograft to delay or prevent recurrence. This treatment option is expensive[10] and is often beyond the means of lower income persons, such as farmworkers. Pterygium reduces health-related quality of life by stigmatizing the individual.

The predominant risk factor for pterygium development appears to be increased exposure to ultraviolet light,[11–15] including living in subtropical and tropical climates and engaging in occupations that require prolonged outdoor activities. Although ultraviolet light exposure is believed to be the most significant risk factor in pterygium development, heredity, allergens, chemicals, and other irritants (eg, wind, dust, dirt, smoke, and air pollution) may also contribute to pterygium formation.[11] Pterygia are reported to occur in men twice as frequently as in women.[11] Patients older than 40 years have the highest prevalence of pterygia, whereas patients aged 20–40 years are reported to have the highest incidence of pterygia.[11] It is uncommon for patients to present with pterygia prior to 20 years of age. Occurrence within the United States varies with geographical location. Within the continental United States, prevalence rates vary from less than 2% above the 40th parallel to between 5% and 15% in latitudes between 28 and 36 degrees.[11,13] Internationally, the relationship between decreased incidence in the upper latitudes and relatively increased incidence in lower latitudes persists, with prevalence rates varying from 1.2% to 23.4%.[11,13,16]

Despite the risk of eye disorders among Latino farmworkers, little literature exists in which researchers addressed ocular health in the migrant farmworker population. Our analysis augments the occupational health literature regarding farmworker ocular health by describing the prevalence of pterygia among a sample of migrant farmworkers in North Carolina; describing the severity of pterygia in this population; and delineating the factors that may contribute to the development of pterygia in the studied population.

METHODS

Data were from a longitudinal surveillance study of skin disease risk factors, prevalence, and incidence among migrant farmworkers in eastern North Carolina. Data collection was completed from May through October, 2005.

Sample

We selected the sample from among all farmworkers employed in a 9-county area of eastern North Carolina served by 2 migrant clinics and 1 farmworker service agency (North Carolina Farmworkers Project, Benson; Snow Hill Clinic, Snow Hill; Harvest Family Clinic, Elm City). Our sample selection proceeded in 2 stages. First, we randomly selected 15 farmworker residential sites from the list of residential sites served by each clinic or agency (total of 45 sites). Interviewers visited the first 15 residential sites on their list and explained the project to site residents before inviting them to participate. If a site on the list was uninhabited for the 2005 season, interviewers visited the next site on the list until 15 residential sites were recruited. There were no inhabited sites at which residents refused to participate. Second, we took a census at all sites where residents gave preliminary consent to participate in the study. Interviewers recruited farmworkers residing in each site from the site census lists, with up to 7 participants recruited at each site (some sites had fewer than 7 residents). The total sample included 304 farmworkers (300 men and 4 women), all of whom were Latinos from Mexico or Guatemala.

Data Collection

The data collection included 2 components, an interviewer-administered questionnaire and a standard set of 10 digital photographs. Three teams of trained interviewers, all of whom were fluent Spanish speakers, collected the data. All interviewers attended a series of training sessions at which they were instructed on interviewing techniques, techniques for taking a standard set of digital photographs, and procedures for obtaining informed consent.

The interview questionnaire included items addressing demographic and background information (eg, age, marital status, history of work in agriculture, country of origin, education, and perceived health status). The digital photographs taken of each participant included 3 close-up images of the face and eyes (front, right profile, and left profile). Interviewers took the photographs with a Nikon Coolpix 5400 camera with an image size of 2592 × 1944 pixels and a FINE image-quality setting (compression to one fourth the size of the original). We stored the images as JPEG files on a secure server compliant with the Health Insurance Portability and Accountability Act of 1996, which was housed at Wake Forest University Baptist Medical Center. Data-collection procedures were reviewed and approved by the Wake Forest University School of Medicine Institutional Review Board.

Measures

The outcome measures for this analysis were the occurrence and severity of pterygia. We constructed 2 measures for pterygium occurrence: (1) a dichotomous measure with the values of present or absent, and (2) a categorical measure with the values none, unilateral, or bilateral. The measure of severity had the values of not present; present and touches the limbus of the cornea; present and crosses the limbus, with less than 25% encroachment; and present and crosses the limbus, with more than 25% encroachment. To construct these measures, 2 of us who are board-certified family physicians (Coates and Taylor) independently reviewed photos of the face of each farmworker in the sample. This process is consistent with standard telemedicine diagnostic procedures.[17,18]

We viewed the photographs on a 15-in. (38-cm) LCD screen with 1024 × 768 pixels and 32-bit color. Each physician rated each eye. Both physicians rated all 304 photo sets and agreed on 91% of the ratings. There were 13 cases in which there was disagreement between raters because one person rated the photo and the other could not evaluate the photo. In 8 cases, the raters disagreed about the presence of pterygia. In 4 cases, the raters agreed that pterygia were present but assigned different severity ratings. In 2 cases, 1 of the raters skipped the rating. The physicians met and viewed all of the photos for which their ratings differed and reached agreement on a final rating. For 8 individuals, the physicians agreed that they could not evaluate the photo for either eye. We did not include these 8 individuals in our analyses.

Demographic and occupational characteristics evaluated as predictors included age (in the categories 18–24 years, 25–30 years, 31–40 years, and 41 years and older for sample description), highest level of education completed (0–5 years, 6–8 years, and 9 years or higher), region of birth (Northern Mexico, Central Mexico, and Southern Mexico, and Guatemala), working with an H2A visa (yes or no; *H2A visas* are documents that allow individuals to legally enter the United States for a specified period of time, usually no more than 6 months, to be employed in agriculture), self-reported health (poor, fair, good, very good, or excellent), and seasons worked in agriculture. Most of the individuals in the sample were born in Mexico. We defined Northern Mexico to include the following states: Baja California, Baja California Sur, Chihuahua, Coahuila, Nuevo Leon, Sonora, Tamaulipas, and Durango. We defined Southern Mexico to include Campeche, Chiapas, Quintana Roo, Tabasco, and Yucatan; we included participants from Guatemala in Southern Mexico. We defined the remaining states and the Federal District as Central Mexico. We defined seasons worked in agriculture to equal the sum of years worked in agriculture in the United States plus years worked in agriculture in the farmworker's native country.

Analysis

We first described the frequency and severity of pterygia with counts and percentages. We estimated unadjusted prevalence odds ratios first to determine the associations of demographic and occupational factors with the occurrence of pterygium. Only age was strongly and precisely associated with pterygium according to the unadjusted odds ratios. The association between age and pterygium increased monotonically with age. Therefore, our modeling strategy was to investigate the possible confounding of the association between age (considered as a continuous variable) and pterygium. We estimated a full logistic regression model containing all the covariates for which we estimated unadjusted odds ratios. Next, we removed covariates from the model one at a time to examine whether their removal affected the association between age and pterygium in a meaningful way. If the removal of a variable changed the estimate of the association between age and pterygium by less than 30% (ie, less than 0.02), we considered it to be a less than meaningful change. We completed all analyses with SPSS version 14.0 (SPSS Inc., Chicago, IL).

RESULTS

The participants' mean age was 31.8 years (SD = 9.3); 26.0% of the participants were under the age of 25, and 17.2% were over the age of 40 (see Table 1). The majority of participants were born in Central Mexico (73.6%), whereas 13.5% were born in Northern Mexico and 12.8% in Southern Mexico or Guatemala. The plurality (47.6%) had completed 6 to 8 years of education, with 33.4% having completed 9 or more years and 18.9% having completed 5 or fewer years. Almost all of the participants (99.3%) spoke Spanish, with 11.8% speaking an indigenous language and 4.1% speaking English. The majority (57.4%) of the participants rated their health as good or better, and 42.6% rated their heath as fair or poor. Most (62.5%) had an H2A visa. Approximately one third of the participants had fewer than 10 seasons of agricultural experience, one fourth had 10 to

Table 1.—Sample Demographic and Occupational Characteristics: Farmworkers in Eastern North Carolina, 2005 (N = 296)

Characteristic	*f*	%	*M*	*SD*
Age (years)			31.8	9.3
18–24	77	26.0		
25–30	66	22.3		
31–40	102	34.5		
41+	51	17.2		
Region of birth				
North	40	13.5		
Central	218	73.6		
South	38	12.8		
Education (grade)				
0–5	56	18.9		
6–8	141	47.6		
9+	99	33.4		
Language spoken*				
English	12	4.1		
Spanish	294	99.3		
Indigenous language	35	11.8		
Self-rated health				
Fair or poor	126	42.6		
Good or better	170	57.4		
H2A visa				
Yes	185	62.5		
No	111	37.5		
Seasons in agriculture†			17.3	15.0
0–9	102	34.5		
10–19	76	25.7		
20+	115	38.9		
Missing	3	1.0		

*A number of participants spoke more than 1 language, so totals exceed 296 and 100%.
†Seasons show the sum of years worked in agriculture in the United States and years worked in agriculture in native country.

Table 2.—Presence and Level of Encroachment of Pterygium in Both Eyes: Farmworkers in Eastern North Carolina, 2005 (N = 296)

Encroachment	*f*	%
Not present in either eye	227	76.7
Present in at least one eye	69	23.3
Unilateral presence	41	13.9
Touches limbus	28	9.5
Crosses limbus; <25% encroachment	12	4.1
Crosses limbus; >25% encroachment	1	0.3
Bilateral presence*	28	9.5
Touches limbus	7	2.4
Crosses limbus; <25% encroachment	20	6.8
Crosses limbus; >25% encroachment	1	0.3

*Severity in worst eye is shown.

19 seasons, and more than one third (38.9%) had 20 or more seasons of experience.

There were 69 people with pterygium present in at least one eye, equivalent to a crude prevalence of 23.3% in the study population (see Table 2). Of these, 41 participants had unilateral presence of pterygium (13.9%), and 28 participants had bilateral presence (9.5%). There were 227 participants (76.7%) who did not have pterygium present in either eye. Among the 41 people with unilateral pterygium, the degree of severity was as follows: touches the limbus, 9.5%; crosses the limbus with less than 25% encroachment onto the cornea, 4.1%; and crosses the limbus with more than 25% encroachment onto the cornea, 0.3%. Among the 28 people with bilateral pterygium, the degree of severity in the eye that was rated as more severe was as follows: touches the limbus, 2.4%; crosses the limbus with less than 25% encroachment onto the cornea, 6.8%; and crosses the limbus with more than 25% encroachment onto the cornea, 0.3%.

Of the demographic and occupational characteristics evaluated, only age was significantly associated with pterygium (see Table 3). The odds ratio for age when measured as a continuous variable is 1.07 (95% confidence interval = 1.03–1.11), which indicates a 7% increase in the presence of pterygium for every additional year of age. Of the 77 participants aged 18 to 24 years, 13.0% had pterygium. Of the 66 participants aged 25 to 30 years, 16.7% had pterygium. Of the 102 participants aged 31–40 years, 30.4% had pterygium. Of the 51 participants aged 41 years and older, 33.3% had pterygium. The remaining variables (education, region of birth, H2A visa, self-reported health, and seasons in agriculture) were not significantly associated with pterygium, and they had only minimal effect on the association between age and pterygium.

Table 3.—Multivariate Models of the Association of Pterygium With Selected Demographic and Occupational Characteristics: Farmworkers in Eastern North Carolina, 2005

	Full model		Parsimonious model	
Characteristic	OR	CI	OR	CI
Age (continuous)	1.07	1.03–1.11	1.05	1.02–1.08
Education (grade)				
0–5	1.00			
6–8	0.92	0.42–2.00		
9+	0.92	0.38–2.24		
Region of birth				
North	1.00			
Central	0.77	0.34–1.76		
South	0.89	0.27–2.93		
H2A visa				
Yes	0.65	0.33–1.28		
No	1.00			
Self-reported health				
Fair or poor	1.11	0.60–2.04		
Good or better	1.00			
Seasons in agriculture				
0–9	1.00			
10–19	1.45	0.65–3.24		
20+	0.82	0.35–1.93		

Note. For farmworkers, N = 296; 4 are women and 292 are men. For the full model, N = 289 (missing data for several of the predictors reduced the sample size in the multivariate analysis from 296 to 289). OR = multivariate adjusted odds ratio; CI = 95% confidence interval.

COMMENT

Participants for this analysis are Latino farmworkers employed in North Carolina who are migrants from Mexico and Guatemala. The prevalence of pterygium in this population is 23.3%, with age being the only risk factor found to have a significant association with this disease. Lower rates of pterygium have been reported for individuals on Cheju Island, South Korea (11.6%),[19] people in New South Wales, Australia (9.6%),[20] Arabs in Israel (9.2%),[21] Eskimos in Greenland (8.6%),[22] and individuals in West Malaysia (7.4%)[23] and Copenhagen, Denmark (0.7%).[22] Pterygium prevalence rates similar to those of these Latino farmworkers have been reported among brine salt workers in India (21.0%), but not among dry salt workers (9.1%) or control subjects (9.2%) in the same study.[24] However, higher prevalence has been reported in studies conducted with Latin American populations. The prevalence reported for Lima, Peru, is 31.1%.[25] For a rural community in the central Mexican state of Tlaxcala, the reported prevalence is 41.6%.[26]

Age is consistently found to be significantly associated with the occurrence of pterygium.[11,16,22,24] Three epidemiological studies[12,27,28] conducted in Australia report a consistent pattern of increased prevalence with age; for example, the National Trachoma and Eye Health Program reported prevalence increases from 9.9% at age 40–59 years to 12.0% at age 60 years or older.[27] The study conducted on Cheju Island, South Korea, found that 4.0% of individuals aged 21 to 30 years had pterygium, compared with 15.9% of those aged 41 to 50 years, and 20.9% of those aged 61 years and older.[19] Finally, among residents of Lima, Peru, rates of pterygium were 16.5% among individuals aged 20 to 29 years,

40.0% among those aged 40 to 49 years, 45.7% among those aged 60 to 69 years, and 52.4% among those aged 70 to 79 years.[25]

The most appropriate comparison for the present analysis is the study conducted in the rural community of San José Teacalco, located in the central Mexican state of Tlaxcala.[26] The investigators attempted to recruit all residents aged 15 to 75 years, with a final sample of 1,075 individuals, or 83.5% of the target population. They reported the prevalence of pterygium as 18% of those aged 20 to 29 years but 74% of those aged 30 to 39 years, and greater than 94% of those greater than 40 years of age. These rates are higher than those found among the Mexican and Guatemalan farmworkers participating in the present study.

The high rates of pterygium reported by Tortolero and Narro[26] for their study in Tlaxcala, Mexico, by Rojas and Malaga[25] for their study of Lima, Peru, and by us in our study of Mexican and Guatemalan farmworkers, compared with much lower rates reported for most non-Latin American populations, suggest both a genetic predisposition for the occurrence of pterygium and similar environmental causes. Common genetic risk factors may be based on the Native American heritage of large proportions of the Mexican, Guatemalan, and Peruvian populations. Environmental risk for pterygium may also accrue to individuals who work outdoors and who are exposed to ultraviolet light. An increased risk of pterygium associated with increased ultraviolet light exposure has been reported in several studies.[27,29–31] A case-control study of 278 participants in Brisbane, Australia, demonstrated that people working outdoors were 4 to 11 times more likely to have pterygia than those not working outdoors.[32] A case-control study of 304 brine salt workers, 561 dry salt workers, and 304 controls in Rajasthan, India found that brine salt workers who are exposed to reflected light experience over twice the prevalence of pterygium as do dry salt workers or control subjects.[24] The association of age with the occurrence of pterygium may be a cumulative measure of ultraviolet light exposure.

The lack of occupational ocular health research among migrant and seasonal farmworkers is extraordinary. In only 2 published studies have researchers documented eye health in this population,[2,4] and in one peer-reviewed article, researchers evaluated an intervention to improve eye safety among farmworkers.[1] Given the prevalence of conditions such as pterygium among farmworkers, and the concern for eye injury,[1,3] significant effort to document and improve eye health is warranted.

The main limitations of this study are its cross-sectional design and the diagnosis of pterygium by use of photographs. The use of photographs would be expected to lead to an undercount of the prevalence of pterygium. Furthermore, our main focus was not pterygium; we designed the larger study to document occupational skin diseases among minority farmworkers. However, the present study included a large, randomly selected sample of Latino farmworkers. There was also high interrater reliability between the 2 physicians who diagnosed pterygium from the photographs.

Although eye injuries and eye health among farmworkers are important public health concerns, very few researchers have actually reported the prevalence of eye problems among farmworkers, the risk factors for eye injuries or illnesses in this population, or the level of preventive behaviors practiced in this population.[1,2] To our knowledge, this is the first study in which researchers document the level of pterygium among farmworkers in the United States, or in other immigrant Latino populations in this country. Further research on the factors that cause pterygium among farmworkers is needed so that sound prevention measures can be taken. In the interim, the high prevalence of pterygium, the potential for disablement that could result, and the effects of age as an indicator of cumulative exposure in increasing the incidence of this condition suggest that improving prevention behaviors in the form of having farmworkers wear ultraviolet protective lenses or brimmed hats are reasonable and inexpensive measures. The use of protective lenses and hats should be advocated as a sound industrial hygiene measure for this occupational group.

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