

FEATURE ARTICLE—PUBLIC ACCESS

Visual Acuity and Self-Reported Visual Function among Migrant Farmworkers

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ABSTRACT

Purpose. Visual impairment presents significant risks for occupational injuries among farmworkers, a vulnerable population with limited access to vision care. Although previous research has noted farmworkers' low lifetime experience with vision screening and high rates of complaints of eye ailments and poor vision, there have been few screening data collected to evaluate these self-reports. The objectives of this analysis are to (1) describe farmworker visual health using standardized visual acuity screening data and self-reported visual function, and (2) to compare the screening and self-report data.

Methods. Data are from a cross-sectional study of eye health among Latino migrant farmworkers in North Carolina with uncorrected vision ($n = 289$). Workers were recruited using methods to achieve a representative sample of a hard-to-reach population. Visual acuity data were collected using Snellen Tumbling E charts for nearsightedness and farsightedness. Binocular data are reported here. Interviews were conducted to obtain personal characteristics and self-assessed visual function.

Results. About 75% of farmworkers reported never having had a vision screening. Based on binocular screening, 1.7% (distance vision) and 6.9% (near vision) had moderate to severe visual impairment ($>20/40$). Farmworkers self-reported poorer visual function, compared with screening results; only 36.4% reported good or very good vision. Sensitivity of distance and near vision self-reports were 60 and 20%, respectively, but specificity was high.

Conclusions. This study confirms past reports of little vision screening among farmworkers. Visual impairment for distance is comparable to other studies of Latinos in the US, though these studies have not reported near vision. Self-reports of vision problems are not a sensitive measure of visual acuity among farmworkers. Screening is needed to identify visual impairment that can create occupational safety risks in this health disparate population.

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Key Words: Latino, farmworker, visual impairment, visual function, health disparities

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.¹⁻³ Visual impairment has the potential to increase the risk of occupational injuries in farmworkers. Workers rely on distance vision when driving vehicles or operating farm equipment. They rely on near

vision to avoid branches or other hazards when picking crops and to see hazard symbols on pesticide labels and posted warnings. Environmental conditions in the workplace such as inadequate lighting or sunlight glare may compound a farmworker's poor vision, resulting in higher risks for falls or other accidents while performing daily tasks.^{4,5} Although the risks of injury resulting from visual impairment are significant for workers in many occupations, the farmworker population is of particular interest because this industry sector has fewer safety regulations than other industries.^{6,7} Weaker occupational safety and health regulations in combination with visual impairment among this population may significantly enhance the risk of injury.

The majority of migrant farmworkers in the United States are Latino.⁷ Latinos are more likely than other groups in the US to suffer from visual impairment.⁸ In addition, Latinos have high rates of age-related illnesses including hypertension, type II diabetes, and pterygium, all of which increase the risk for visual

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impairment.^{8,9} Although visual impairment is acknowledged among the general Latino population,¹⁰ documentation among Latino migrant farmworkers is scarce.

Existing studies have relied on self-reported information to measure visual impairment among farmworkers.^{11–13} 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 specific tasks that require near vision).¹¹ Although such self-reported data have been used to document the prevalence of perceived visual impairment among farmworkers, they have not been compared to standard assessments of refractive error using standardized eye chart protocols. 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.¹³ Although the results of visual screening tests in migrant health clinics might shed some light on vision problems, few farmworkers use healthcare in the US except when injured or experiencing significant illness, due to their immigration status, low income, lack of health insurance, and the limited number of migrant health facilities.^{14,15} Therefore, there is a need to conduct vision screening among the general farmworker population to assess the prevalence of impaired vision and a need to compare self-reported vision with more objective screening measures. Understanding the prevalence of visual impairment and the association of self-report and screening measures can help clinicians prioritize the need for visual screenings in this at-risk population.

This study was designed to obtain data on vision from the general population of migrant farmworkers with uncorrected vision by gathering data at farmworker residential sites. The objectives of this analysis are (1) to describe farmworker visual function using self-report and standardized visual acuity screening data, and (2) to compare the self-report and screening data. Analyses are restricted to workers not currently using corrective lenses to describe the burden of uncorrected visual impairment in these workers.

METHODS

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

Sample

Participant recruitment and selection has been described previously.¹⁶ Briefly, the study employed an approach similar to ones used previously to recruit a representative sample in this hard-to-reach population.^{17–19} This involved two steps: (1) identifying and selecting residential camps, and (2) identifying and selecting workers within camps. Farmworker residential sites chosen for this study were located in three eastern North Carolina counties: Harnett, Johnston, and Sampson. The North Carolina Farmworkers Project, a community research partner, served all of the camps in the region and provided a list of camps to the study team.

Camps from the list were selected in simple random order. If a randomly selected camp was not occupied, 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; no more than six participants were recruited per camp to ensure that at least 50 camps were included in the study. 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. The total number of residents across 52 camps was 1076 (mean = 20.7 residents per camp); 55 were women. At the 52 camps, 457 individuals were invited to participate, and 157 refused, for a participation rate of 66% (300/457). Of the 300 recruited, 11 reported wearing corrective lenses and were excluded, for a final sample size of 289 farmworkers with uncorrected vision. Those reporting wearing corrective lenses were excluded because some could not produce their corrective lenses, and it was not known if these were prescribed for the person wearing them.

Data Collection

Data collection included an interviewer-administered questionnaire and visual acuity screening using the Snellen Tumbling E Charts for distance (20 feet) and near (16 inches) visual acuity. The questionnaire and visual acuity screening protocol were developed in English and translated into Spanish by a native Spanish speaker familiar with vernacular specific to Mexican culture and farmworker vocabulary. Five farmworkers were recruited to pilot 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 variables, 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 as very good, good, moderate, bad, or very bad. They were asked how much difficulty they had in four activities requiring far or near vision: (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, and extreme/cannot do.

Interviewers fluent in Spanish performed both monocular and binocular visual acuity screening tests using the Snellen Tumbling E Charts at distance and near. These require the worker to indicate the orientation of the E by pointing up, down, left, or right. The Snellen Tumbling E chart was chosen to eliminate the variable effect of crowding and use of various random letters,²⁰ and to eliminate literacy demands inherent in charts using letters or numbers. Original standardized charts (Precision Vision, La Salle, IL) for use in the clinical setting were used. Appropriate measures were taken to make sure that the charts were well lit and placed in locations free of distractions, light reflections, glare, or visual obstruction.

Interviewers participated in a 1-day training program conducted by investigators and project coordinators. Interviewers demonstrated mastery of executing all examination protocols in

Spanish by the end of the training and participated in the pilot testing of the examination protocol before the study. Project coordinators experienced in administering eye screenings supervised the interviewers in the field to ensure standardized protocols were followed. Vision screenings and self-reported vision questions were administered by different trained interviewers. All procedures were approved by the Wake Forest School of Medicine Institutional Review Board. Signed informed consent was obtained from each participant.

Values for distance visual impairment, based on visual acuity measurement, were categorized as none (20/10 to 20/40), moderate (>20/40 to 20/100), and severe (>20/100). Values for near visual impairment are none (20/10 to 20/40), moderate (>20/40 to <20/200), and severe (\geq 20/200). These categories were based on the literature, which frequently reports 20/40 as a threshold for visual impairment.^{21,22} Visual acuity of 20/100 has been suggested as a functional threshold for distance in occupational settings.²³

Gender and age were obtained during the interview; age was classified into one of three groups (18–29, 30–39, >40). Last eye examination was assessed by asking individuals if they had their eyes checked: never, 5 or more years ago, 1–4 years ago, or less than a year ago. Reason for not having his/her eyes checked in the past 12 months was assessed by asking if it was due to cost or insurance, not having or knowing an eye doctor, transportation or traveling distance, there was no reason to go, did not think about it, and other, where they were asked to provide a reason.

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. Self-reported uncorrected visual acuity data are described by counts and frequencies. Cross-tabulations were used to compare standardized vision screening with self-reported overall vision, self-reported distance, and self-reported near vision. Sensitivities and specificities were calculated to examine how well self-reported visual function predicts actual visual acuity measured by a standardized vision screening in this population.

RESULTS

The sample consisted of 275 men and 14 women (Table 1). Approximately two-thirds (69.2%) were between 18 and 39 years of age; the remainder were 40 years or older (mean = 34.6, SD = 10.2).

Previous Professional Eye Examination

Most (74.4%) farmworkers had never had their vision screened by a health professional, and an additional 17% had not had their vision screened in one or more years. Of those who had never had their vision screened, almost three-quarters (70.7%) had never thought about doing so; 11.4% stated that cost or lack of insurance was a barrier, and 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 vision screened. The remaining 3.3% farmworkers reported some other

TABLE 1.
Personal characteristics of farmworkers

Personal characteristics	Total	
	N (289)	%
Gender		
Male	275	95.2
Female	14	4.8
Age		
18–29 yrs	91	31.5
30–39 yrs	109	37.7
40 yrs and older	89	30.8
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*		
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

*Frequencies and percentages are based on farmworkers who responded “never” to the question “last time their eyes were checked” (n = 215).

reason for not having their vision screened such as lack of time or because the doctor spoke only English.

Visual Acuity Screening

Results of the distance vision screening (for the right and left eyes, respectively) showed that a small number of farmworkers had moderate (7, 3) or severe impairment (6, 3) (Table 2). When binocular distance visual impairment was screened, 98.3% of workers had normal vision. The near vision screening found more individuals with abnormal vision: moderate visual impairment was found in about 10% of workers for each eye and for 6.6% of the total sample for binocular vision. Few workers had severe impairment for near vision.

Age was associated with the prevalence of visual impairment (moderate and severe, combined). For binocular distance vision, 4 of 89 (4.5%) farmworkers aged 40 and older had impaired vision, compared to only 1 of 200 (0.5%) farmworkers less than 40. Likewise, for binocular near vision, 19 of 89 (21.3%) farmworkers aged 40 and older had impaired vision, compared to only 1 of 200 (0.5%) farmworkers less than 40.

Self-Reported Vision

Only about a third reported their eyesight to be very good (7.3%) or good (29.1%) (Table 3). Over half (58.8%) rated their eyesight as moderate, and the remainder as bad (3.5%) or very bad (1.4%). For self-reported distance vision tasks, difficulty recognizing a friend across the street was reported by 5.9% and difficulty watching television was reported by 19.7%. Approximately a

TABLE 2.

Uncorrected visual impairment screening results for distance and near vision (N = 289)

Variable	Right eye		Left eye		Binocular	
	N	%	N	%	N	%
Distance visual impairment*						
None	279	96.5	280	96.9	284	98.3
Moderate	7	2.4	6	2.1	4	1.4
Severe	3	1.0	3	1.0	1	0.3
Near visual impairment†						
None	260	90.0	259	89.6	269	93.1
Moderate	27	9.3	29	10.0	19	6.6
Severe	2	0.7	1	0.3	1	0.3

*Distance vision impairment ranges are: 20/10 to 20/40 = none, >20/40 to 20/100 = moderate, and >20/100 = severe.

†Near vision impairment ranges are: 20/10 to 20/40 = none, >20/40 to <20/200 = moderate, and ≥20/200 = severe.

quarter of farmworkers reported mild to extreme difficulty with near vision tasks: 23.8% had difficulty reading fine print and 25% had trouble doing work or hobbies requiring up close vision.

Comparing Visual Acuity Screening and Self-Reported Vision

For distance vision, five farmworkers were identified as having moderate to severe binocular impairment by the screening, but only three of those farmworkers identified themselves as having bad to very bad vision (sensitivity = 60%) (Table 4). Two hundred eighty-four farmworkers were identified as having no binocular impairment for distance vision by screening, and 273 rated themselves as having very good to moderate vision (specificity = 96.1%). For near vision, 20 farmworkers were identified as having moderate to severe binocular impairment by the screening, but only 4 of those farmworkers rated themselves as having bad to very bad vision (sensitivity = 20%). Two hundred sixty-nine farmworkers were identified as having no impairment in near vision by screening, and 259 rated 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 distance visual acuity screening (Table 5). In both these cases, none of the five farmworkers who were identified as having moderate to severe impairment by the distance screening 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 high. Almost all of the farmworkers who were identified as having no distance impairment by the screening rated themselves for both distance vision questions as having very good to moderate vision.

Similarly, when compared to the screening, both self-reported near vision questions had low sensitivities of 10%. For both questions, only 2 of the 20 farmworkers who were identified as having moderate to severe vision impairment by the near vision

screening rated their near vision as bad to very bad. The specificities for near vision items were high. Almost all farmworkers who were identified as having no impairment by the administered near vision screening also self-identified for both near vision questions as having very good to moderate vision.

DISCUSSION

Immigrant Latino communities in the US experience barriers to health services utilization, including language and cultural barriers, lack of healthcare insurance, unavailability of services and transportation, fears related to immigration status, and different interpretations of health and illness.^{15,17,24–27} Farmworkers, in particular, access health services only when necessary,¹⁴ and most have never visited a medical clinic or doctor for a vision screening.^{3,11} The California Agricultural Worker Health Survey (CAWHS) indicates that two-thirds of all agricultural workers have never had an eye screening,² a figure close to the 74.4% of farmworkers in this study. The most common reasons for farmworkers not having had a vision screening are similar to those reported previously.²

Latinos are the fastest growing and largest minority group in the United States. A few studies have addressed visual impairment among the Latino population^{28,29}; however, visual impairment

TABLE 3.

Self-reported uncorrected vision 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 cannot do	—	—
Difficult watching television		
None	232	80.3
Mild	43	14.9
Moderate	14	4.8
Severe	—	—
Extreme or cannot do	—	—
Difficulty reading fine print		
None	220	76.1
Mild	52	18.0
Moderate	14	4.8
Severe	—	—
Extreme or cannot 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 cannot do	2	0.7

TABLE 4.

Comparison of overall self-reported vision with results of visual impairment screening for binocular distance and near vision (N = 289)

Self-reported overall vision	Binocular visual impairment screening results					
	Moderate* or severe†		None		Total	
	N	%	N	%	N	%
Comparison with distance vision screening						
Bad to very bad	3	60.0	11	3.9	14	4.8
Very good to moderate	2	40.0	273	96.1	275	95.2
Total	5	100.0	284	100.0	289	100.0
Comparison with near vision screening						
Bad to very bad	4	20.0	10	3.7	14	4.8
Very good to moderate	16	80.0	259	96.3	275	95.2
Total	20	100.0	269	100.0	289	100.0

*Distance vision impairment ranges are 20/10 to 20/40 = none, >20/40 to 20/100 = moderate, and >20/100 = severe.

†Near vision impairment ranges are 20/10 to 20/40 = none, >20/40 to <20/200 = moderate, and ≥20/200 = severe.

studies among Latino migrant farmworkers are scarce and limited to self-reported data rather than standardized vision screening.^{11,12,28} Results from this study expand on existing data by documenting the prevalence of visual impairment beyond the inherent limitations of self-reported questionnaires.

Findings from the vision examinations indicate that a number of farmworkers experience moderate to severe visual impairment, placing them at risk for occupational injury or further vision problems if their vision remains uncorrected.^{4,30-32} The proportion of farmworkers with any visual impairment in this study is

1.7% for distance and 6.9% for near. Monocular screening results (data not shown) were similar; more farmworkers had impaired near vision than distance vision. Farmworkers with visual impairment are at a higher risk of injury because they may not recognize cues that can alert them to potential occupational and environmental hazards.^{4,5} For example, poor light during dusk or dawn hours in combination with visual impairment may result in higher risks for slips and falls while walking or operating farm equipment. The greater proportion with near vision impairment is particularly important because of the work farmworkers do in

TABLE 5.

Comparison of self-reported distance and near vision with results of binocular vision screening for distance and near vision (N = 289)

Self-reported vision: distance and near vision questions	Binocular visual impairment					
	Moderate* to severe†		None		Total	
	N	%	N	%	N	%
Because of your eyesight, how much difficulty do you have in watching television?						
Severe or extreme/cannot do	0	0	0	0	0	0
None to moderate	5	100.0	284	100.0	289	100.0
Total	5	100.0	284	100.0	289	100.0
Because of your eye sight, how much difficulty do you have recognizing a friend across the street?						
Severe or extreme/cannot do	0	0	1	0.4	1	0.3
None to moderate	5	100.0	283	99.6	288	99.7
Total	5	100.0	284	100.0	289	100.0
Because of your eye sight, how much difficulty do you have reading print?						
Severe or extreme/cannot do	2	10.0	1	0.4	3	1.0
None to moderate	18	90.0	268	99.6	286	99.0
Total	20	100.0	269	100.0	289	100.0
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/cannot do	2	10.0	0	0	2	0.7
None to moderate	18	90.0	269	100.0	287	99.3
Total	20	100.0	269	100.0	289	100.0

*Distance vision impairment ranges are 20/10 to 20/40 = none, >20/40 to 20/100 = moderate, and >20/100 = severe.

†Near vision impairment ranges are 20/10 to 20/40 = none, >20/40 to <20/200 = moderate, and ≥20/200 = severe.

picking crops where branches and other parts of plants pose risks for injuries,³ the resistance of workers to wear eye protection,^{11,12,16,33} and the frequent unavailability of eye protection.^{11,12,16}

In this study, visual impairment is more common among individuals aged 40 years and older. The overall rate of moderate to severe distance vision impairment in US adults aged 40 years and older is 4.3%²¹ comparable to the rate of 4.5% among farmworkers of the same age. Similarly, the rate for near vision impairment among farmworkers 40 and older in this study (21.3%) is comparable to the overall national rate (25%) for near vision impairment.³⁴ Rates among the 40 years and older group from this study of Latino farmworkers are higher than rates reported in a Latino population-based study. The Los Angeles Latino Eye Study (LALES) reported that 0.9% of Latinos aged 40 and older had visual impairment or blindness.²⁹ It is possible that farmworkers' poor access to health services results in more untreated disease (e.g. diabetes) that impairs vision.²⁸ Alternately, the LALES may have lower rates due to differences in the populations studied (e.g. different ethnicities, different lifetime experiences with health care).

This study adds to the current literature by comparing results from the standardized vision screening, rarely conducted on a general, non-clinic-based farm-working population, to self-reported assessment questionnaires about farmworker vision that are more commonly used in surveys of farmworker health. Self-reported assessment of distance vision (difficulty watching television) is slightly worse than that obtained by Quandt et al.¹¹ (19.7% vs. 13.0%) in a similar farmworker population. Similarly, self-reported near vision assessment also indicates 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.¹¹ (19.5% and 9.0%, respectively). Farmworkers who have difficulty performing close tasks (i.e. cutting crops with sharp blades, sharpening tools, picking orchard crops) are at risk of injuring themselves while performing day-to-day occupational activities.³³ Visual impairment can result in farmworkers receiving fewer visual cues that alert them of potential hazards.^{4,5} Inadequate perception of distances to sharp objects (i.e. branches, twigs) resulting from poor near vision can result in eye abrasions or penetrating eye wounds.^{33,35}

Assessment questions about overall vision and self-reported ability to perform various tasks that require either distance or near vision appear to be inadequate for farmworkers to report visual impairment accurately. None of the questions have a sensitivity exceeding 60%, and many of the sensitivities are 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 a vision screening. Self-reported questionnaires appear to be valid only among farmworkers who have no visual impairment. Most farmworkers do not seek healthcare due to a variety of factors including limited healthcare facilities, pressure to work, and cultural/linguistic barriers,²⁸ 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. These results contrast with those of the LALES that reports strong associations in the general Latino population aged 40 years and older

of self-reported visual functioning and visual impairment.¹⁰ The LALES included only data from individuals 40 and older, so this may account for the differences: it may be that older individuals are better at assessing their visual function deficits, and that their deficits are more severe.

This study should be interpreted in light of its limitations. The study had a participation rate of 66%. No data are available on selection bias. Farmworkers with the most severe visual impairment may have chosen not to participate in fear of losing their jobs or having their work tasks restricted. This would result in underestimating of the prevalence of visual impairment. The few workers who had corrective lenses were excluded, as there was no way to ascertain the source or appropriateness of their lenses. The vision screening was not a complete eye examination and does not measure other problems (e.g. impaired peripheral vision, depth perception, or ability to perceive contrasts) which could also increase the risk of occupational injuries among farmworkers. Additional studies using more comprehensive eye examinations are necessary to measure the prevalence of eye conditions that may impact the risk of occupational injuries. Finally, specificity and sensitivity results should be interpreted with caution, as the vision screenings identified a small number of farmworkers with vision impairment or blindness. Additional studies are necessary to establish statistically generalizable sensitivity and specificity findings. Self-reported assessments that are used to calculate sensitivity and specificity may also be biased, as farmworkers might not have reported their vision accurately if they were afraid that it might affect their job and questions about other situations of vision use might be more relevant to farmworkers' life experiences.

Nevertheless, this study is among the first to obtain standardized screening data for visual impairment from a general, non-clinic-based population of migrant farmworkers. It is also one of the only studies to compare self-reported vision assessment to measured visual impairment data among these workers. Findings indicate that some farmworkers have serious visual impairment, and they do not obtain routine eye examinations. Although vision examinations at farmworker residential sites provide an opportunity for workers to become more aware of the importance of a vision screening, future studies are necessary to assess comprehensive eye health beyond the scope of standardized vision examinations.

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REFERENCES

1. Lacey SE, Forst LS, Petrea RE, Conroy LM. Eye injury in migrant farm workers and suggested hazard controls. *J Agric Saf Health* 2007; 13:259–74.
2. Villarejo D. The health of U.S. hired farm workers. *Annu Rev Public Health* 2003;24:175–93.

3. Quandt SA, Schulz MR, Talton JW, Verma A, Arcury TA. Occupational eye injuries experienced by migrant farmworkers. *J Agromedicine* 2012;17:63–9.
4. Legood R, Scuffham P, Cryer C. Are we blind to injuries in the visually impaired? A review of the literature. *Inj Prev* 2002;8:155–60.
5. Tobis JS, Block M, Steinhaus DC, Reinsch S, Tamaru K, Well D. Falling among the sensorially impaired elderly. *Arch Phys Med Rehabil* 1990;71:144–7.
6. Sanford C. Agricultural safety in OSHA state plans. *Job Safety Health Q* 2001;13:35–6.
7. Wiggins MF. Farm labor and the struggle for justice in the Eastern United States. In: Arcury TA, Quandt SA, eds. *Latino Farmworkers in the Eastern United States: Health, Safety, and Justice*, New York: Springer; 2009:201–20.
8. Varma R, Mohanty SA, Deneen, J, Wu J, Azen SP; Los Angeles Latino Eye Study Group. Burden and predictors of undetected eye disease in Mexican-Americans: The Los Angeles Latino Eye Study. *Med Care* 2008;46:497–506.
9. Taylor SL, Coates ML, Vallejos Q, Feldman SR, Schulz MR, Quandt SA, Fleischer AB, Arcury TA. Pterygium among Latino migrant farmworkers in North Carolina. *Arch Environ Occup Health* 2006;61:27–32.
10. Globe DR, Wu J, Azen SP, Varma R, Group Los Angeles Latino Eye Study. The impact of visual impairment on self-reported visual functioning in Latinos: The Los Angeles Latino Eye Study. *Ophthalmology* 2004;111:1141–9.
11. Quandt SA, Feldman SR, Vallejos QM, Schulz MR, Verma A, Fleischer AB, Arcury TA. Vision problems, eye history, and ocular protection among migrant farmworkers. *Arch Environ Occup Health* 2008;63:13–6.
12. Quandt SA, Elmore RC, Arcury TA, Norton D. Eye symptoms and use of eye protection among seasonal and migrant farmworkers. *South Med J* 2001;94:603–7.
13. Retzlaff C, Hopewell J. *Puntos de Vista: Primary Eye Care in Migrant Health. Eye Care Needs Assessment*. Austin, TX: Migrant Clinic Network (MCN) Monograph Series; 1996.
14. Arcury TA, Quandt SA. Delivery of health services to migrant and seasonal farmworkers. *Annu Rev Public Health* 2007;28:345–63.
15. Chavez LR, Flores ET, Lopezgarza M. Undocumented Latin-American immigrants and United States health services—an approach to a political-economy of utilization. *Med Anthropol Q* 1992;6:6–26.
16. Verma A, Schulz MR, Quandt SA, Robinson EN, Grzywacz JG, Chen H, Arcury TA. Eye health and safety among Latino farmworkers. *J Agromedicine* 2011;16:143–52.
17. Arcury TA, Feldman SR, Schulz MR, Vallejos Q, Verma A, Fleischer AB, Rapp SR, Davis SF, Preisser JS, Quandt SA. Diagnosed skin diseases among migrant farmworkers in North Carolina: prevalence and risk factors. *J Agric Safety Health* 2007;13:407–18.
18. Arcury TA, Quandt SA, Preisser JS. Predictors of incidence and prevalence of green tobacco sickness among Latino farmworkers in North Carolina, USA. *J Epidemiol Community Health* 2001;55:818–24.
19. Arcury TA, Quandt SA, Preisser JS, Norton D. The incidence of green tobacco sickness among Latino farmworkers. *J Occup Environ Med* 2001;43:601–9.
20. Taylor HR. Applying new design principles to the construction of an illiterate E chart. *Am J Optom Physiol Opt* 1978;55:348–51.
21. Vitale S, Frances-Cotch M, Sperduto RD. Prevalence of visual impairment in the United States. *JAMA* 2006;295:2158–63.
22. Qiu M, Wang SY, Singh K, Lin SC. Racial disparities in uncorrected and undercorrected refractive error in the United States. *Invest Ophthalmol Vis Sci* 2014;55:6996–7005.
23. Johnson CA. Occupational psychophysics to establish vision requirements. *Optom Vis Sci* 2008;85:910–23.
24. Flores G, Abreu M, Olivar MA, Kastner B. Access barriers to health care for Latino children. *Arch Pediatr Adolesc Med* 1998;152:1119–25.
25. Iniguez E, Palinkas LA. Varieties of health services utilization by underserved Mexican American women. *J Health Care Poor Underserved* 2003;14:52–69.
26. Poss JE, Meeks BH. Meeting the health care needs of migrant farmworkers: the experience of the Niagara County Migrant Clinic. *J Comm Health Nurs* 1994;11:219–28.
27. Scott G, Ni H. Access to health care among Hispanic/Latino children: United States, 1998–2001. *Adv Data* 2004;1–20.
28. Azen SP, Varma R, Preston-Martin S, Ying-Lai M, Globe D, Hahn S. Binocular visual acuity summation and inhibition in an ocular epidemiological study: The Los Angeles Latino Eye Study. *Invest Ophthalmol Vis Sci* 2002;43:1742–8.
29. Varma R, Ying-Lai M, Klein R, Azen SP, Los Angeles Latino Eye Study Group. Prevalence and risk indicators of visual impairment and blindness in Latinos: the Los Angeles Latino Eye Study. *Ophthalmology* 2004;111:1132–40.
30. Klein BE, Klein R, Lee KE, Cruickshanks KJ. Performance-based and self-assessed measures of visual function as related to history of falls, hip fractures, and measured gait time. *The Beaver Dam Eye Study. Ophthalmology* 1998;105:160–4.
31. Zwerling C, Sprince NL, Wallace RB, Davis CS, Whitten PS, Heeringa SG. Risk factors for occupational injuries among older workers: an analysis of the health and retirement study. *Am J Public Health* 1996;86:1306–9.
32. Zwerling C, Whitten PS, Davis CS, Sprince NL. Occupational injuries among workers with disabilities: the National Health Interview Survey, 1985–1994. *JAMA* 1997;278:2163–6.
33. Luque JS, Monaghan P, Contreras RB, August E, Baldwin JA, Bryant CA, McDermott RJ. Implementation evaluation of a culturally competent eye injury prevention program for citrus workers in a Florida migrant community. *Prog Community Health Partnersh* 2007;1:359–69.
34. The Eye Diseases Prevalence Research Group. The prevalence of refractive error among adults in the United States, Western Europe, and Australia. *Arch Ophthalmol* 2004;122:495–505.
35. Mackiewicz J, Machowicz-Matejko E, Salaga-Pylak M, Piecyk-Sidor M, Zagorski Z. Work-related, penetrating eye injuries in rural environments. *Ann Agric Environ Med* 2005;12:27–9.

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