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Coccidioidomycosis knowledge and behaviors of California Hispanic farm workers

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Abstract

Objectives: (1) Describe knowledge, attitudes, beliefs and behaviors related to coccidioidomycosis (Valley fever, VF) reported by farm workers in a highly-endemic area to design and evaluate prevention messages, and (2) identify health information sources preferred by farm workers to disseminate VF prevention messages.

Methods: 119 primarily Mexican-born residents of two migrant farm labor housing centers in Kern County completed an interviewer-administered survey on VF knowledge, attitudes, beliefs and behaviors in 2017.

Results: The 73% of participants aware of VF demonstrated a knowledge score of 53%. Over 90% erroneously believed VF was associated with pesticide exposure; approximately two-thirds believed that wearing a bandana mask was protective. Over half of respondents believed that VF was contagious, could be contracted from contaminated food or water, and caused gastrointestinal symptoms. Seventy-five percent of those aware of VF expressed concern about becoming infected because of where they lived and working outdoors. Working outdoors in dusty conditions was the most commonly reported risk-associated work practice. Among 67 participants reporting use of respiratory protection, 94% indicated wearing a bandana; most male participants did not wear face coverings in dusty conditions. The most frequent protective work practice was wetting soil. Preferred sources of health information included television; family, friend or co-worker; healthcare provider; and radio.

Conclusion: Farm workers reported multiple risk factors for VF. Results identified several areas of poor knowledge, risk behavior and preferred channels of prevention messages. Important protective behaviors are not under the control of farm workers; engagement with employers is essential.

Keywords

coccidioidomycosis; Valley fever; knowledge; attitudes; beliefs and behaviors; prevention; farm workers

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Introduction

California's San Joaquin Valley is of great economic importance due to its agricultural production [1]. The area is endemic for *Coccidioides immitis*, the fungus that causes San Joaquin Valley fever (VF). In 2019, California reported 9,004 new VF cases, the highest number since 1995 [2], when California instituted mandatory case reporting [3]. That year, Kern County reported 3,371 new cases (368 per 100,000), a 193% increase from 2013 and the highest county incidence in California [2]. Counties reporting ≥20 annual VF cases per 100,000 population are considered "highly endemic" [4].

VF surveillance data likely underestimate the true case number by a factor of 6 to 14 [5]. VF is mild and self-limited in most cases. Persons with mild disease often do not see a doctor or complete a VF test, particularly if they lack medical insurance or paid sick leave. Those seeking medical attention are often misdiagnosed [6]. Migrant workers may seek care in non-endemic locations where clinicians are unfamiliar with VF.

The disease burden of VF among farm workers, who are predominantly Hispanic [7], is poorly understood. Disease-reporting forms often lack race/ethnicity [2] and occupational [8] data. From 2013-2019, race/ethnicity data were available for approximately two-thirds of California VF cases [2]. Of those, 47% reported Hispanic origin [2] compared to 39% of the total population [9]. Agricultural workers in Kern County are potentially at elevated VF risk from occupational dust exposure [8], diabetes [10-12], low socioeconomic status, reduced access to health care [7], and inadequate risk and prevention education.

Occupational outbreaks of VF in California have been documented among archeologists [13], film crews [14], solar power farm construction workers [15-17], roadway and construction workers [18,19], and prison employees [20]. Studies of VF outbreaks have identified work-related risks: absence of dust-suppression measures, open-cab equipment, absence of mask or respirator use, being in a dust cloud or storm, working in a trench, and traffic dust on dirt roads [8]. Although point-source outbreaks among agricultural workers have not been reported, agricultural workers in endemic counties of California are considered at-risk due to outdoor work in dusty conditions [8]. California Workers' Compensation data from 2000 to 2007 showed the highest rates of VF-related claims among farming, fishing and forestry occupations (1.24 per 100,000 civilian workers ages ≥16 years) [18].

California Assembly bill AB203 requires that construction employers performing soil-disturbing work in VF-endemic areas provide effective employee awareness training [21]. AB203 does not cover agricultural workers. The Occupational Health Branch (OHB), California Department of Public Health (CDPH) has published educational material to reduce work-related VF among construction workers, wildland firefighters, and oil and gas, ranch, agricultural and mineworkers [22]. OHB's risk-reduction recommendations include soil wetting for dust control, wearing fit-tested N95 or greater filtration respirators, stopping work when dust or wind is excessive, and hygienic measures to prevent taking home potentially infectious dust [4]. Personal hygiene recommendations are based on findings

from OHB's worksite outbreak investigations, published studies and industrial hygiene best practices, and scientific knowledge on *Coccidioides* spores and other airborne particles [20]. They include providing a clean area to shower or wash up after work, requiring a change of clothes before leaving work, boot-cleaning stations, and washing off tools and equipment [4].

We report here the results of a VF knowledge, attitudes, risks, and behaviors assessment among migrant Hispanic farm workers residing in seasonal housing centers in Kern County, CA. We also identify favored sources of health information.

Methods

Study Design

This is a cross-sectional study among California Hispanic farm workers in Kern County, CA. Data collection occurred from June to November 2017.

Study Sites

Data were collected from residents of the Migrant Farm Labor Centers in the towns of Arvin and Shafter, located at the southern end of California's Central Valley. The Kern County Housing Authority administers these government-supported Migrant Housing Centers (MHCs), which open in May and continue operating for about six months. Each MHC consists of 88 households with two to four bedrooms. Residency is restricted to seasonal farm laborers residing ≥50 miles from the MHC during the remainder of the year. Residents are required to have work authorization and seasonal contracts with a local grower. With permission from the Kern County Housing Authority, we met with MHC managers, who agreed to support the study. Recruitment fliers posted at approved locations in each MHC invited farm workers to participate in a VF survey without describing or defining VF.

Sample Selection

We used a random number generator to select a group of 10 households in each MHC. Once all 10 households in the group were contacted (i.e., at least one adult agreed to interview, all qualified residents in the household declined participation, or no contact was made after five attempts), a new group of 10 households was randomly selected from the remaining households. We attempted to recruit a maximum of two participants per household. Once an interview was scheduled, three attempts were made to complete the interview. Sampling by groups of 10 continued until at least 50 participants were recruited and interviewed in each MHC.

Inclusion Criteria

Farm workers ≥18 years of age residing in the MHCs were eligible for participation if they claimed Hispanic or Latino origin, worked in local outdoor agriculture at least one month in the last year, and provided verbal informed consent to complete an interviewer-administered survey in English or Spanish. The University of California Davis Institutional Review Board approved the study (UCD IRBNet ID 747508).

Interview Procedure

Bilingual, bicultural interviewers conducted individual interviews lasting approximately 45 minutes either in participants' homes or in a private outdoor area of the MHC. If the participant had never heard of VF before the study, items addressing knowledge, attitudes, and beliefs were excluded. Participants received a $15 gift certificate at a local department store.

Survey Instrument

Interview content was primarily derived from a 2015 VF knowledge, attitudes and behaviors telephone survey in Kern County, a survey prepared by the CDPH for a 2014 solar farm construction workers' outbreak investigation [15], lay informational documents from the California Departments of Industrial Relations (www.dir.ca.gov) and Public Health (www.cdph.ca.gov), the UC Davis MICASA farm labor survey [23], and a contemporaneous case-control study survey of occupational coccidioidomycosis risk factors in Kern County Hispanic farm workers [24].

The questionnaire included VF-related knowledge (15 items); attitudes (5 items); agricultural tasks and work practices, including risk-associated (5 items) and protective (8 items) behaviors; health history (8 items); and health information sources (15 items). We generated indices for knowledge (percent correct responses of 15 items; range 0-100%) and attitude (sum of 5 items reported as reasons for VF concern; range 0-5). Using the sum of ordinal numbered five-level Likert responses for frequency (0=Never, 1=Rarely, 2=Half time, 3=Most of the time, 4=Always), we constructed indices incorporating five risk-associated behaviors (working outdoors, working in dusty conditions, working in trenches, digging with shovel, and driving tractors; range 0-20) and eight protective behaviors (stopping work in dusty conditions, wetting the soil in dusty conditions, mask or respirator use in dusty conditions, washing hands with soap and water prior to lunch, washing hands with soap and water at end of shift, changing clothes at work at shift's end, changing clothes on arriving home after work, showering at home after work; range 0-32). We collected demographic information and outdoor agricultural work history with job start and end dates for the preceding year, weekly hours, outdoor work frequency, crop or commodity, tasks, and subjective dust exposure. We characterized separate jobs according to dates worked in a specific crop, location, employer, and task. Participants reporting any work-related respiratory protection selected mask or respirator type used from photographs.

Data Management and Analysis

Twenty-five percent of questionnaires were randomly selected for independent double entry, excluding the prior-year job data. Those files were compared for discrepancies, which were checked against the coded hard copy of the questionnaire and corrected. We identified and corrected a single entry error among 126 variables per questionnaire (3780 total data fields; error rate < 0.03%).

Data were analyzed using Stata 15.1 (College Station, TX). Distributions of continuous variables were summarized with either mean and standard deviation (for approximately bell-shaped distributions) or median and interquartile range (IQR). Categorical variables

were summarized as frequencies and percentages within each category. Group comparisons utilized Fisher's exact test for non-ordinal categorical variables and the Kruskal-Wallis test for continuous and ordinal categorical variables. We used the Spearman rank correlation coefficient (r_S) to assess correlations between indices for knowledge, attitudes, risk-associated and protective behaviors, and ordinal Likert scale frequencies for individual work practices. We did not adjust for multiple comparisons.

Results

Sample

We interviewed participants in 84 (82%) of 102 households contacted. From an original sample of 125 persons, six (4.8%) lacked ≥1 month prior agricultural work experience in the Central Valley in the last 12 months and were deemed ineligible. The final sample comprised 119 persons (65 in Shafter from 25 single-participant households and 20 two-participant households; 54 in Arvin from 20 single-participant households and 17 two-participant households).

Demographic Characteristics

Median age was 43.3 years. Nearly 90% of participants were born in Mexico, predominantly in Michoacán and Guanajuato (Table 1). Most participants first entered the US in their late teenage years; the median age at first residence or work in Kern County was 20 years. Over 90% reported speaking Spanish at home. Six reported speaking Purhépecha, a language indigenous to Michoacán, Mexico. All but one interview were conducted in Spanish. Participants reported a median educational level of seven years and median annual income category of $15,000 - $20,000. Median annual income category was lower for women compared to men (Kruskal-Wallis test, p = 0.01); men and women did not differ statistically for other characteristics listed in Table 1.

Occupational Characteristics and Behaviors

Median time working in outdoor agriculture fell in the 16-to 20-year category (Table 2). During the previous 12 months, 92% reported previously working a second job in outdoor agriculture, 69% a third job, 40% a fourth job, and 20% a fifth job. Eighty-eight percent of participants reported Kern County as their current primary work location, and 95% reported always working outdoors. Nearly 90% of participants worked in grapes; other crops included blueberry, watermelon, almond, pistachio, cherry, and orange.

Work tasks differed by gender (p = 0.02, Fisher's exact test, Table 2); women were more likely than men to engage in outdoor produce packing (46% vs. 28%). Nearly 50% reported a second task in their current job; 36% reported working in a second location, and 15% reported working in a third location. Of the 110 participants reporting outdoor agricultural employment immediately prior to their job at the time of interview, nearly 85% of those preceding jobs were in grapes; 48% worked in the Central Valley, and 45% worked in Riverside County, approximately 200 miles southeast of Kern County.

Working outdoors in dusty conditions showed the highest mean frequency score among risk-associated work practices (between “most of the time” and “always”, Table 3). Digging with a shovel, work in ditches or trenches, and tractor driving were uncommon, especially among women. The summary risk index was similar for men and women, but the protective-behaviors index was significantly more favorable among women (20.9 vs. 18.7, p = 0.009). The most frequent protective behaviors were related to personal hygiene. The most frequent protective work practice was wetting soil to limit dust, with mean frequency between “half the time” and “most of the time”. Mean frequency for stopping work because of high dust levels was reported between “never” and “rarely”. Use of respiratory protection in dusty conditions was most common among women (mean frequency: “most of the time”) and rare among men (p=0.0001, Kruskal-Wallis test); this pattern was observed in all crops and tasks in which both men and women worked. Among 67 participants reporting use of respiratory protection, 94% indicated using a bandana mask. The protective-behaviors index showed a weak negative correlation with age (r_s −0.26, p = 0.02).

Coccidioidomycosis Knowledge, Attitudes and Beliefs

Among 87 persons (73.1%) aware of VF, the median percent correct for 15 knowledge items was 53% (Table 4). Over 80% were aware that VF was related to dust exposure, typically presented with cough, fever, and fatigue, and could rarely be fatal. Over two-thirds correctly understood that wearing a respirator was protective. Among incorrect beliefs, over 90% associated VF with pesticide exposure; 63% believed that wearing a bandana mask was protective; and more than half of respondents believed that VF was contagious, could be contracted from contaminated food or water, and caused gastrointestinal symptoms.

The attitude index among respondents reporting VF awareness showed a median of three of the five listed reasons for VF concern (Table 4). Respondents’ agreement with each area of concern ranged from 74% (lack of health insurance) to 80% (cannot afford to miss work). The attitude index was weakly correlated with knowledge score (r_s +0.26, p = 0.02), but not with risk-associated or protective-behaviors indices, age, sex, birthplace, income, or duration of work in Kern County.

Health Information Sources

Approximately half of participants with prior VF awareness learned first from someone with a history of VF, or that case’s family member (Table 5). The respondent’s family, friend or co-worker, and television were the next most reported sources of first information about VF.

Preferred sources of health information included television; family, friend or co-worker; physician or other healthcare provider; and radio (Table 6). Women were more likely than men to prefer physicians or healthcare providers as health information sources (69% vs. 42%; p = 0.003, Fisher’s exact test); men and women were otherwise similar in their preferences.

Discussion

This paper reports VF knowledge, attitudes, beliefs and behaviors among Hispanic migrant farm workers residing in two Migrant Housing Centers in Kern County, California. Nearly

three-fourths of study participants were aware of VF; of those, 8% reported a personal diagnosis of VF, and over three-quarters were aware of its basic clinical features and association with dust exposure. However, the median VF knowledge score was only 53%. Important misconceptions included beliefs that VF (1) was associated with pesticide exposure or contaminated food or water, (2) caused gastrointestinal symptoms, (3) was transmissible person to person, and (4) was prevented by bandana masks. Erroneous beliefs can lead to inappropriate, ineffective prevention behaviors.

Self-reported risks, behaviors and working conditions support the need for risk-reduction interventions for this population. Eleven percent of study participants reported a physician diagnosis of diabetes, placing them at higher risk for severe VF [11]. Participants reported income in the range of the 2017 federal poverty guidelines of $16,240 for a household of two and $20,420 for a household of three [25]. Although only a few participants reported high-risk activities, most reported working long hours (median hours/week=48), and 95% reported always working outdoors, often in dusty conditions.

Women were significantly more likely than men to use respiratory protection, primarily a bandana mask, in dusty conditions. This illustrates concerning patterns with significant gender differences. *Coccidioides* arthroconidia tend to be slightly larger than 2.5 μm [26]. Although no data directly addressing Coccidioides arthroconidia filtration by bandana masks exist, a parallel may be drawn from Mueller et al. findings with similarly-sized volcanic ash, for which a single, double and triple layer of bandana material were demonstrated to block 29%, 31% and 40% of $PM_{2.5}$, respectively [27]. In contrast, negative-pressure half-mask air-purifying respirators equipped with N95, N100, or P100 filters reduce the average arthroconidia concentration to one tenth of the ambient concentration [18]. However, respirators have lower breathability and may cause discomfort after hours of wearing [28], particularly in the hot conditions of the San Joaquin Valley. These characteristics of the N95 respirator, and their relative expense, pose barriers to widespread adoption.

Occupational and public health agencies face a dilemma between promoting bandana use by farm workers (knowing it provides some limited filtering efficiency) and use of more-efficient respiratory protection, e.g., N95 respirators (knowing few farm workers will use them). Most male study participants reported not wearing a mask or respirator in dusty conditions. In view of the greater acceptability of bandanas among farm workers, promoting the consistent use of triple-layer bandanas as opposed to the common use of double-layer bandanas as a harm-reduction measure may afford a useful degree of population protection [27]. Given the low dose of inhaled arthroconidia required to cause infection [29], a concern with this approach is inadvertently promoting the belief that bandanas provide adequate protection, and that more-efficient respiratory protection (e.g., N95 respirators) is unnecessary. Involving employers in efforts to increase efficient respiratory protection use, e.g., providing respirators or incentives for their use, may improve uptake.

Farm workers' VF-related concerns included inability to take off work when ill, lack of medical insurance, working with pesticides, and living and working in an endemic area. The inability to take time off work or afford medical care limit farm workers' access to diagnosis and treatment. In addition, farm workers have little direct control over work practices that

can mitigate risk, e.g., stopping work under excessively windy or dusty conditions, soil wetting, and OHB-recommended hygiene measures.

Study participants demonstrated a similar level of VF awareness (73%) as that observed for participants on the 2016–2017 California Behavioral Risk Factor Surveillance System survey (BRFSS) residing in high-incidence regions (71.7%) [30]. However, three-quarters of study participants were aware that they lived in a high-incidence area, as compared to only 33.2% of BRFSS participants residing in high-incidence areas [30]. Improved awareness can drive personal behavior change and provide impetus for changing work practices under control of the employer, if accompanied by actionable behavior messages and removal of barriers to behavior change [31].

The most common sources for first learning about VF were persons who had contracted VF or family members of such persons (40%), personal VF diagnosis (8%), or from a co-worker, friend or family member (23%). Thus, peers and family members with direct or indirect VF experience provided initial information about VF to the majority of participants. As many participants prefer to receive health information from friends, family members or co-workers, preparing farm workers diagnosed with VF and their family members as informal peer health educators may encourage effective prevention and healthcare-seeking behaviors, such as requesting a test for VF when presenting with VF symptoms, which has been shown to facilitate earlier diagnosis and appropriate treatment [32].

Preferred sources of general health information included television; friends, family members, or co-workers; physicians; and radio. Television as a medium for educational purposes is likely to be much less cost-effective than radio [33]. VF education may be delivered by radio in the fields. Over half of participants, particularly women, cited healthcare providers as preferred sources of health information; none reported healthcare providers as their first VF sources. This highlights an outreach opportunity: medical providers serving farm workers in endemic areas should include VF discussion and educational materials as standard practice.

Over one-third of participants reported place of employment as a preferred source of health information. California's AB203 requiring VF prevention and early diagnosis education for construction workers in endemic areas [21,22] should be extended to farm workers.

Study strengths include its focus on a large and important at-risk population in one of the nation's most highly endemic areas for VF [6]. Study instruments were developed using surveys from prior investigations with similar populations. Our bilingual, bicultural interview team shared language and cultural characteristics with the target population, contributing to our acceptance in the community. The sample is gender-balanced, facilitating comparison between men and women and development of focused preventive health messages.

The major limitation of the study is its small scope, weakening generalizability. Many characteristics of this sample are similar to those described in the 2015-2016 National Agricultural Workers Survey [7]. Farm workers accessed from other locations that lack experience in endemic VF areas may respond differently to questionnaire items in

unpredictable ways. Farm workers without the pre-arranged employment and housing available to our study participants may differ in assigned tasks with varying VF exposure risk as well as demographic and health characteristics contributing to overall risk. However, these differences are not knowable without further study inclusive of a wider spectrum of farm workers. Finally, we were unable to validate survey responses with objective outcomes or corroboration. Reporting bias may arise, for example, if persons knowledgeable about VF underreported high-risk behaviors to avoid stigma. We observed no significant correlation between knowledge score and the preventive behaviors index ($r_s = -0.03$, p=0.78) and consider this bias unlikely.

Conclusion

Hispanic farm workers in California's Central Valley are at risk for VF and are ill-equipped with knowledge and protective practices for this serious occupational disease. Study findings should be used to develop, disseminate and evaluate VF occupational health messages among at-risk farm workers using favored communication channels. These messages should focus on a variety of adaptation behaviors, rather than avoidance behaviors, and include the target audience in message content development and dissemination, with secure funding to provide sustained messaging [31]. Messaging should reinforce important facts and correct widespread misconceptions such as the role of pesticides and mode of transmission. Further study should address barriers to mask or respirator use, especially among men.

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Data availability statement:

Requests for data supporting the results or analyses presented in this paper can be made directly to the manuscript's authors.

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Table 1.

Selected Sociodemographic and Health Characteristics among Migrant Hispanic Farm workers, Kern County, CA 2017

Characteristic	Total (n=119)	Women (n=59)	Men (n=60)
Age [y]			
Median (IQR[1])	43.3 (32.7, 53.9)	37.7 (32.9, 49.8)	43.4 (31.6, 56.1)
Country of Origin [n (%)]			
Mexico	105 (88)	55 (93)	50 (83)
US	14 (12)	4 (7)	10 (17)
Mexico State of Origin [n (%)]			
Michoacán	37 (31)	22 (37)	15 (25)
Guanajuato	21 (18)	12 (20)	9 (15)
Sinaloa	10 (8)	3 (5)	7 (12)
Nuevo León	8 (7)	4 (7)	4 (7)
Other State	29 (24)	14 (24)	15 (25)
Age of first USA entry [y]			
Median (IQR)	18 (11, 22)	17 (13, 23)	18 (8, 21)
Age first lived in Kern County [y]			
Median (IQR)	20 (16, 25)	21 (16, 25)	20 (17, 26)
Years lived or worked in Kern County [n (%)]			
≤ 5 y	29 (24)	17 (29)	12 (20)
6-10 y	25 (21)	12 (20)	13 (22)
11-20 y	29 (24)	15 (25)	14 (23)
>20 y	35 (29)	14 (24)	21 (35)
Years of education			
Median, IQR	7 (6, 12)	6 (6, 12)	8 (6, 12)
Current Household U.S. Annual Income [n (%)]			
≤ $6,000	14 (12)	12 (20)	2 (3)
$ 6,001 - $12,000	27 (23)	12 (20)	15 (25)
$12,001 - $15,000	11 (9)	6 (10)	5 (8)
$15,001 - $20,000	12 (10)	5 (8)	7 (12)
> $20,000	39 (33)	14 (24)	25 (42)
Not stated	16 (13)	10 (17)	6 (10)
Self-reported Medical History [n (%)]			
Diabetes	13 (11)	7 (12)	6 (10)
Hypertension	11 (9)	8 (14)	3 (5)
Asthma	7 (6)	5 (8)	2 (3)
Valley fever	7 (6)	5 (8)	2 (3)
Hypercholesterolemia	4 (3)	2 (3)	2 (3)
Current smoker	4 (3)	0 (0)	4 (7)

[1] interquartile range

Table 2.

Recent Agricultural Work History among Migrant Hispanic Farm Workers, Kern County, CA 2017

Characteristic	Total (n=119)	Women (n=59)	Men (n=60)
Years in outdoor agriculture [n (%)]			
≤ 5 y	17 (14)	9 (15)	8 (13)
6-10 y	23 (19)	12 (20)	11 (18)
11-15 y	12 (10)	5 (8)	7 (12)
16 – 20 y	21 (18)	14 (24)	7 (12)
>20 y	45(38)	18 (31)	27 (45)
Weeks worked at current job [median (IQR)]	7.8 (4, 13)	6 (4, 13)	9.1 (4, 14)
Hours per week at current job [median (IQR)]	48 (48,51)	48 (48,51)	48 (48, 54)
Crop in current job [n (%)]			
Grape	105 (88)	55 (93)	50 (83)
Other	14 (12)	4 (7)	10 (17)
Primary task in current job [n (%)][1]			
Pack produce (outdoors)	44 (37)	27 (46)	17 (28)
Harvest produce	39 (33)	19 (32)	20 (33)
Remove leaves	16 (13)	8 (14)	8 (13)
Trim tips & un-bunch grape clusters	6 (5)	4 (7)	2 (3)
Operate tractor	3 (3)	0 (0)	3 (5)
Other outdoor tasks	11 (10)	1 (2)	10 (17)

[1] p = 0.02, df = 5. Fisher's exact test for men vs. women contrast

Table 3.

Agricultural Tasks and Behaviors Affecting Risk of Coccidioidomycosis in Current Job among 119 Migrant Hispanic Farm Workers, Kern County, CA 2017

Task: How often do you …	**Mean Weighted Frequency Score[1]**	
	Women (n=59)	**Men (n=60)**
Risk-associated behaviors		
… work outdoors?	4.0	3.8
… work when lots of dust is generated?	3.2	2.8
… dig with a shovel?	0	0.2
… work in a ditch or trench?	0.1	0.2
… drive a tractor?	0	0.5
Risk index[2]	3.2	3.6
Protective work behaviors		
… stop work because of dusty conditions?	0.3	0.4
… wet soil in dusty conditions?	2.7	2.7
… use a mask or respirator in dusty conditions?[3]	3.1	0.6
… wash hands with soap and water before lunch?	3.7	3.7
… wash hands with soap and water at end of shift before leaving work?	3.3	3.3
… change clothes at work before leaving at end of shift?	0.6	0.6
… change clothes on arriving home after work?	3.4	3.8
… shower when you get home after work?	3.8	3.8
Protective behaviors index[4,5]	20.9	18.7

[1] 0=Never, 1=Rarely, 2=Half time, 3=Most of the time, 4=Always

[2] Risk index is the sum of the ordinal Likert scale frequency score values for the five risk-associated work behaviors shown in the table (range 0-20)

[3] p = 0.0001, Kruskal-Wallis test for men vs. women

[4] Protective behaviors index is the sum of the ordinal Likert scale frequency score values for the eight protective work behaviors shown in the table (range 0-32)

[5] p = 0.009, Kruskal-Wallis test for men vs. women

Table 4.

Coccidioidomycosis Knowledge[1] and Attitudes among 87 Migrant Hispanic Farm Workers with Prior Awareness of Valley Fever, Kern County, CA 2017

Statement	Correct Response	Percent Correct
Knowledge		
1. VF causes fever, cough, and fatigue.	True	86
2. You can catch VF by breathing dust from dirt that has a fungus living in it.	True	85
3. You are more likely to catch VF if you work or live around a lot of dust.	True	85
4. In rare cases, VF can be fatal.	True	83
5. Valley fever causes muscle aches.	True	79
6. Wearing a respirator helps to protect against VF.	True	69
7. VF causes weight loss.	True	67
8. Wetting soil to keep dust down helps to protect against VF.	True	54
9. You can catch VF from someone sick with VF.	False	46
10. Wearing a bandana helps to protect against VF.	False	37
11. VF usually causes few or mild symptoms.	True	36
12. You can catch Valley fever from contaminated food or water.	False	28
13. Valley fever causes diarrhea.	False	16
14. Valley fever causes nausea and vomiting.	False	9
15. You can catch VF from being exposed to pesticides.	False	9
Summary knowledge score [percent correct (IQR)]		53 (47, 67)
Attitudes		
I am very concerned that I might get Valley Fever because…		Respondents in agreement (%)
… I can't afford to miss work.		80
… I work with pesticides.		79
… of the area where I live.		75
… I work outdoors.		75
… I don't have health insurance.		74
Number of concerns endorsed [median (IQR)]		3 (0,5)

[1] sorted by descending order of percent correct

Table 5.

Source of First Valley Fever Information[1] among 87 Migrant Hispanic Farm Workers with Prior Awareness of Valley Fever, Kern County, CA 2017

"I first heard about Valley fever from…" [n (%)]	**Total (n=87)**	**Females (n=43)**	**Males (n=44)**
Someone who had Valley fever, or their family member	42 (48)[2]	22 (51)	20 (45)
Family, friend or co-worker	20 (23)	9 (21)	11 (25)
Television	16 (18)	9 (21)	7 (16)
Radio	4 (5)	0 (0)	4 (9)
Employer or supervisor	2 (2)	0 (0)	2 (5)
Brochures, fliers, handouts	2 (2)	2 (5)	0 (0)
Community, church or school meeting	1 (1)	1 (2)	0 (0)

[1] sorted in decreasing order of frequency reported

[2] included 7 individuals (8%) with personal history of VF

Table 6.

Preferred Health Information Sources[1] among Migrant Hispanic Farm Workers, Kern County, CA 2017

Preferred Source of Information [n (%)]	Total (n=119)	Females (n=59)	Males (n=60)
Television	86 (72)	43 (73)	43 (72)
Family, friend, or co-worker	70 (59)	34 (58)	36 (60)
Physician or other healthcare provider[2]	66 (55)	41(69)	25(42)
Radio	53 (45)	27 (46)	26 (43)
Place of employment/work	44 (37)	23 (39)	21 (35)
Internet sites	26 (22)	10 (17)	16 (27)
Grocery or drugstores	19 (16)	9 (15)	10 (17)
Community lectures or presentations	17 (14)	6 (10)	11 (18)
Newspaper or magazine	15 (13)	8 (14)	7 (12)
Lay health educator (*promotora*)	13 (11)	5 (8)	8 (13)
School, college, place of education	11 (9)	8 (14)	3 (5)
Church or religious group	7 (6)	3 (5)	4 (7)
Labor union representative, or community group member	5 (4)	2 (3)	3 (5)
Traditional folk healer (*curandero*)	3 (3)	2 (3)	1 (2)
Other	14 (12)	7 (12)	7 (12)

[1] sorted in descending order of frequency reported

[2] p = 0.003, Fisher's exact test