The California Agricultural Workers Health Survey

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ABSTRACT. *The California Agricultural Workers Health Survey was a statewide cross-sectional household survey of 970 hired farm laborers. Randomly selected participants residing in randomly selected dwellings were recruited in seven communities representing all of the state's agricultural regions. Participants were interviewed in their preferred language by professional staff. The response rate was 83%. The comprehensive interview included self-reported health conditions, doctor-reported health conditions, work history, workplace health conditions, field sanitation, and work-related injuries. A farm workplace injury during the twelve-month period prior to the interview was reported by 6% of male workers (95% CI: 4% - 8%) and 2% of female workers (95% CI: 1% - 3%). Significant numbers of both male (41%) and female (40%) workers reported persistent pain (every day for more than one week) in the back, neck, knees, shoulders, hands, feet, or multiple body parts. The number of body parts in which female workers reported persistent pain correlated with increased years of U.S. hired farm work (Spearman $r = 0.24$, $p < 0.01$). Direct contact with pesticides from being sprayed or drifted upon among both male and female workers was associated with multiple workplace health conditions such as irritated, itchy, or water eyes (male: OR 2.9, 95% CI: 1.6 - 5.0; female: OR 13.8, 95% CI: 4.3 - 44.7). Persistent stomach aches among male and female participants was associated with being required to taste unwashed grapes for sweetness while picking (male: OR 4.6, 95% CI: 2.1 - 9.9; female: OR 5.8, 95% CI: 2.6 - 12.6).*

Keywords. *California, Farm workers, Hispanic, Illness, Injury, Pesticides, Picking, Women.*

California agriculture is now more reliant on hired workers than at any time in the past century as a consequence of major increases in the amount of land used for fruit and vegetable production (Villarejo and Schenker, 2005). California farms reported a record $30 billion in cash receipts in 2004, representing a 25% increase over the preceding two years (California Department of Food and Agriculture, 2006). Annual production of grapes, tree fruits, and vegetables in the state has steadily increased from 21 million tons in the early 1970s to 34 million tons in the early 2000s.

Labor demand has correspondingly increased with the production of these labor-intensive crops, even as the number of farmers and ranchers in the state has declined. The U.S. Census of Population and Housing found that the number of California residents who indicated their occupation was "farmer or rancher" has continued to fall, from 39,271 in 1980 to 36,814 in 1990, then to just 26,770 in 2000 (U.S. Department of Commerce, 1980, 1990, 2000). Hired workers are supplying an ever-increasing share of the labor needed on California farms. According to the California Department of Employment Development, the annual average of monthly employment on the state's farms grew from about 314,670 in the period 1975-1977 to 392,791 in 1999-2001 and

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then fell slightly to 368,666 in the period 2002-2004 (California Department of Employment Development, various years). "Employment" refers to the number of full-time equivalent (FTE) workers.

Despite the increased importance of hired labor in California agriculture, there is a paucity of reports in the literature on the health status, including occupational health, of this population (Villarejo, 2003; Villarejo and Baron, 1999; Schenker, 1996). Even such basic information as denominator data remains unknown. McCurdy et al. (2003) summarized findings regarding injuries among hired farm laborers in California.

This article is an effort to begin to fill the data gap. First, a method for obtaining statewide cross-sectional health survey data appropriate to this population is described: the California Agricultural Workers Health Survey. Second, some of the findings of self-reported health conditions are presented. Third, findings concerning workplace safety and risk are described. Finally, bivariate statistical associations between health conditions and selected workplace risk factors are discussed.

Methods

The California Agricultural Workers Health Survey (CAWHS) was a statewide cross-sectional household survey of the health status of hired farm laborers. The research was conducted by the California Institute for Rural Studies and was sponsored by The California Endowment (California Endowment, 2000). The sampling methodology involved directly contacting potential survey participants in person at their place of residence.

Study Area

The survey used a multi-stage sampling strategy that focused on successively smaller geographical areas: agricultural employment region, regional groupings of census tracts, community, and dwelling. Subjects were randomly selected from among all eligible residents in randomly selected dwellings. The multi-stage sampling strategy began with the selection of seven communities that reportedly have farm laborers among their residents. Each of the state's 58 counties is assigned to one of six agricultural employment regions according to well-defined geographical features: North Coast, Sacramento Valley, Central Coast, San Joaquin Valley, South Coast, and Desert. The California Rural Health Policy Council groups census tracts into medical service study areas (MSSA), which were used to randomly select sub-regions (California Rural Health Policy Council, 1999). Ultimately, a randomly selected community (identified by U.S. Postal Service zip code) was determined in each of the first five named regions, based on probability of selection proportional to the size of reported agricultural employment in the 1990 census. The five randomly selected communities corresponding to those named regions were Calistoga, Arbuckle, Gonzales, Cutler, and Vista.

Two other communities were added. Mecca was purposefully selected in the Desert region based on the presence of a federally funded migrant health clinic in the town. Firebaugh, a community on the west side of the San Joaquin Valley, was added because fully half of the state's agricultural employment is in that region, and the region's randomly selected community, Cutler, is on the east side of the San Joaquin Valley. Because the east and west sides of the San Joaquin Valley are distinct in terms of climate and agriculture, both communities were studied to ensure adequate representation of this important agricultural region.

Sampling Procedures

The crucial next step was complete enumeration of all occupied and vacant dwellings in each community, including both usual types of residence as well as irregular structures not intended for human habitation, but which were likely to be farm laborer dwellings.

Within each community, defined by zip code boundaries in all but Vista, where census tract boundaries were utilized, comprehensive lists of dwelling locations were generated. Project staff performed "ground truth" verification of those lists by visually locating every dwelling as well as adding irregular dwellings and recently constructed dwellings not on the initial lists. As was discovered in this process, a "dwelling unit" occupied by farm laborers may be of any type: house, apartment, motel, trailer, motor home, tool shed, garage, tent, vehicle, or an open camp site "beneath the trees." Irregular dwellings were mapped or their precise locations were described in writing.

The next stage of sampling was random selection of dwellings from the dwelling enumeration lists. Each randomly selected dwelling was contacted in person by a project interviewer. If at least one individual aged 18 or older resided there who had performed hired farm work for any length of time within the previous twelve months, then all eligible residents of the dwelling were enumerated on participant selection lists. Persons who met these qualifications, including those who were injured and unable to work at the time of the survey, were included. There were no restrictions imposed on the type of hired farm work that the individual may have performed. Dairy, poultry, and other types of livestock production work were considered to qualify, along with any type of crop production work.

Participation selection lists were prepared in order of descending ages, first of eligible female residents and then of eligible male residents. If the dwelling had eligible female residents, a randomly selected individual from that portion of the list was selected. Otherwise, an eligible male was randomly selected. If seven or more eligible persons were residents of a single dwelling, the survey protocol allowed for the random selection of more than one resident of the dwelling. Tables of random numbers, prepared in advance and described as "lottery tables" to prospective participants, were used for random selection.

A total of 1,643 individuals were enumerated in the participation selection lists: 522 women and 1,121 men. Women were deliberately over-sampled in the process described above in order to gain greater precision of findings in this group. Based on the fraction of all eligible persons enumerated who were female, we estimate that 35 additional women were included in the sample as compared with the number that a gender-neutral draw would likely have yielded.

Altogether, 11,876 dwellings were enumerated in the seven communities, and 2,989 randomly selected dwellings were contacted in person, yielding an overall sampling fraction in the seven communities of 25%. The sampling fraction varied considerably from community to community: as high as 40% in Cutler, and as low as 12% in Calistoga.

The participation rate in the CAWHS main survey instrument was 83%, determined as follows. Using the lottery tables, 1,174 individuals were asked to participate in the survey. Of these, 970 agreed to participate: 627 men and 343 women. Health information was gathered for nearly 3,000 persons during the interview phase: extensive information on the 970 participants and limited second-hand information on the roughly 2,000 other household members. An additional 1,300 individuals also resided in these same dwellings, but were not considered "household members" by the selected participants. For these additional persons, only very limited data were gathered: whether they were children or adults, and whether they worked in agriculture, other types of employment, or were not working.

Protection of Human Subjects

An informed-consent form was presented to prospective participants and read aloud to them in their preferred language. If the individual agreed to participate, a signature was obtained, and the interviewer proceeded to administer the main survey instrument. The study plan and materials were approved by the Human Subjects Committee of the University of California, Davis.

CAWHS Study Sample

The targeted number of participants in each of the seven communities was proportional to the regional share of 1999 annual average of monthly agricultural worker employment reported by the California Department of Employment Development. In this way, the CAWHS sample proportionally represents each of California's six agricultural regions. Table 1 summarizes the CAWHS community sites, each region's share of 1999 annual average agricultural worker employment, and the corresponding regional share of CAWHS participants actually obtained in the project.

Survey Instruments

The CAWHS had three principal components: the main survey instrument, a physical examination, and a behavioral risk survey instrument. Participants who completed all three components of the CAWHS were provided with a review of their physical examination findings by medical staff, referral for treatment of adverse health conditions when appropriate, and a $30 cash payment at the conclusion of this consultation in consideration of their time.

Because this article is primarily concerned with workplace safety and health, only findings from the main survey instrument are reported here. The main survey instrument was administered in or near the participant's residence, usually at the time of first contact, by a bilingual/biliterate (i.e., read, write, and speak English and Spanish) professional interviewer. Participants were asked which language they preferred, and over 96% of the interviews were conducted in Spanish. Just 33 participants preferred to complete the main survey instrument in English. A few participants spoke only Mixteco, an indigenous Mexican language, and a bilingual (Spanish and Mixteco) interviewer translated and administered the instrument in these cases.

The main survey instrument of the CAWHS includes sections on access to health care services, self-reported and doctor-reported health conditions, and workplace health conditions (California Institute for Rural Studies, 2002). Table 2 provides a detailed outline of the instrument. Health-related data were requested not only about the participant, but also for each member of the participant's household. Household members were defined as those persons with whom the participant shared housing, food, transportation, clothing, and medical costs. Mostly, such persons were members of the

Table 1. Agricultural employment share by region and survey participants (CAWHS, California, 1999).

Region	Agricultural Employment (%)	Community Site	CAWHS Participants (%)
Central Coast	14	Gonzales	15
Desert	9	Mecca	12
North Coast	4	Calistoga	3
Sacramento Valley	16	Arbuckle	13
San Joaquin Valley	50	Cutler, Firebaugh	47
South Coast	7	Vista	9

Table 2. Main survey instrument (CAWHS, California, 1999).

Section	Topics Included
Household composition	Family enumeration, family member's age, place of birth, education, current employment, farm employment.
Personal demographics	Race, ethnicity, place of permanent residence, Spanish/English proficiency.
Health services utilization	Health insurance status, cost, most recent visit to doctor, clinic, dentist, eye care provider, chiropractor, and traditional healer, use of home remedies.
Self-reported health conditions	Dental, respiratory, musculoskeletal, gastrointestinal, urinary, eye, ear, traumatic injuries, emotional illnesses, ethnospecific illnesses.
Doctor-reported health conditions	Tuberculosis, cancer, diabetes, hypertension, heart attack, anemia, arthritis/ rheumatism, stroke/embolism, asthma, hepatitis, allergies, skin conditions, learning disabilities, neurological disorders.
Work history	Jobs in past twelve months, use of tools, transportation to job, employer provided health insurance, worker's compensation insurance.
Income and living conditions	Personal and family income, housing conditions and costs, use of social services.
Workplace health conditions	Eye irritation, blurry or clouded vision, skin irritation, headache, dizziness, nausea or vomiting, numbness or tingling, diarrhea, dehydration.
Working with pesticides in the U.S.	Mixed, loaded, or applied pesticides, use of personal protective equipment, injury or illness when working with pesticides, pesticide contact by drift or being sprayed upon, health reactions to pesticide contact.
Field sanitation	Toilets, drinking water and disposable cups, wash water.
Work-related injuries	Detailed profile of any injury while doing farm work or while traveling to and from farm work.
Immigration status	Current status, program, social security card.

nuclear family, but in some cases they comprised extended family members as well (e.g., uncles, aunts, cousins, nephews, and nieces).

The main survey instrument utilized questions from the National Agricultural Workers Survey (NAWS) and included a household grid and work grid that are essentially identical to those found in the NAWS (U.S. Department of Labor, 2006). Questions relating to demographics and housing conditions were taken from the U.S. Census of Population and Housing (long form).

Field research began in March 1999 and was completed in December 1999. Data collection began in Mecca, the Desert region site, in the early spring, when farm employment there reaches an annual peak. Since Mecca was also the pilot site for the project, all aspects of the work there were subject to intensive review. Some modifications of the main survey instrument were adopted for use in the subsequent sites.

Data Management and Statistical Analysis

Participation rates in the CAWHS interview varied among sites, from a low of 67% in Mecca to a high of more than 90% in two of the sites. A professional firm handled coding and data entry using duplicate data entry procedures. SPSS version 11.5 (SPSS, Inc., Chicago, Ill.) was used for statistical analysis.

Results and Discussion

Demographic and Other Characteristics of the CAWHS Sample

The main feature of the CAWHS sample is that it mostly comprised young, married, Mexican men who have little formal education (table 3). The sample median age is

Table 3. Hired farm workers: Demographics and personal characteristics (CAWHS, California, 1999).

Characteristic	Male (N = 627)	Female (N = 343)
Age-years (median)	34	35
Birthplace: "Mexico"	90%	89%
Race: census "some other race"	92%	92%
Hispanic description: census "Mexican"	89%	89%
Married	60%	59%
Educational attainment (median category)	4th, 5th, or 6th grade	4th, 5th, or 6th grade
Immigration status: citizen or permanent resident	57%	61%
Read English well or very well	8%	11%
Read Spanish well or very well	66%	69%

34 years, about 92% are foreign-born (mostly of Mexican origin), over half are married, 63% have attained six or fewer years of formal education, relatively few speak or read English, only two-thirds say they can read Spanish well or very well, and two-fifths lack work authorization for U.S. employment.

Interestingly, when asked to identity their race, using the exact wording of the census, 92% of respondents chose "some other race." Respondents who were of indigenous origin, whether from Mexico or Central America, frequently chose to identify as Latino, Hispanic, or Mexican in response to a probing question of their choice within the "some other race" category. Only by comparing their responses to both *race* ("some other race," as specified by the respondent) and *ethnicity* for Hispanic persons (again, in response to a probing question regarding the "other" category, as specified by the respondent) was it possible to determine that 8% of respondents claimed "indio," "indígena," or "indigenous" in at least one of their responses. It is likely that additional indigenous persons did not so identify because of the obfuscation of their ethnic identity in the census questions concerning race and ethnicity.

Male workers reported significantly more years performing U.S. farm work than female workers, had higher hourly wage rates, and earned more in annual income from farm work (table 4). Differences in values for characteristics between men and women were statistically significant, except for median "total family income," in which case they are identical. In addition, 2.9% of men who said they were paid exclusively on an hourly rate basis reported wage rates below the state minimum wage of $5.75. Among women, the corresponding fraction reporting less than the California minimum wage was 4.7%.

Overall, 73% of female participants and 74% of male participants lacked health insurance. Of men who had health insurance, more said they had coverage through their employer than were insured through a government program, such as Medicaid (known as MediCal in California). Just the opposite was the case for women: more had government-sponsored coverage than were insured through their employer. Nearly one-fifth (18%) of men reported that their current or most recent job was with an employer who offered a health insurance plan, and about one-eighth (13%) of all male workers were enrolled in an employer-sponsored plan. But among women, only 8% had been offered health insurance at their job, and just 4% had this coverage. Most workers who had declined health insurance through their employer said they could not afford to pay the required employee share of the premiums.

There were substantial differences in the types of farm tasks performed by male and female workers, likely reflecting the persistence of gender discrimination in agricultural employment, as has been previously reported (Barton and Halfon, 1978). One-third (35%) of men reported having operated on-farm machinery (exclusive of trucks or pickups) at their current job, but only 3% of women performed such tasks. And while

Table 4. Hired farm workers: Farm work and income (CAWHS, California, 1999).

Characteristic	Male (N = 627)	Female (N = 343)
Years U.S. farm work (median)[a]	11	6
Currently employed by farm operator	71%	50%
Currently employed by labor contractor	23%	36%
Current hourly wage rate (median)[b]	$6.00	$5.75
Operates tractor or other on-farm machinery at current job	35%	3%
Ever mixed, loaded, or applied pesticides while working on U.S. farms	19%	1%
Trained in pesticides safety	60%	52%
Income from farm work, 1998 (median category)[c]	$10,000 to $12,499	$5,000 to $7,499
Total family income, 1998 (median category)[c]	$12,500 to $14,999	$12,500 to $14,999
Employer offers health insurance in current or last farm job	18%	8%
Has health insurance through your employer	13%	4%

[a] Years U.S. farm work difference is significant at the $p < 0.001$ level (Wilcoxon signed rank test).
[b] Hourly wage rate difference is significant at the $p < 0.001$ level (Wilcoxon signed rank test).
[c] Income findings based on 534 male and 279 female respondents who reported 1998 U.S. earnings. Persons not in the U.S. labor force in 1998, including some newly arrived migrant workers, reported no 1998 U.S. earnings.

one-fifth (19%) of men said they had mixed, loaded, or applied pesticides while working on U.S. farms, just 1% of women had ever done that type of work. Nevertheless, more than half of both men (60%) and women (52%) said they had been trained in the safe use of pesticides.

The fact that female workers report much lower annual income from hired farm work than men likely reflects fewer total farm work hours per year. This inference is based on the observation that there is a small difference between their respective median hourly pay rates ($6.00 versus $5.75) but a substantial difference in their reported farm work incomes. Based on their respective reported hourly wage rates and 1998 farm work income, the ratio of total yearly farm work hours for a typical female worker in the CAWHS sample as compared with a typical male worker is estimated to be about 0.59.

Health Findings of the CAWHS Sample

The most frequently cited adverse health outcomes were persistent musculo-skeletal pain lasting for more than one week (back, neck, knee, shoulder, hand, or foot), dental problems, itching or irritated eyes, *nervios* (an ethno-specific condition related to anxiety), and persistent stomach ache (lasting three or more days in a week). These health conditions were not reported in the context of the participant's employment experience. Rather, the responses were part of the main survey instrument's section on health that included such topics as access to care, utilization of providers, use of home remedies, doctor-reported adverse health outcomes, and whether the participant had health insurance coverage.

There were significant gender differences in the prevalence of some self-reported health complaints (table 5). For example, women workers were more likely to report neck pain, hand pain, and stomach ache. Only for knee pain did men report significantly greater numbers of complaints.

When asked about health conditions perceived by the subjects as work-related, CAWHS participants, both male and female, indicated that irritated, itchy, or watery eyes was most prevalent, followed by headaches, blurry or clouded vision, and skin irritations (table 6). Much less prevalent were dizziness, diarrhea, numbness or tingling, nausea or vomiting, and dehydration.

Table 5. Self-reported general health conditions, hired farm workers (CAWHS, California, 1999).

General Health Condition	Male (%) (*N* = 627)	Female (%) (*N* = 343)
Back pain, persistent (>1 week)	23	21
Neck pain, persistent (>1 week)[a]	9	13
Knee pain, persistent (>1 week)[a]	17	12
Shoulder pain, persistent (>1 week)	10	12
Hand pain, persistent (>1 week)[a]	11	19
Foot pain, persistent (>1 week)	14	18
Diarrhea, persistent (>3 consecutive days)	6	3
Stomach ache, persistent (3 days per week)	9	13
Itching or irritated eyes	21	23

[a] $p < 0.05$ (chi-squared test) for difference between males and females.

Table 6. "In the last twelve months, while doing hired farm work, have you had...," work-related health conditions, hired farm workers (CAWHS, California, 1999).

Workplace Health Condition	Male (%) (*N* = 552)	Female (%) (*N* = 292)
Irritated, itchy, or watery eyes	24	21
Blurry or clouded vision	13	10
Skin irritations (inflammations, rashes, hives)[a]	9	16
Headaches	14	18

[a] $p < 0.05$ (chi-squared test) for difference between males and females.

Note that these questions were not asked of CAWHS participants in the first community site (Mecca) and were added following review of the pilot survey instrument. Thus, the number of participants shown in this table is less than the full survey population.

Occupational Injury and Safety and Health Compliance

Altogether, 38 men and 7 women reported having experienced a farm-related occupational injury during the twelve-month period preceding their participation in the CAWHS, yielding one-year cumulative incidence for injury of 6% (95% CI: 4% – 8%) for men and 2% (95% CI: 1% – 3%) for women. The male-female difference of cumulative incidence is statistically significant. In this context, it should be noted that, on average, female CAWHS participants were estimated to have just 59% of the annual total work hours of a male participant, and this difference is not accounted for in the comparison of cumulative incidences.

California state law requires that all employers, not just those in agriculture, have a written workplace safety plan that addresses such important topics as whether employees shall be instructed in safe work practices. While it is not known whether safety training would have been required for those workers who reported farm-related occupational injuries in the prior twelve months, only 12 of 38 (32%) men and 1 of 7 (14%) women said they received safety training prior to their injury.

There are several ways to measure compliance with health and safety regulations in California. First, the state has long required that employers of hired farm laborers provide minimal field sanitation facilities: potable drinking water, wash water and soap, and clean toilets with ample supplies of toilet paper. Second, federal Worker Protection Standard regulations seek to protect workers from the risk of exposure to dangerous agricultural chemicals by requiring a variety of protective measures, such as restricting re-entry to a field after it has been sprayed. Third, Cal-OSHA regularly inspects work sites in all

industries, including agriculture, and seeks to obtain compliance with a variety of safety regulations.

Table 7 reports the CAWHS findings regarding compliance with field sanitation regulations as well as whether workers were exposed to agricultural chemicals in the previous twelve months. Female workers reported significantly better compliance regarding potable drinking water and the availability of toilets than was the case for male workers. There was no significant difference between male and female workers reporting the availability of wash water and soap. But neither male nor female workers reported 100% compliance for any of the requirements under field sanitation regulations. An additional finding, which was brought to the attention of the survey team by the workers themselves, occurred exclusively at the CAWHS desert site (Mecca): being required to pick and taste unwashed grapes for sweetness before proceeding with harvest work. Based on this discovery, all workers in the CAWHS sample were asked if they were required to taste "unwashed fruit" in the field while picking. In no other site or crop was this practice reported by workers.

The number of workers who reported having had direct contact with pesticides during the twelve months prior to the interview was not small: 12% of men and 7% of women reported having been sprayed or drifted upon. As many as 6% of male workers reported direct contact with pesticides as a result of having been spilled upon or while cleaning pesticide containers. Few female workers reported those latter two types of direct exposure, very likely because few female workers report having ever mixed, loaded, or applied pesticides while working on U.S. farms. Some male and female workers reported having entered a field that was still wet with pesticides after an application had been completed or having been told by a supervisor to enter a sprayed field "before it was time." It is not possible to objectively evaluate the exact circumstances of such self-reported incidents. Nevertheless, the responses indicate awareness by workers of possible exposures that may be associated with employer non-compliance with field re-entry restrictions.

Finally, in the CAWHS community of Mecca, field workers directed the attention of survey staff to a practice with which the researchers were previously unfamiliar. Workers said they had been directed by supervisors to taste unwashed grapes in vineyards to test whether the crop was sweet enough to pick, and then to proceed with the harvest if the grapes were sufficiently sweet. The concern of workers was whether the unwashed fruit was safe to eat. This query was added to the survey instrument for all CAWHS participants. Surprisingly, 10% of female workers and 6% of male workers had been told to engage in this practice. This practice is not subject to regulation under the Worker

Table 7. Workplace conditions, hired farm workers (CAWHS, California, 1999).

Workplace Condition	Male (%) (N = 627)	Female (%) (N = 343)
Potable drinking water and disposable cups every day	74	90
Clean toilets with adequate supplies every day	84	95
Wash water and soap every day	81	84
Direct contact with pesticides by being sprayed or drifted upon[a]	12	7
Direct contact with pesticides by being spilled upon[a]	4	1
Direct contact with pesticides while cleaning chemical containers[a]	6	0
A supervisor told you to enter a sprayed field before it was time[a]	3	4
Entered a field wet with pesticides[a]	5	3
Asked to taste unwashed fruit in the field, testing for ripeness while picking	6	10

[a] Previous twelve months only.

Protection Standard. In litigation, some employers argue that the picked fruit is only subject to regulations governing the marketing of fresh produce, which does not require washing.

Associations Between Health Conditions and Farm Work

Self-reported general health and farm workplace health conditions were analyzed in the context of work history and workplace conditions. Determinations of associations between health conditions, either general or workplace, and variables from tables 3, 4, and 7 were made using standard statistical measures, including bivariate logistical regression to determine odds ratios (OR) and the associated 95% confidence interval (CI).

This analysis found an association between the number of different body parts experiencing self-reported persistent pain and the total number of years of U.S. farm work. In other words, as in a dose-response association, the longer the lifetime duration of farm work, the greater the chance of having persistent pain in multiple body parts. For female workers, the correlation coefficient (Spearman's rho) equals 0.24 ($p < 0.01$); for male workers, the correlation coefficient equals 0.09 ($p < 0.05$). Females experience a similar prevalence of musculoskeletal complaints in comparison to males (40% vs. 41%, respectively) despite working approximately 40% fewer hours.

The CAWHS found no statistically significant associations between any of the field sanitation conditions and either general health or workplace health conditions. For this reason, they are excluded from further consideration.

Direct contact with pesticides is associated with several self-reported workplace health conditions (table 7) for both male and female workers: having been sprayed or drifted upon is associated with irritated, itchy, or watery eyes; with blurry or cloudy vision; with skin irritations; and with headaches ($p < 0.01$). These associations are summarized in table 8. For both men and women, the employer-imposed requirement to taste unwashed grapes for sweetness while picking was associated with persistent

Table 8. Self-reported health conditions and workplace exposures to risk hired farm workers (CAWHS, California, 1999).

Workplace Health Condition	Pesticide Contact (%)	No Pesticide Contact (%)	Odds Ratio (95% CI)
Men: Direct pesticide contact; sprayed or drifted upon ($N = 550$), $p < 0.01$			
Irritated, itchy, or watery eyes	20	8	2.9 (1.6 - 5.0)
Blurry or clouded vision	23	9	3.1 (1.6 - 5.8)
Skin irritations	27	9	3.9 (1.9 - 7.7)
Headaches	31	12	3.2 (1.7 - 5.9)
Women: Direct pesticide contact; sprayed or drifted upon ($N = 287$), $p < 0.01$			
Irritated, itchy, or watery eyes	75	18	13.8 (4.3 - 44.7)
Blurry or clouded vision	38	8	7.1 (2.3 - 21.3)
Skin irritations	67	13	13.4 (4.3 - 41.4)
Headaches	62	14	9.8 (3.4 - 28.6)
General Health Condition	**Tasted Unwashed Fruit (%)**	**Not Tasted Unwashed Fruit (%)**	**Odds Ratio (95% CI)**
Men: Required to taste unwashed fruit for sweetness while picking ($N = 570$), $p < 0.01$			
Diarrhea, more than 3 consecutive days	31	5	7.9 (3.4 - 18.2)
Stomach aches, 3 days or more in 1 week	20	5	4.6 (2.1 - 9.9)
Women: Required to taste unwashed fruit for sweetness while picking ($N = 307$), $p < 0.01$			
Stomach aches, 3 days or more in 1 week	40	10	5.8 (2.6 - 12.6)

stomach aches, lasting three or more days in one week ($p < 0.01$). In addition, for male workers, this practice was also associated with persistent diarrhea, lasting more than three consecutive days ($p < 0.01$).

Conclusion

This article describes a methodology to conduct large-scale cross-sectional health research on hired farm laborers, a population that has proved difficult to study. The demographic profile of the CAWHS sample compares favorably with the NAWS sample for California (Aguirre International, 2005). However, the NAWS sample is limited to hired crop farm workers who were employed during the two-week period prior to contact by survey staff. The CAWHS sample included all hired farm laborers, such as livestock workers, as well as those who are injured and unable to work at the time of the survey.

Participation in the CAWHS was high: 83% of randomly selected workers in a statewide sample of randomly selected dwellings agreed to participate. It is likely that the household survey methodology on which the CAWHS is based contributes to the high response rate. In contrast to the CAWHS, the NAWS is an employer-based survey and relies on the cooperation of the employer, which is a potential barrier in seeking worker interviews.

Among the CAWHS findings pertaining to occupational safety are that hired farm laborers report high levels of persistent musculo-skeletal pain: 41% of men and 40% of women say they have persistent pain in their backs, necks, knees, shoulders, hands, feet, or multiple body parts. Most male workers (65%) and nearly all female workers (97%) do not operate tractors or other farm machinery in their current job. In other words, they perform manual labor. It is therefore not surprising that such a large share of the farm labor force endures persistent musculo-skeletal pain. We found a positive correlation between the number of body parts experiencing persistent pain and the number of years of U.S. hired farm work.

Nearly one-fifth (19%) of men said they had mixed, loaded, or applied pesticides while working on U.S. farms. Just 1% of women said they had ever performed those tasks. Nevertheless, 12% of men and 7% of women said they had experienced direct contact with pesticides from being sprayed or drifted upon in the previous twelve months. These exposures were associated with several self-reported workplace health conditions: irritated, itchy, or watery eyes; blurry or clouded vision; skin irritations; and headaches ($p < 0.01$).

A previously unknown workplace health risk was brought to the attention of survey staff: some workers reported having been required to taste unwashed grapes in vineyards for sweetness while picking. This practice was associated with stomach aches lasting three or more days in a week for both males and females. For male workers, diarrhea lasting more than three consecutive days in one week was also associated with being required to taste unwashed fruit in vineyards.

These findings suggest that significant additional attention is needed for occupational health among farm workers, especially addressing musculo-skeletal pain. Both intervention and new research are needed to develop farming techniques that are less physically stressful.

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