Occupational Health and Safety Status of Indigenous and Latino Farmworkers in Oregon

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ABSTRACT. *Exposure to pesticides poses great risk to agricultural workers and their families. Of the approximately 174,000 agricultural workers in Oregon, studies estimate that up to 40% of the workers in Oregon are indigenous and may be particularly vulnerable to the health risks of working in pesticide treated areas. Surveys conducted with Oregon farmworkers suggest that Latino and indigenous farmworkers differ demographically and may have diverse occupational and health needs. All Latino workers reported Spanish as their native language, while indigenous workers spoke several different native languages. Latino workers were employed mostly in orchards (28%) and nurseries (24%), while indigenous workers were mostly pickers (40%). Indigenous farmworkers reported less frequent suitable occupational safety training, and potentially less knowledge of the health consequences of pesticides. Addressing the barriers to obtaining pesticide health and safety information is of primary importance, given the changing demographics of farmworkers in Oregon. This article concludes with a discussion of these findings and the programmatic activities that have been implemented in Oregon to improve farmworkers' understanding of hazards and rights associated with agricultural work.*

Keywords. *Agricultural workers, Indigenous farmworkers, Occupational health, Pesticides, Promotores.*

Agricultural workers are frequently exposed to hazardous conditions that can increase their risk of fatal and non-fatal injuries. In 2006, agriculture, forestry, and fishing were identified as the most dangerous occupations in the U.S., with 29.6 fatalities per 100,000 workers, compared to the average of 3.9 fatalities per 100,000 workers for all sectors combined (DOL, 2006). At 6.1 non-fatal events per 100 full-time agricultural workers, only the construction and manufacturing industries have more occupational injuries and illnesses (DOL, 2006). Workplace fatality rates have steadily increased for Hispanic and Latino workers, who make up about 90% of the agricultural workforce (DOL, 2005, 2006).

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Farm work can be hazardous because of improper use of equipment or unintentional injuries, and exposure to pesticides may also pose a risk to agricultural workers (McCauley et al., 2006). Over one billion pounds of pesticides are used in the U.S. each year (NIOSH, 2006). Pesticides have been linked to various acute and chronic diseases and conditions, including skin rashes, eye irritation, headaches, shortness of breath, and vomiting (Reigart and Roberts, 1999). Longer-term effects caused by chronic low levels of exposure can include non-Hodgkins lymphoma, leukemia, brain cancer, birth defects, sterility, neurological disorders, convulsions, coma, and even death (Arcury et al., 2003, Alavanja et al., 2004, Kamel and Hoppin, 2004, Strong et al., 2004).

Currently, seven states utilize a national surveillance program to monitor pesticide poisonings. In 1998 and 1999, 1,009 acute pesticide poisonings were reported in these seven states, 51% of which occurred in the agricultural sector (Calvert et al., 2004). In the same analysis, the estimated rate for acute pesticide-related illness was 18.2 per 100,000 for those employed in agriculture, and 1.17 per 100,000 for those not employed in agriculture. Although these numbers show elevated rates of poisoning for agricultural workers, experts believe that these numbers underestimate the disease burden. For example, current estimates indicate that about only 23% of farmworkers in the U.S. haves some type of health insurance, and thus those without insurance are unlikely to report symptoms related to pesticide poisoning to health providers (DOL, 2005). Additionally, pesticide poisonings are underreported by healthcare personnel who may not have the training or resources to recognize symptoms (Institute of Medicine, 1995, Reigart and Roberts, 1999). This article aims to increase understanding of the health burdens and occupational safety concerns of migrant farmworkers in Oregon, and it focuses more specifically on indigenous workers from Mexico or Guatemala who may not speak or read Spanish. We describe the results from a survey completed with 150 Latino and indigenous farmworkers, highlighting demographic characteristics of the farmworkers, and data related to pesticides safety training and health outcomes.

Pesticides Regulations and Federal Standards

There are few federal regulations that protect farmworkers from harmful exposure to pesticides. The Environmental Protection Agency's Worker Protection Standard (WPS) is the primary law designed to protect those who work around pesticides (EPA, 1992). Under the WPS, pesticide handlers are required to have adequate personal protective equipment and access to information about where pesticides are applied and when the fields are safe for re-entry after pesticide application (known as restricted entry intervals, or REIs). For all farmworkers in pesticide-treated areas, farm owners are required to provide information about the WPS, including information about REIs, safety, and protection. Owners are also required to provide workers with access to decontamination facilities, drinking water, emergency first aid, and emergency care locations. Additionally, pesticide training is required before employees working in pesticide treated areas accrue five days of work, and every five years thereafter. Training must be in a language that the employees understand, and they must have the opportunity to ask questions. Another federal mechanism designed to protect farmworkers is the Occupational Health and Safety Act (OSHA), which applies to workers on farms that have 11 or more workers (DOL, 1987). OSHA's Field Sanitation Standard

mandates toilets, drinking water, and hand washing facilities in the fields, and certain minimum standards for employer-provided housing. OSHA's Hazard Communication Standard (DOL, 1996) requires training on the short- and long-term health effects of the chemicals at the work place, as well as the availability of material safety data sheets, a chemical list, and labeled products. The state of Oregon extends the federal OSHA standards in the Oregon Safe Employment Act (ORS, 1973) to include agricultural operations of any size.

Over 17 million acres are dedicated to agriculture in the state of Oregon (ORDOA, 2007). The main crops, such as apples, strawberries, vegetables, grapes, and tree fruits, as well as many nurseries, use numerous pesticides (Nigg et al., 1992; NEDLC, 2006). Of the estimated 174,000 agricultural workers and their families in Oregon, 90% are from Latin America (Larson, 2002). In recent years, the population arriving from Mexico and Guatemala has been increasingly of indigenous descent, meaning that they have linguistic and cultural traditions that are distinct from those of Latino workers. Although the number of indigenous workers may vary across the state, approximately 40% of the workers in Washington County, Oregon, have been identified as indigenous (McCauley et al., 2001; McCauley et al., 2002). Since information specific to indigenous workers is not systematically collected, this provides an estimate of the numbers in the study area. The expanding indigenous farmworker population in Oregon is particularly vulnerable to the health risks of working in pesticide-treated areas. Many indigenous languages do not have a standard contemporary written format, and many indigenous workers do not speak or read enough Spanish to understand training provided in Spanish. Addressing the barriers to obtaining pesticide health and safety information is of primary importance given the changing demographics of farmworkers in Oregon.

Materials and Methods

The Promoting the Occupational Health of Indigenous Farmworkers project was established to better understand the occupational and health needs of Oregon's indigenous agricultural communities. Actively involved in the project partnership are indigenous-language speaking community educators, farmworker advocates, labor union representatives, environmental scientists, and healthcare providers. The project is funded by the National Institute of Environmental Health Sciences and the National Institute for Occupational Safety and Health and includes representatives from the Oregon Law Center, Salud Medical Center, Pineros y Campesinos Unidos del Noroeste (PCUN), Portland State University School of Community Health, Farmworker Justice, and project consultant Dr. Linda McCauley. The project addresses the health concerns of indigenous populations that migrate to Oregon to work in agriculture, and seeks to increase their access to economic, health, and social services. Two project aims addressed in this article are: (1) to investigate the needs of farmworkers speaking indigenous languages, and of healthcare providers and other stakeholders, and to identify priorities for workplace education, intervention, and policy change; and (2) to explore the existing channels of communication currently employed by indigenous farmworkers to obtain information, and examine the strengths and weaknesses of these channels.

Project partners conducted baseline surveys to better understand the occupational and health needs of Oregon's indigenous and Latino farmworkers. Development of the

survey was guided by the principles of community-based participatory research (Israel et al., 1998), and all project partners contributed to survey questions and protocol. Partners reviewed and modified questions from other survey tools that have been validated with farmworker populations (for example, see McCauley et al. 2004) and combined these questions with others that were relevant to our communities and project objectives. Survey design and question selection was also guided by the results of preliminary focus groups that were conducted earlier in the project (Farquhar et al., 2008a). The focus group results highlighted the principal occupational, health, and legal concerns of indigenous farmworkers and identified areas that required further investigation. The final survey included 107 items to assess demographic variables, language skills and preferences, health status, occupational exposures, pesticides knowledge and training, experiences with discrimination, attitudes and beliefs about work and community, and access to health and safety information.

Surveys were administered between April and October 2006, allowing the project to access workers in a variety of agricultural sectors based on seasonal schedules. Multilingual project community educators administered surveys to both Spanish and indigenous-language speaking respondents. Participants were given the option to complete the interview in Spanish or by listening to a prerecorded version in Mixteco Alto, Mixteco Bajo, or Triqui (Copala) when available. Project partners prerecorded the survey in the indigenous languages to ensure that the questions were appropriate for some of the indigenous languages most commonly spoken in Oregon, and to increase the consistency and reliability of the survey administration. The interviewer played the tape-recorded questions and response categories for those who preferred to complete the survey in their indigenous language.

Surveys were conducted primarily at labor camps, farmworker homes, and community centers by multilingual, indigenous-speaking community educators. Locations for recruitment and survey administration were selected based on the interviewers' knowledge of where farmworkers were most likely to spend time. As a first step in sampling and selection, we identified a target numbers of workers in each category to ensure representation from the major categories of agricultural workers in Oregon: 25 orchard, 30 nursery, 25 cannery, 40 pickers, 10 pine trees/wreaths, and 20 reforestation workers. We expected to have equal numbers of indigenous and Latino workers in each category, but results indicate that indigenous workers were more likely to work in certain categories (e.g., as pickers) than others (e.g., in orchards). We also sought to include in our sample at least 20% women to reflect the national average of female farmworkers. Using these numbers to guide recruitment, we used a nonprobability convenience sampling method whereby interviewers completed surveys with participants who fit the target categories and were available to complete the surveys. Interviewers reported very few refusals and stated that the few individuals who did refuse to complete the survey mentioned a lack of time and lack of interest in the topic. All survey participants received information about their rights and responsibilities as a participant before the survey was administered. Participants were not required to sign a written consent due to lack of a written format for most of their native languages; however, the forms were translated orally into the participants' native languages, and verbal consent indicated a willingness to participate. Surveys took on average 41 minutes to complete, and participants were given a $10 gift certificate to compensate for their time and participation.

All partner organizations, including the interviewers, participated in a four-hour training on survey interviewing. The training was conducted by the university partners and interpreted into Spanish for participants. It included sections on confidentiality, the importance of rigor and consistency in conducting surveys, a discussion of ethics and participants' rights, and review of the informed consent. All interviewers practiced asking the survey questions, and trainers emphasized the importance of maintaining neutrality and reading the questions exactly as worded. Interviewers reviewed questions related to survey administration during additional practice sessions and bi-weekly meetings. Human subjects approval was obtained from the Institutional Review Board at Portland State University.

Data Analysis

Project partners at PSU entered and coded the survey data and used SPSS (version 11.5) to analyze the data. Frequencies and descriptive statistics were computed for all survey items, and a subset of surveys was rechecked for accuracy in data entry. T-tests for independence and analyses of variance (ANOVA) were used to examine differences between indigenous and non-indigenous (Latino) farmworkers' responses. Post-hoc analyses (Bonferroni) were computed for significant ANOVAs to identify significant differences between categories. Pearson's chi-square tests were used to examine differences between indigenous and Latino farmworkers' responses for all categorical data. We calculated eta-squared coefficients to identify the magnitude of the effect sizes for the significant results and used Cohen's guidelines. Project partners from the Oregon Law Center, PCUN, and Salud Medical Center reviewed the survey data with PSU researchers and provided suggestions for additional analyses and interpretations of results.

Results

Demographics

A total of 150 farmworkers (74 Latino and 76 indigenous farmworkers) were interviewed between April and October 2006. The sample included 102 men and 48 women who work in Oregon's agricultural sector. Latino and indigenous farmworkers differed significantly on many demographic variables. Latino farmworkers were older, had more formal education, and have been in the U.S. and Oregon longer than indigenous farmworkers (table 1). Respondents reported originating from Mexican states, with most indigenous workers from Oaxaca (83%) and Latino workers from a variety of states, including Oaxaca (34%) and Michoacan (27%). All Latino workers reported Spanish as their native language, while indigenous workers spoke several different native languages. Of the 11 self-reported languages spoken by indigenous participants, the most commonly spoken were Mixteco Bajo (32%), Zapoteco Bajo (16%), and Trique (13%). The types of agricultural work participants engaged in at the time of the survey were also diverse. Latino workers were employed mostly in orchards (28%), nurseries (24%), canneries (18%), and in jobs that require hand-harvesting from the trees and the ground (called "pickers") (19%). Indigenous workers were mostly pickers (40%). However, 91% of all workers surveyed said they had planted, thinned, or picked crops in the past, 50% had worked in nurseries, and 39% had worked in canneries. Note that while cannery workers are not required to

Table 1. Demographic characteristics of respondents.[a]

	Total Sample (n = 150)	Indigenous (n = 76)	Latino (n = 74)	p-value
Women	48 (32%)	21 (28%)	27 (36%)	ns
Age	34.2	32.5	36.0	<0.05
Years of education in Mexico	4.6	4.1	5.2	<0.05
Years of education in the U.S.	0.2	0.1	.2	ns
Years in the U.S.	9.5	7.6	11.4	<0.01
Years in Oregon	7.7	6.4	9.1	<0.05
Mexican state of origin				
Oaxaca	88 (59%)	63 (83%)	25 (34%)	<0.01
Michoacan	21 (14%)	1 (1%)	20 (27%)	
Guerrero	16 (11%)	11 (14%)	5 (7%)	
Other	25 (17%)	1 (1%)	24 (32%)	
Native language				
Spanish	74 (49%)	-	74 (100%)	<0.01
Mixteco	7 (5%)	7 (9%)	--	
Mixteco Alto	8 (5%)	8 (11%)	--	
Mixteco Bajo	24 (16%)	24 (32%)	--	
Mixteco Costa	2 (1%)	2 (3%)	--	
Mixteco Guerrero	1 (1%)	1 (1%)	--	
Zapoteco	5 (3%)	5 (7%)	--	
Zapoteco Bajo	12 (8%)	12 (16%)	--	
Zapoteco Valle	2 (1%)	2 (3%)	--	
Trique	10 (7%)	10 (13%)	--	
Nahautl	3 (2%)	3 (4%)	--	
Purepecha	2 (1%)	2 (3%)	--	
Current work type				
Orchard	24 (16%)	3 (4%)	21 (28%)	<0.01
Nursery	32 (21%)	14 (19%)	18 (24%)	
Cannery	21 (14%)	8 (11%)	13 (18%)	
Picker	44 (30%)	30 (40%)	14 (19%)	
Christmas Trees	11 (7%)	8 (11%)	3 (4%)	
Other	17 (11%)	12 (16%)	5 (7%)	
Previous jobs				
Planting, thinning, picking	137 (91%)	72 (95%)	65 (88%)	ns
Nursery	74 (50%)	38 (51%)	36 (49%)	ns
Cannery	57 (39%)	31 (41%)	26 (36%)	ns
Months worked annually	8.6	8.4	8.8	ns
Months worked annually in Oregon	6.8	6.1	7.6	<0.05
Most hours worked per week	48.3	47.7	48.9	ns
Least hours worked per week	29.8	31.0	28.6	ns

[a] Means are reported for continuous variables.

receive training under the WPS, they were not excluded from our study because it is likely that they worked in other agricultural sectors. All farmworkers surveyed worked about 8.6 months of the year and almost 7 of those months were spent in Oregon. The average work week was reported between 29.8 and 48.3 hours.

Pesticides and Training

Forty-eight percent of the workers surveyed said they currently work in areas that have been treated with pesticides (table 2). Significantly more Latino workers reported working in treated areas than indigenous workers (65% vs. 31%, $p < 0.01$). Given the farming practices in the region, it is probable that most respondents are exposed to pesticides in their workplace, but indigenous workers may be less likely to be aware of

Table 2. Pesticide exposure.[a]

	Total Sample (n = 150)	Indigenous (n = 76)	Latino (n = 74)	p-value
Currently work in pesticide treated areas	67 (48%)	21 (31%)	46 (65%)	<0.01
Have mixed or applied pesticides	31 (21%)	12 (16%)	19 (26%)	ns
Breathed pesticides in the air	90 (61%)	44 (59%)	46 (63%)	ns
Touched plants with pesticide residue	58 (39%)	28 (37%)	30 (42%)	ns
Sprayed with pesticides by a plane or tractor	51 (34%)	26 (34%)	25 (34%)	ns
Entered field within four hours after pesticide treatment	39 (26%)	16 (21%)	23 (31%)	ns
Workplace facilities available				
Handwashing water	132 (89%)	68 (91%)	64 (88%)	ns
Drinking water	134 (90%)	67 (89%)	67 (91%)	ns
Bathrooms nearby	145 (97%)	73 (96%)	72 (97%)	ns
Remove boots when entering home	137 (93%)	76 (100%)	61 (85%)	<0.01
Bathe daily	145 (99%)	74 (99%)	71 (99%)	ns
Time to change clothing when entering home (minutes)	25	24	27	ns
Time home before bathing (minutes)	36	25	48	<0.05
Laundry facilities in home	55 (37%)	25 (33%)	30 (41%)	ns
Number in household	5.5	6.4	4.6	<0.01

[a] Means are reported for continuous variables.

pesticide practices and health consequences due to a lack of linguistically appropriate training. Mixing or applying pesticides is only one route of exposure that can be hazardous to health. Although only 21% of workers surveyed have ever mixed or applied pesticides, 61% said they have breathed pesticides in the air, 39% have touched plants with visible pesticide residue, and 34% have been accidentally sprayed with pesticides by a plane or tractor. Twenty-six percent of the workers surveyed reported being asked to re-enter a field within four hours after pesticides had been applied. Of the workers surveyed, 89% reported that handwashing water was available at work, 90% had access to drinking water, and 97% indicated that there was a bathroom available nearby. Workers were not asked about the quality of facilities provided or the sufficiency of warm water for bathing or washing hands.

Although this study did not test for the presence of pesticides in farmworker homes, we asked about hygiene practices that may increase the risk of exposure. The majority of workers (93%) removed their boots upon entering their homes and bathed daily (99%). However, only 9% of workers changed their clothes or bathed immediately after arriving at home. Workers in our sample waited approximately 25 minutes to change their clothing and approximately 36 minutes to bathe after returning home from work. Only 37% of workers had laundry facilities in their home. Those who lived in labor camps were less likely to have access to laundry facilities (22%) than those who live in other types of housing (43%) ($p < 0.05$). Indigenous workers reported living in significantly more crowded housing conditions than Latino workers (6.4 vs. 4.6 people in household, $p < 0.01$), which may contribute to increased waiting times for showers.

Only 57% of the farmworkers who reported currently or previously working in pesticide-treated areas had received some form of health and safety training (table 3). On average, farmworkers' last training occurred 9.7 months prior to the interview. Pesticide training was most commonly provided by the mayordomo or other supervisor (57%) or the rancher (25%). Sixty-six percent of workers who reported that they had received some form of training had watched a pesticide training video, 55% received

Table 3. Pesticide training.

	Total Sample (n = 150)	Indigenous (n = 76)	Latino (n = 74)	p-value
Work/ed in treated area and have received pesticide training[a]	46 (57%)	18 (60%)	28 (55%)	ns
Months since last training[a]	9.7	17.6	5.5	<0.05
Mode of training[a]				
Video	29 (66%)	11 (65%)	18 (67%)	ns
Written materials	24 (55%)	7 (41%)	17 (63%)	ns
Presentation	10 (23%)	4 (24%)	6 (22%)	ns
Language of written training materials[a]				
Spanish	15 (65%)	2 (29%)	13 (81%)	ns
English	3 (13%)	2 (29%)	1 (6%)	
Both	4 (17%)	2 (29%)	2 (13%)	
Language of oral training (video or presentation)[a]				
Spanish	35 (90%)	15 (100%)	20 (83%)	ns
English	1 (3%)	--	1 (4%)	
Both	2 (5%)	--	2 (8%)	
Understands Spanish well enough to receive orally presented information	130 (94%)	59 (87%)	71 (100%)	<0.01
Understands Spanish well enough to receive written information	73 (53%)	27 (40%)	46 (66%)	<0.01

[a] These numbers are calculated using a subset of participants who currently or have previously worked in pesticide treated areas.

written materials, and 23% received a presentation. The majority of both oral and written training information was given in Spanish, with 90% of oral training and 65% of written training materials presented in Spanish. Training was also presented in English, or a combination of English and Spanish. No training was reportedly conducted in any indigenous language. Ninety-seven percent of all indigenous workers interviewed said Spanish was their second language, yet only 87% said they understood Spanish well enough to receive training information presented orally, such as a presentation or video. Far fewer indigenous workers (40%) said they could understand Spanish well enough to obtain written training information, such as a pamphlet or brochure. These numbers highlight the low Spanish literacy rate of indigenous workers, even when they consider Spanish as their second language.

Farmworkers' Health

Workers were generally concerned about the health effects of pesticides. The majority of workers said they were concerned about the effects of pesticides on their immediate health (74%) and their future health (93%) (table 4). However, significantly fewer indigenous workers than Latino workers said they were concerned about the effects of pesticides on both their immediate health (65% vs. 83%, $p < 0.05$) and future health (88% vs. 99%, $p < 0.05$). Similarly, compared with Latino workers, indigenous workers less frequently agreed that pesticides can cause health problems for children of agricultural workers (89% vs. 100%, $p < 0.01$). Although only 16% of the sample reported becoming sick while working around pesticides, many workers reported health conditions that have been associated with pesticides in previous studies. Forty percent of workers had itchy skin, 35% had eye irritation or blurriness, 31% had muscle weakness, and 7% had problems breathing. Workers also reported health problems that have been associated with agricultural work but not necessarily pesticides,

Table 4. Farmworkers' health.

	Total Sample (n = 50)	Indigenous (n = 76)	Latino (n = 74)	p-value
Concerned about immediate health effects of pesticides	87 (74%)	39 (65%)	48 (83%)	<0.05
Concerned about future health effects of pesticides	126 (93%)	59 (88%)	67 (99%)	<0.05
Believe pesticides can cause health problems for children of farmworkers	138 (95%)	65 (89%)	73 (100%)	<0.01
Have become sick from working around pesticides	24 (16%)	8 (11%)	16 (22%)	ns
Health conditions reported				
Itchy skin	59 (40%)	31 (41%)	28 (38%)	ns
Eye irritation/blurriness	52 (35%)	21 (28%)	31 (42%)	ns
Muscle weakness	47 (31%)	26 (34%)	21 (28%)	ns
Problems breathing	10 (7%)	3 (4%)	7 (9%)	ns
Arthritis	22 (15%)	12 (16%)	10 (14%)	ns
Back pain	81 (54%)	44 (58%)	37 (50%)	ns
Self-reported general health				
Excellent	9 (6%)	5 (7%)	4 (5%)	ns
Good	43 (29%)	18 (24%)	25 (34%)	
Fair	89 (59%)	50 (66%)	39 (53%)	
Poor	9 (6%)	3 (4%)	6 (8%)	

such as arthritis (15%) and back pain (54%). Additionally, 65% of workers said their health was "fair" or "poor."

Discussion

Given the widespread use of pesticides in Oregon and the survey responses, farmworkers in this study are likely exposed to pesticides but may not be provided with adequate information and opportunities to protect themselves from exposure. Results suggest that the current federal pesticide training requirements are not being met. For example, 26% of the farmworkers reported being asked to re-enter a field within four hours after pesticides had been applied, yet the WPS requires a minimum time delay for re-entry into treated fields of four hours under all circumstances. Although the WPS requires that workers receive pesticide safety training in a language they understand before the sixth day of work in a treated area (and every five years thereafter), only 46 (57%) of the farmworkers who reported currently or previously working in pesticide treated areas had received some form of health and safety training. This finding mirrors other studies around the U.S., some of which estimate the proportion of farmworkers who have received the mandated training to be between 32% and 57% (Villarejo et al., 2000; Arcury et al., 2001; McCauley et al., 2002; Shipp et al., 2005). In one study, only 48% of workers said their employers inform them when pesticides are used (Arcury et al., 2001).

Providing training in a language that is understood is challenging, in part because of the diversity of languages spoken by farmworkers. There are a number of indigenous languages spoken in Oregon, the most predominant among farmworkers being Mixteco, Zapoteco, and Triqui and variations of each. The lack of a standard and contemporary written format for these languages makes the provision of appropriate pesticide health and safety training more difficult. In addition, while many indigenous workers report some basic understanding of Spanish, some may disregard indigenous

language fluency and overstate Spanish understanding to avoid discrimination in the U.S. and Mexico (DOL, 2005). In this study, almost all indigenous workers reported Spanish as their second language. However, 13% of indigenous workers reported that they would not be able to understand a video or training presentation given in Spanish, and 60% reported that they cannot understand Spanish well enough to read a training brochure or pamphlet. Focus groups conducted earlier in this study indicated that a greater number of indigenous workers experienced language discrimination in the workplace than Latinos, and that they might hide their native language from their mayordomo or supervisor to avoid discrimination (Farquhar et al., 2008b). This potential for language discrimination may also partially explain why, despite the attempt to use cassette tapes to standardize indigenous language interviews, some participants felt more comfortable using the Spanish version of the survey, or being read the questions in their indigenous language by the interviewer.

Studies also suggest that the degree to which farmworkers protect themselves varies, as do the reasons for noncompliance. Workers may not use personal protective equipment (PPE) provided by employers for practical reasons: it may be too hot, difficult to get accustomed to, improperly fitting, uncomfortable, or seen as unnecessary (Elmore and Arcury, 2001). Some workers may feel that the equipment slows down their work (Austin et al., 2001). In one study, McCauley et al. (2002) found that while 50% of adolescent pesticide handlers interviewed sometimes or always wore protective clothing, 40% of the all workers interviewed believed there was no way to protect oneself from the dangers of pesticides. Other findings indicate that workers may not always use the health and safety information to protect themselves if they do not believe that they have control over the harmful effects of pesticides (Austin et al., 2001). In some instances, the facilities provided by employers, such as drinking water, laundry, and toilets, are not used because they are in conflict with workers beliefs. For example, workers in North Carolina reported that washing in the iced water supplied for drinking while their hands or bodies were hot from working in the fields could lead to rheumatism (Arcury et al., 2001).

As noted, many of the farmworkers in this study have breathed pesticides in the air, touched plants with visible pesticide residue, and have been sprayed with pesticides by a plane or tractor. Findings from this study correspond to other recent studies that have identified multiple routes of pesticides exposure (Wilk, 1993; Jackson, 2002). In a study by Reeves and Schafer (2003), 76% of pesticide poisonings in the state of California were due to drift and residue on plants, a mode of exposure that the WPS does not adequately protect against. Pesticides can also be tracked into the home on clothing or shoes, or through drift in the air. McCauley et al. (2001) found pesticide residue in dust in the homes of Oregon agricultural workers, while other studies show that those who do not apply pesticides are equally likely to take pesticides home with them on their clothes or shoes (Thompson et al., 2003).

A consequence of exposure and the inability to protect themselves from the potential hazards of agricultural work may explain the elevated rates of certain health conditions in this population. Farmworkers in our study experience higher rates of physical ailments associated with agricultural work, including symptoms of arthritis, back pain, itchy skin, eye irritation, muscle weakness, and difficulty breathing. The prevalence of these symptoms in the general U.S. population has not been studied for comparison. However, in a study of physical symptoms of Persian Gulf War veterans, a control group of veterans who were not deployed to the Middle East provides an estimate of

the prevalence of these symptoms in the general U.S. population. In this group of veterans, 18% experienced back pain (compared with 54% of the workers in this study); 2% had itchy skin, eczema, rashes, or allergies (compared with 40% of the workers in this study); and 4% had problems breathing (compared with 7% of workers in this study) (Proctor et al., 1998). This study's results are similar to a recent study of Colorado farmworkers in which 49% reported skin irritation, inflamed eyes or headaches and 22% had difficulty breathing (Jackson, 2002).

In addition to the physical symptoms described here, 65% of workers said their general health was "fair" or "poor," which is a lower rating than the general U.S. Hispanic population, who on average rate their health as "good" (CDC, 2006). When workers experience poor health, there may be cultural barriers to the use of healthcare services. Many workers believe in traditional or folk medicine healing systems. "Susto," an illness in which the soul leaves the body due to fright, shares many symptoms with pesticide poisoning, and workers may be unlikely to seek medical care if the American biomedical approach is not considered an acceptable treatment for "susto" (Baer and Penzell, 1993). Other barriers to seeking and receiving healthcare among farmworkers include limited clinic office hours, linguistic barriers that hinder patient-physician communication, poverty, job insecurity, lack of transportation to services, no or inadequate medical insurance, and reliance on home remedies (Villarejo et al., 2000; Bade 1993).

Another important discovery of this study are the differences between indigenous and Latino farmworkers. For example, significantly more indigenous farmworkers were pickers, were younger, and have been in the U.S. for less time than Latino farmworkers. Although both groups of workers reported concern about health, the finding that Latino workers reported more concern about the effects of pesticides on their health and the health of their children than indigenous workers likely reflects a general deficit of pesticide training and related knowledge, and not a lack of concern about health. Other studies, including a study of adolescent farmworkers in Oregon, have found lower pesticide knowledge among indigenous workers compared with those of Latino descent (McCauley et al., 2002). These differences and the unique needs of indigenous farmworkers must be considered when developing occupational safety training materials and policy solutions to improve the occupational health of all farmworkers.

These study results should be interpreted with the following limitations in mind. First, the data are based on 150 survey interviews with farmworkers in Oregon using convenience sampling. The small sample size and sampling method may reduce the generalizability of the study findings to other farmworkers. In an effort to address this potential limitation, interviews were conducted from spring through early fall of 2006 to include farmworkers in a variety of agricultural settings. We also interviewed seasonal farmworkers who live in Oregon year-round and migrant farmworkers who move between states and are more transient to understand the experiences of farmworkers outside this region. To increase uniformity of survey administration during the several months of data collection, the same four interviewers conducted all surveys, and the indigenous-language audiotapes were used when appropriate. Another potential limitation is that the survey was translated from written Spanish into the indigenous languages, which may affect the survey participants' understanding of the questions. The indigenous-speaking community educators worked in pairs, identified concepts and terms that would be difficult to interpret into the indigenous languages,

and agreed upon translations to increase accuracy and consistency of translations. To elicit additional clarification of terms and findings, survey results were shared with members of the farmworker community during three community forums, or feedback sessions. Community educators invited participants to the forums, which were conducted in Spanish with simultaneous Mixteco interpretation when needed. Community educators presented the survey results and invited reaction from forum participants to the results. A follow-up survey to evaluate differences in farmworkers' responses from baseline will be administered spring to summer 2008.

Conclusion and Project Next Steps

As demonstrated with the results presented here, farmworkers may not be receiving the appropriate training or equipment needed to protect themselves from the health effects of pesticides. Additionally, farmworkers in this study reported health problems that are consistent with pesticide exposure. The changing demographics of the agricultural workforce require development of appropriate services and materials for indigenous farmworkers, and protection from health-threatening exposures. To address the needs of the workers identified in the survey results and to build leadership, project partners trained indigenous farmworkers as *promotores*, or community health workers. The initial and ongoing trainings address issues such as pesticide and field sanitation, problem solving, policy, and community advocacy. The project is also increasing awareness among medical providers, regulating agencies, and employers that indigenous languages are not simply a variation of Spanish, and that indigenous cultures have traditions distinct from other Latino communities. Such efforts are imperative to address the unique occupational and health conditions of a fast-growing community of agricultural workers.

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