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Pesticide Risk Communication, Risk Perception, and Self-Protective Behaviors Among Farmworkers in California's Salinas Valley

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Agricultural pesticide use is the highest of any industry, yet there is little research evaluating farmworkers' understandings of the health risks chemical exposure poses. This study examines pesticide education, risk perception, and self-protective behaviors among farmworkers in California's Salinas Valley. Fifty current and former farmworkers were interviewed for this research. Despite several potential barriers to risk communication (e.g., language differences and nonuniform methods of pesticide safety training), the respondents understood many of the potential health consequences of exposure while holding elevated levels of risk perception relative to the general public. They received information on the health effects of pesticide exposure from both grower-based training and personal social networks; however, the respondents continued to participate in unnecessarily risky behaviors.

Keywords: *farmworkers; pesticides; risk perception; risk communication; self-protective behaviors*

Racial and ethnic minorities tend to have elevated perceptions of social and environmental risks relative to their White counterparts (Finucane, Slovic, Mertz, Flynn, & Satterfield, 2000; Slovic, 2000b). Explanations for this trend have included that minorities have a lower perceived control over environmental hazards (Flynn, Slovic, & Mertz, 1994), are more vulnerable to the hazards (Slovic, 2000b), and benefit little from the hazard's existence

(Finucane et al., 2000). These studies have tended to base their conclusions on research of accessible populations, such as college students or suburban residents, and those people most at risk from environmental hazards are rarely solicited for participation. This is especially true as it pertains to Latina/o farmworkers and their perception of the risks contained within exposure to chemical pesticides.

The U.S. Environmental Protection Agency (USEPA) estimates that 1.2 billion pounds of chemical pesticide active ingredient were applied in 2001; of these, 907 million pounds (76%) were used in agriculture (USEPA, 2006). Despite this concentration of chemicals in the agricultural industry, there are only a handful of studies on farmworker risk perception with respect to pesticide exposure (see, for example, Arcury, Quandt, & Russell, 2002; McCauley, Sticker, Bryan, Lasarev, & Scherer, 2002; Vaughan, 1993a, 1993b). This is especially relevant in California, as this state accounts for approximately 21% of all agricultural pesticide use in the country (California Department of Pesticide Regulation [CDPR], 2000). Within the farmworker community of California's Salinas Valley, this study seeks to evaluate the current levels of pesticide exposure risk communication, risk perception, understandings of potential health consequences, and pesticide exposure–specific self-protective behaviors.

Background

Agricultural Pesticides and Health Risks

Agricultural labor is the United States' second most hazardous occupation in terms of workplace injuries, illnesses, and deaths, and it is the most dangerous employment open to children (Tucker, 2000, p. 2). A key factor contributing to this health risk is chemical pesticide exposure. Pesticides are created to perform biological interventions, including sterilization, impairment of the central nervous system, and even death. Since 1947,

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pesticides have been legally classified as *economic poisons* (Moses, 1995). They are not organism specific, affecting humans and aphids alike. Thus, it is not a matter of *if* pesticides are dangerous but rather how farmworkers can minimize the risks pesticide exposure poses to them and their families. There are between 10,000 and 20,000 reported pesticide-related illnesses every year in U.S. agriculture; however, due to underreporting and misdiagnoses, the USEPA estimates the number to be over 300,000 poisonings annually (Salazar, Napolitano, Scherer, & McCauley, 2004; Tucker, 2000).

Pesticide exposure can be both acute and chronic, which can result in "elevated risks of cancer, neurobehavioral deficits, congenital malformations, and other health risks such as leukemia and neoplasms" (Thompson et al., 2003, p. 1). Children are especially susceptible to the effects of pesticide exposure because of "their high skin surface area to weight ratio, developing organs, permeable skin, and high metabolism" (Zartarian & Leckie, 1998, p. 135). Even if children are not directly exposed to pesticides in agricultural fields, their parents can track chemicals into the home on their work clothes (Goldman, Eskenazi, Bradman, & Jewell, 2004). The health risks posed by pesticide exposure may not be avoidable in agricultural labor; however, farmworkers can reduce them through a combination of education and behavior modification (Vaughan, 1993b).

Farmworkers, Pesticide Exposure Risk Communication, and Risk Perception

For farmworkers to mitigate the risks involved in pesticide exposure, they need to first receive information regarding specific hazards, but there are many potential obstacles to this risk communication. The majority of California farmworkers are poor, Latina/o immigrants (predominantly from Mexico), 50% of whom do not speak English, while 80% cannot read English (Burgarin & Lopez, 1998). Thus, growers have to be sensitive to the specific needs of their employees in terms of pesticide training. It is not only necessary for farmworkers to understand the hazards in their environments, but it is also the law. The USEPA Worker Protection Standard requires growers to provide adequate, understandable training to their employees regarding the risks of pesticide exposure and proper pesticide use (USEPA, 1992). This training ideally should result in farmworkers being able to consciously mitigate the health risks posed by pesticide exposure.

This has not been the case, as demonstrated by studies examining pesticide safety training among farmworkers. Arcury, Quandt, Austin, Preisser, and Cabrera (1999) found that "only 35.2% of this sample of farmworkers reported ever having received any information or training on pesticide safety" (p. 461). Thus, it is not surprising that in Vaughan's study (1993b), 55% of farmworkers interviewed believed cancer to be the result of unavoidable environmental exposures compared to less than 33% of the American population (p. 7). This is relatively consistent with Arcury, Quandt, and Russell (2002), who found that 48.3% of their farmworker respondents felt they had either no or only small amounts of control in avoiding the possible harmful effects of pesticides (p. 236). Increased perceived control is associated not only with decreased risk perceptions but also with increased self-protective behaviors (Slovic, 2000a). The few studies focusing on farmworkers have shown the opposite trends among this population: decreased perceived control with respect to environmental hazards, increased perceptions of risk, and decreased self-protective behaviors (McCauly et al., 2002; Salazar et al., 2004; Vaughan, 1993a, 1993b).

Gender differences also affect perceptions of health risks. While there has been little exploration of gendered differences in farmworker risk perception, there is a large body of knowledge highlighting how men tend to have lower perceptions of risk relative to women (Bord & O'Connor, 1997; Finucane et al., 2000). This is, in part, a function of "differences in perceived vulnerability to risks from the environment" (Bord & O'Connor, 1997, p. 1), especially for pregnant women. The key to decreasing health risks is translating information and perceptions of risk into increased self-protective behaviors.

Self-Protective Behaviors

There is a modest but growing body of literature regarding behaviors farmworkers can change to lessen the health risks posed by pesticide exposure. Some interventions include the following: changing out of work clothes before returning home from the fields (Goldman et al., 2004); separating work clothes from nonwork clothes for laundry (Braaten, 1996); using protective clothing while in the field, such as gloves, long-sleeve shirts, and coveralls (Thompson et al., 2003); and wearing work clothes only once before washing (Braaten, 1996).

While these have been identified as specific behaviors farmworkers can modify to reduce their and their family's pesticide exposure, there is little research on whether or not they use such precautions. In addition, there is little information regarding whether or not the need for changing these behaviors is even being communicated to agricultural laborers. Within this context, the questions guiding this study are as follows:

- What information sources are farmworkers receiving regarding pesticide exposure?
- How risky do farmworkers understand pesticide exposure to be?
- In what pesticide-related self-protective behaviors do farmworkers participate?

These questions guide an inquiry into pesticide risk communication and risk perception among Salinas Valley farmworkers.

Method

Data Source and Sample

A questionnaire was developed to assess farmworker understandings, perceptions, and self-protective behaviors with respect to agricultural pesticides. The first section examined the specific means of pesticide risk communication to understand where the respondents received their information. The second section asked farmworkers about their perceptions of the risks associated with 20 voluntary activities (including pesticide exposure) on a Likert-type scale of 1 (*low risk*) to 10 (*high risk*). The third section addressed farmworkers and their understandings of potential health consequences of pesticide exposure. The final section of the questionnaire focused on the respondents' self-protective behaviors with respect to pesticide exposure.

The questionnaire was written in English and then translated into Spanish by a native-Spanish speaker. Three other native-Spanish speakers edited the translated questionnaire, and a final native-Spanish speaker translated it back to English, comparing the result with the original document. Two trial runs of the questionnaire were administered to Salinas farmworkers, corrections were made, and one final trial run was administered to another community member. Once the survey was developed, 50 farmworkers in California's Salinas Valley were recruited to participate in this research. The Salinas Valley was chosen because it is located in Monterey County, which had the fifth-highest agricultural pesticide use in California (CDPR, 2000). Participants in this study either currently work or have worked in the fields, and all of the solicitations for participation took place after community meetings and other community-based public arenas. The questionnaire took approximately 30 minutes to complete and was administered orally in the language of the participant's choice (49 out of 50 were in Spanish) to avoid varying reading and writing ability levels. To complete 50 interviews, 110 individual solicitations were required.

Results

Demographics

All of the respondents were of Mexican decent, but birthplace and citizenship status were not asked due to the sensitive nature of the questions. Twenty-seven of the participants were male, and 23 were female. This represents a gender bias in the sample; however, it is less than the gender split of the California farmworker population, which is more than 70% male (Bugarin & Lopez, 1998). The participants' per capita income averaged between $10,000 and $15,000 per year. This is slightly higher than the California farmworker average of $10,000 per year, but it still represents poverty-level wages. The average respondent was 39 years old, which is high for an agricultural community but expected because Salinas Valley farmworkers tend to be a semipermanent-to-permanent workforce.

All 50 respondents spoke Spanish, 16 spoke English, and 48 could read Spanish, while 15 could read English. However, reading and writing abilities were limited because participants completed an average of 7.8 years of school, almost exactly the California farmworker average of 8 years (Burgarin & Lopez, 1998). While all of the respondents had worked in the fields (averaging over 6 years of experience each), 28 were working in the fields at the time of the interviews. The others were either on disability, laid off, returning to school, or retired.

Pesticide Exposure Risk Communication

There were two types of pesticide exposure education the farmworkers received: *mandated* (i.e., grower provided) and *supplemental* (i.e., non–grower provided).[1] The respondents were asked to describe which sources of information they relied upon to form their understandings of pesticide exposure risk (see Table 1).

Half of the 50 respondents received some type of pesticide education from their employer. All 25 received information in Spanish, and 3 received additional educational materials in English. Of the 28 respondents working in the fields at the time of the interview, 68% (n = 19) reported receiving information from the grower, while only 27% (n = 6) of the remaining 22 received this training. There were also differences along gender lines, as two thirds (n = 18) of the male respondents received mandated training compared to only 30% (n = 7) of the females.

The farmworkers received multiple types of media for this education. Of the 25 farmworkers who received mandated trainings, 64% (n = 16) watched

Table 1
Sources of Pesticide Exposure Health Risk Information

	Female[a]		Male[b]		Total[c]	
Source	*n*	(%)	*n*	(%)	*n*	(%)
Mandated sources						
Presentation	7	(30)	12	(44)	19	(38)
Pamphlet	5	(22)	12	(44)	17	(34)
Videotape	5	(22)	11	(41)	16	(32)
Other	2	(9)	5	(19)	7	(14)
Total (no repeats)	7	(30)	18	(67)	25	(50)
Supplemental sources						
Television	12	(52)	10	(37)	22	(44)
Family	10	(43)	6	(22)	16	(32)
Friends	6	(26)	8	(30)	14	(28)
Newspaper	7	(30)	0	(0)	7	(14)
Health clinic	2	(9)	3	(11)	5	(10)
Magazine	2	(9)	0	(0)	2	(4)
Total (no repeats)	19	(83)	21	(78)	40	(80)

a. $n = 23$.
b. $n = 27$.
c. $n = 50$.

videotapes, 68% ($n = 17$) read pamphlets, and 76% ($n = 19$) viewed presentations. In addition, 76% ($n = 19$) of these respondents felt the training was sufficient to generate understandings of the risks involved in exposure, 1 reported the training was too much, and 5 reported there was not enough training. While mandated education is important, it is not the entire picture with respect to pesticide exposure risk communication. The respondents also heavily relied upon supplemental sources for their pesticide information, and in many cases, they received more information from these resources.

Supplemental sources of pesticide risk communication are not mandated by law, and it was therefore surprising to find such an extensive use of this means of pesticide education. While 50% ($n = 25$) of the respondents received mandated pesticide education information, 80% ($n = 40$) received information on the subject from supplemental sources. The most commonly reported were television (44%, $n = 22$), family (32%, $n = 16$), and friends (28%, $n = 14$). Unlike mandated training, men and women tended to rely upon supplemental sources of information equally. Of the female respondents, 83% ($n = 19$) utilized at least one supplemental source of pesticide exposure risk information, while 78% of men ($n = 21$) did as well. Women on average tended to utilize more supplemental sources of pesticide information ($\bar{X}_{female} = 1.70$) than men ($\bar{X}_{male} = 1.00$); however, running a *t* test revealed these differences were not significantly different. The primary gender difference for supplemental information came from reading the newspaper. Of the female respondents, 30% ($n = 7$) received pesticide exposure risk information from this source, while none of the male respondents did.

Risk Perception

Participants were asked to evaluate 20 voluntary activities (e.g., riding a motorcycle) in terms of the potential health risks perceived by the respondent. On a Likert-type scale from 1 (*low risk*) to 10 (*high risk*), pesticide exposure received an average score of 9.46, ranking it as the second most risky behavior behind drinking and driving (9.88) and just ahead of firing a gun (9.36). The perceived risk specific to pesticide exposure is elevated relative to White men, who tend to understand pesticide exposure to be between a slight and a moderate risk (Flynn et al., 1994). In addition, the participants in this study understood pesticide exposure to be more potentially hazardous than even the women of color who have previously rated it slightly above a moderate risk (Satterfield, Merz, & Slovic, 2004).

Within the sample of farmworkers participating in this study, there were differences between men and women with respect to their pesticide exposure risk perception. Men on average rated pesticide exposure 9.15 ($SD = 1.63$), while women rated it 9.83 ($SD = 0.49$). Running a two-tailed *t* test of samples with unequal variances showed this to be a significant difference ($t(2, 48) = 2.05, p < .05$).[2] Consistent with the literature, women tend to have significantly elevated perceptions of environmental risks relative to their male counterparts (Finucane et al., 2000).

Understanding Health Consequences of Pesticide Exposure

Through open-ended questions, the respondents were asked to identify possible health outcomes of pesticide exposure in terms of both acute and chronic poisonings (see Table 2).

Of the respondents, 78% ($n = 39$) identified at least one consequence from acute pesticide exposure, 80% ($n = 40$) identified at least one possible health result of chronic exposure, and 60% ($n = 30$) identified at least one potential effect from both.

The respondents tended to identify multiple health consequences, with the mean number of responses for acute exposures being 2.33 ($n = 39$) and

Table 2
Potential Effects of Pesticide Exposure

	Acute Exposure							Chronic Exposure					
	Female[a]		Male[b]		Total[c]			Female[a]		Male[b]		Total[c]	
Effect	*n*	(%)	*n*	(%)	*n*	(%)	Effect	*n*	(%)	n	(%)	n	(%)
Rash	9	(39)	11	(42)	20	(40)	Cancer	6	(26)	10	(37)	16	(32)
Skin irritation	7	(30)	6	(23)	13	(26)	Illness (nonspecific)	6	(26)	7	(26)	13	(26)
Dizziness	6	(26)	5	(19)	11	(22)	Death	4	(17)	3	(11)	7	(14)
Blurry vision	6	(26)	3	(12)	9	(18)	Allergies	2	(9)	2	(7)	4	(8)
Vomiting	6	(26)	3	(12)	9	(18)	Birth defects	0	(0)	3	(11)	3	(6)
Nausea	4	(17)	4	(15)	8	(16)	Asthma	2	(9)	1	(4)	3	(6)
Headache	4	(17)	3	(12)	7	(14)	Tuberculosis	1	(4)	0	(0)	1	(2)

Note: Respondents were allowed to list more than one potential effect of pesticide exposure. In total, 37 (74%) respondents identified at least one effect of short-term pesticide exposure, and 39 (78%) identified one long-term health effect.
a. $n = 23$.
b. $n = 27$.
c. $n = 50$.

for chronic exposures being 1.59 ($n = 40$). The most common responses for acute exposures were rash (40%, $n = 20$), skin irritations (26%, $n = 13$), and dizziness (22%, $n = 11$), while the most common responses for chronic exposures were cancer (32%, $n = 16$), nonspecific illness (26%, $n = 13$), and death (14%, $n = 7$). In addition, Table 2 illustrates there were minimal differences between men and women in terms of their understandings of potential health consequences of pesticide exposure.

Self-Protective Behaviors

Even though the farmworkers interviewed had high perceptions of pesticide exposure risk and understood potential health consequences, they still participated in risky pesticide-related activities (see Table 3).

The respondents wore their work clothes an average of 1.4 times ($n = 50$) before washing, and 22% ($n = 11$) washed their work clothes with nonwork clothes. In addition, 28% ($n = 14$) of the respondents reported working in the fields wearing either short sleeves or no shirt at all. Men on average tended to wear their work clothes before washing ($\bar{X}_{\text{male}} = 1.63$) more times than women ($\bar{X}_{\text{female}} = 1.15$), and this difference was statistically significant ($t(2, 48) = 2.79$, $p < .01$).

In addition, 100% ($n = 50$) wore their work clothes home from the fields, and 62% ($n = 31$) wore their work shoes or boots home. Of these respondents, 54% ($n = 27$) reported changing their clothing upon returning home, while 46% ($n = 23$) changed out of their work shoes or boots at this time. There were some gender differences within clothes changing, as 65% ($n = 15$) of female respondents changed out of their work clothes immediately after coming home compared to 44% ($n = 12$) of men. In addition, 26% ($n = 7$) of the male respondents waited until bedtime to change out of their work clothes, while none of the female respondents reported waiting this long. While this is by no means an exhaustive exploration of behavioral patterns, it does indicate there are many areas the respondents can target to reduce their pesticide exposures. It is consistent with previous findings that illustrate how farmworkers often receive training, but this does not necessarily translate into increased self-protective behaviors (Arcury et al., 1999).

Discussion

In this study, the respondents had elevated perceptions of pesticide exposure risk relative to previous research among nonfarmworker populations

Table 3
Self-Protective Behaviors

	Female[a]		Male[b]		Total[c]	
Behavior	*n*	(%)	*n*	(%)	*n*	(%)
Protective clothing worn in the fields						
Gloves	6	(26)	4	(15)	10	(20)
Boots	2	(9)	5	(19)	7	(14)
Coveralls/Overalls	0	(0)	4	(15)	4	(8)
Chemical-resistant clothing	2	(9)	2	(7)	4	(8)
Bandana	1	(4)	0	(0)	1	(2)
Changing work clothes						
Before returning home	0	(0)	0	(0)	0	(0)
Upon returning home	15	(65)	12	(44)	27	(54)
Several hours after returning home	8	(35)	8	(30)	16	(32)
Not until bedtime	0	(0)	7	(26)	7	(14)
Changing work shoes						
Before returning home	8	(35)	11	(41)	19	(38)
Upon returning home	12	(51)	11	(41)	23	(46)
Several hours after returning home	3	(13)	2	(7)	5	(10)
Not until bedtime	0	(0)	3	(11)	3	(6)
Work clothes washed with nonwork clothes	4	(17)	7	(26)	11	(22)
Number of times wearing work clothes before washing**	1.15		1.63		1.41	

a. $n = 23$.
b. $n = 27$.
c. $n = 50$.
**$p < .01$ (two-tailed t test comparing male versus female).

(see, for example, Flynn et al., 1994). This was surprising considering the potential barriers to pesticide exposure risk communication and the fact that only half of the respondents received pesticide education from the grower. In addition, the respondents could identify short-term and long-term health effects of pesticide exposure. However, without addressing dread (i.e., how adverse the participants were to hazardous outcomes), it was not possible to determine how much this knowledge affected perceptions of pesticide exposure risk or self-protective behaviors.

In addition, a lack of voluntariness could also account for farmworkers' elevated pesticide exposure risk perceptions (Vaughan, 1993b). Voluntary activities are frequently viewed as less risky than ones where participation is involuntary (Slovic, 2000a). This relates to farm labor because, as Griffith and Kissam (1995) argue, "Farm work does not represent a viable economic strategy except for persons who have explicit and effective social strategies for surviving well below the poverty level" (p. 227). People tend to seek employment in agricultural labor because they do not have other options, as illustrated by the approximately 47% of Vaughan's (1993b) participants who believed there was no other work available to them (p. 20). If the farmworkers interviewed did not feel they had a choice in their employment (and by inference, their pesticide exposure), this could partially explain their levels of perceived risk.

At all four steps of this analysis (i.e., pesticide exposure education, risk perception, understanding potential health consequences, and self-protective behaviors), female respondents tended to have elevated perceptions of risk and participate in more self-protective behaviors despite receiving less mandated training. While these results are consistent with previous literature (see, for example, Finucane et al., 2000; Slovic, 2000a), it still remains unresolved why this gender difference exists. Is *machismo* preventing men from viewing the pesticide hazard as potentially harmful to their health? Are women more vulnerable to the health hazards posed by pesticide exposure, and therefore their elevated risk perception is a function of heightened risk? Regardless, pesticide safety training methods need to be sensitive and responsive to the differing orientations of men and women with respect to their views on environmental risks.

The results from the behavioral questions were not sufficiently in-depth to draw direct inferences between risk perception and subsequent behavior. However, some results remained troubling. Specifically, the majority of the participants did not change out of their work clothes and shoes or boots before returning home. They frequently washed their work clothes with nonwork clothes while also wearing work clothes multiple times before washing. This could potentially be related to the previously discussed issue of voluntariness: If pesticide exposure is viewed as inevitable, why would people change their behaviors? Additionally, it begs a question regarding the content of pesticide training. Previous research illustrates that when farmworkers are educated regarding the potential health effects of pesticide exposure, intervention strategies are frequently not part of this training (Arcury et al., 1999).

This study adopted an individualistic framework for examining farmworker pesticide risk perception. Scherer and Cho (2003) argue that individuals adopt the attitudes and behaviors of their respective social networks. Thus, analysis of an individual's training and education alone are insufficient to understanding how she or he develops perceptions of risk. The respondents in this study lived in a semipermanent-to-permanent farmworker community, and given the salience of pesticide use, understandings of risk could be communally generated. This hypothesis is reinforced by the respondents' frequent reliance upon supplemental sources of pesticide exposure information in generating their understandings of the health risks these chemicals pose.

The participants' use and reliance upon supplemental sources of information offered an alternative to grower-based intervention strategies. While primary responsibility for pesticide safety education falls on the growers, only half of the participants received this training, and this is a high rate for farmworkers. Utilizing community-based social networks could be a potential method of disseminating pesticide safety information; however, this may not be an effective strategy in agricultural areas that have a greater migratory farmworker population. Future research needs to differentiate between these two types of farmworker communities (migratory vs. permanent or semipermanent) so intervention strategies can be adapted to local community needs.

Notes

1. The terms *mandated* and *supplemental* are used in this study because the United States Environmental Protection Agency (USEPA) Worker Protection Standard mandates growers provide pesticide education to their workers (USEPA, 1992), and all other forms are therefore supplemental to this federal regulation.

2. See Ruxton (2006) for the difference between a standard *t* test versus the unequal variance *t* test.

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