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Un Lugar Seguro Para Sus Ninos: Development and Evaluation of a Pesticide Education Video

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The need exists for culturally appropriate and effective educational interventions to reduce pesticide exposure in migrant and seasonal farmworker (MSFW) communities. The development of one such intervention was part of a community-based research project which partnered the Oregon Health Sciences University and the Oregon Child Development Coalition (Migrant Head Start). The process involved identifying an optimal educational method and content, evaluating existing educational materials on pesticides, developing the selected educational tool (a video), and assessing the effectiveness of the video as an intervention.

Focus groups were conducted with MSFWs to elicit their perceived need for education and desired content, method, and delivery. Four currently used educational tools were evaluated for satisfaction, preference, recall ability and knowledge change. Based on these findings, a pesticide exposure video directed at the protection of children was produced. To determine the effectiveness of the video, knowledge, satisfaction and self-reported behaviors were assessed with MSFWs. A sizeable increase in overall pesticide knowledge was measured after seeing the video ($p < 0.0001$). MSFWs overall were satisfied with the video and reported increased protective behaviors after seeing the video.

KEY WORDS: migrant farmworker; pesticide exposure prevention education; community-based research.

INTRODUCTION

In 1991, an estimated 817 million pounds of active pesticide ingredients were used in agricultural applications in the United States (1). Pesticides, while improving the quality of fresh fruits and vegetables in our diets, can also cause harm by damaging the environment and accumulating in ecosystems. Depending on the dose, some pesticides can cause a range of adverse effects on human health.

While all populations have a degree of risk in relation to pesticide exposures from nonagricultural use, and through residues on food, there exist certain subgroups of the population with higher risk of potential exposure and health effects. For example, the number of agricultural workers potentially exposed to pesticides is estimated to be 1.5 million, and up to 2.4 million unpaid workers or family members are involved in farming or related activities, which may expose them to pesticides (2). Minority workers are typically overrepresented in jobs involving exposure to hazardous chemicals, including the farmworker population (3). The Office of Migrant Health estimated that there are 3 million "migrant and seasonal farmworkers and their dependents" in the United States (4). Pesticides represent one particular group of environmental contaminants

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to which minorities and socioeconomically disadvantaged groups are inequitably exposed (5).

The work and living environments of the migrant farmworker present numerous sources for pesticide exposure. Mobed *et al.* categorized these sources of exposure as avoidable (e.g., diluting and mixing pesticides, applying pesticides, being sprayed), unavoidable (e.g., drifts, contact with residues), and unknown (e.g., contaminated water, contaminated fruits and vegetables) (6). Migrant farmworker housing can be a major source of contamination through proximity to sprayed fields and exposure to drifts of pesticides during and following their application. Farmworkers themselves may contaminate their dwellings by inadvertently carrying pesticides home from work on their clothes, skin, hair, tools, and vehicles. Pesticides may persist in dwellings longer than in outdoor environments due to the lack of degradative environmental processes such as sun, rain, and microbial activity (7).

Immediate health consequences of pesticide exposure have been documented for acute exposures (e.g., gastrointestinal distress, headache, skin rashes, eye irritation, malaise, ataxia, and mild psychological and behavioral deficits) while the long-term health effects due to acute and low-dose, long-term pesticide exposures are unclear (8). Associations have been made between long-term exposures and several types of cancer, neurotoxic effects, and reproductive problems (9–11). While levels of occupational exposure to pesticides have been established and studies of both acute and chronic exposure have been reported, much greater attention needs to be paid to assessing exposures and adverse health effects in population subgroups known to be exposed to pesticides, including minority groups that may be at increased risk such as migrant and seasonal farmworkers.

In 1992, the U.S. Environmental Protection Agency (EPA) Worker Protection Standard established national guidelines for the minimum requirements for teaching pesticide safety to farmworkers and more stringent requirements for pesticide handlers' safety (12). As part of the guidelines, farmworker safety education is required to include 11 specific topics related to pesticide exposure. The Worker Protection Standard (WPS) directs employers to provide pesticide safety training in a nontechnical and understandable written, audiovisual, or oral form as well as to allow time for the employer to answer questions. Training should be provided to each farmworker once every 5 years. Since the authorization of the WPS, a variety of training materials have been developed to help employers meet the WPS with the focus being on educating the agricultural worker to protect him or herself at work. These materials, usually bilingual in English and Spanish, vary greatly in quality (sound, content, and graphics) and reading level. As with the majority of pesticide training materials, no information exists on their effectiveness or acceptability.

In order to address the need for culturally appropriate and effective education for the migrant community, we have developed and evaluated a video aimed at teaching Latino farmworker families ways to protect their children from pesticide exposure. This paper outlines the process of selection of video as the best format and the development and evaluation of the video. This effort can be divided into four steps. They are 1) identifying the optimal training method and content; 2) evaluating existing educational materials on pesticides; 3) developing the selected method; and 4) assessing the effectiveness of the video as an intervention. In addition, the paper describes not only the process but also the implementation of the process in order to share the lessons learned while doing research with culturally diverse populations.

The Reducing Pesticide Exposure in Minority Families Project, funded by the National Institute of Environmental Health Sciences, is a 4 year (1996–2000) interdisciplinary community-based environmental research program focusing on pesticide contamination in agricultural communities in Oregon. The Oregon Health Sciences University's Center for Research on Occupational and Environmental Toxicology (CROET) partnered with the Oregon Child Development Coalition (OCDC) in the development and implementation of this project. OCDC operates the Migrant Head Start (MHS) Program for the state of Oregon. The research advisory committee for this project includes MHS parents, local growers, agricultural researchers, and health providers. A major goal of the project is to develop and evaluate a culturally appropriate educational intervention regarding pesticides for MHS families in Oregon. The project also includes cross-sectional surveys of pesticide use and protection practices, analyses of home dust samples for pesticide residues, assessment of biomarkers of organophosphate exposure, and assessment of effects on neurobehavioral function.

STEP I: IDENTIFYING THE OPTIMAL TRAINING METHOD

Fundamental to the development of an educational intervention for migrant farmworkers is gaining an understanding of (a) their beliefs and practices regarding pesticides, (b) their perceived need for future pesticide education, (c) their past pesticide education, and (d) their preferences for methods of pesticide education. Focus groups were chosen as the most practical means for obtaining this information from MHS parents.

Five MHS centers in Oregon were selected as sites for the focus groups. Family service workers at the centers informed parents through notes sent home with the children. Focus groups were conducted on weekday nights or weekends depending on the site. Food and childcare were provided. A staff member fluent in Spanish served as moderator for the sessions. Sessions were conducted in Spanish and lasted approximately 1.5 h. Questions for the focus groups and the demographic questionnaire were translated into Spanish by an individual of Mexican birth and farm working history and reviewed by other similar individuals. The process of planning and implementing the focus groups with the MHS parents required careful consideration of the characteristics of the participant population, their lifestyle, and effective process techniques.

Results of Step I

A total of 59 parents participated in the focus groups. Size of groups varied according to site [4–17]. Their ages ranged from 21 to 30 years (42% female, 58% male). All were born in Mexico. Fifty percent had received less than 5 years of formal education.

Information from the focus groups revealed that parents had not consistently received pesticide education from their employers. Educational methods typically involved pamphlets, videos, and/or lectures by the growers or supervisors. Information tended to be one sided without opportunities for the parents to ask questions or clarify the information. Not all parents could read the pamphlets or chose not to read them. Anecdotally, parents commented that it was difficult to remember the information or to understand all the information. The parents were divided as to whether the information provided was sufficient or not; however, the majority asserted they needed more pesticide information. They wanted to be told what they needed to know and they wanted us to tell the "patron" (the employer). Several stated "tell us what is missing from our answers so we will know."

The parents also requested specific information be included in pesticide education. These topics were (a) consequences of pesticide exposure, (b) the level of danger of the pesticides in their workplace, (c) the symptoms and illnesses of exposure and how they are caused by pesticides, (d) level of exposure experienced in order to inform supervisor, (e) emergency care, and (f) overall prevention of exposure.

Most parents cited videos as the preferred method for pesticide education. One parent suggested an audiocassette that could be played at home as desired. Parents identified physicians, specialists, teachers, or those who had studied pesticides as preferred resources to explain about pesticides. This person did not need to speak Spanish as long as an interpreter was present, nor did this person have to look like them. Preferably, a competent person who could answer questions would be available following the video. A few parents wanted a Spanish-speaking person in the fields with them to answer questions. Almost all of the parents preferred the education take place in their children's MHS center and a few additionally wanted the information to be presented at work.

A major theme that emerged from the parents' beliefs and practices regarding pesticides was their concern for the vulnerability of their children and their desire to protect their children from pesticides. This finding became central to the development of the intervention. Development of the intervention was also based on other key findings. That is, the parents wanted more information on pesticides and had areas of specific interest. They possessed certain beliefs and practices that could be addressed in the intervention. They requested an authority figure as teacher and preferred a video format.

STEP II: EVALUATING EXISTING EDUCATIONAL METHODS ON PESTICIDES

The second stage in the project's development of an intervention was to test various existing pesticide education methods. The goals for the testing were 1) to determine the MHS parents' level of satisfaction and preference of methods following exposure to various methods; 2) to ascertain any differences in the parents' ability to recall pesticide information following exposure to each method; and 3) to measure for change in pesticide knowledge following participation in the testing.

The first step in the process was to identify the methods to be tested. Four of the most commonly used educational methods were chosen: video, pamphlets, posters, and popular education. Examples of each method were collected from various sources such as the Occupational Health and Safety Administration (OHSA), the U.S. Environmental Protection Agency (EPA), and state programs. Each example was reviewed by project staff for clarity, information provided, appeal, and language appropriateness. One sample item was chosen for each method. The representative items were a video on pesticide exposure from the Idaho Department of Agriculture and the University of Idaho, booklets from the Environmental Protection Agency (Protect Yourself from Pesticides) and the Oregon Health Division (Cuidado con los Pesticidas y Metodos de Seguridad), and an EPA poster and an interactive skit developed by La Familia Sana, an experienced group of lay health promoters in Hood River, Oregon. Certain project staff were trained by La Familia Sana in the techniques of popular education in order to include this method in the testing. Content common to each method was selected and each method was reduced to include only that content. For example, the video was shortened to 5 min to include information on pesticides in general, pesticide residues, and preventive methods (e.g., hand washing, separating work clothes).

Four questionnaires were developed, including a demographic questionnaire, to address the goals of the testing. All questionnaires were translated into Spanish and reviewed by the same individuals who translated and reviewed the focus group materials. To determine the parents' preference of methods, questions were asked regarding the individual's first two choices for learning about pesticides. They also were asked why they liked their preferred methods. Recall ability was assessed by asking each individual what he or she remembered from the particular method, for example, the poster. The question was followed by a second question asking if anything else was remembered from the method. To measure change in pesticide knowledge, identical pre- and posttests were used. Content for questions on the knowledge test was derived from the chosen educational methods. Five open-ended questions were asked. Each question was followed by 2–5 "si/no" statements (total 16) stemming from each open-ended question.

Four MHS centers were selected as the sites for testing (Sandy, Hermiston, Ontario, and Nyssa). All parents with children attending these centers were notified by MHS staff of the testing on a certain date and time (usually Sunday as per parents' suggestion). Parents were paid $25 each for participation. Child care and food were provided.

Parents were individually administered the demographic questionnaire and the knowledge pretest as they arrived to the testing site. The parents were arbitrarily divided into four groups and each group started in one of the educational testing areas. One project staff was assigned to each testing area. The process was explained and parents were given 15 min to examine or view the particular educational method. Then each parent was asked apart from the group to recall what they remembered from the educational method. When all individuals had been interviewed, the groups rotated to a different testing area and the process was repeated until every group had been to all four testing areas. The knowledge posttest and preference questions were then administered to each individual.

The first MHS center served as the pilot site. Lessons learned included a longer than anticipated process, fatigued parents, confusing questions, and interviewer inconsistency. Based on these lessons, the testing started immediately (instead of snacks being offered) and times were monitored closely, more interviewers were added and they were trained regarding consistency, and lastly, questions were reworded. These changes eliminated the original problems noted.

Results of Step II

Fifty MHS parents participated in the testing during summer and fall of 1998. Fifty-eight percent of the parents were female. Sixty-six percent were in their 20s, 26% in their 30s, and less than 4% were older. All but two of the parents were born in Mexico.

Regarding preference of methods, the video was preferred by 52% of the MHS parents. The other methods chosen as "best" were almost evenly distributed: poster (16%), booklets (14%), and skits (12%). After eliminating the first choice, parents chose skits (32%), video (22%), booklets (22%), and poster (16%) as their second choice. Reasons given for their choice of the video were predominately oriented toward being able to see—to see themselves in general, to see their daily lives, to see what they do wrong, and to see what they should do. According to the parents, they were better able to understand and learn information from the video.

Parents' recall of information from each method was judged to be adequate or inadequate. Recall was rated as adequate if the parent could give two or more correct items of information from the method. The number of parents giving adequate responses for each method were booklets (87%), skit (85%), video (78%), and poster (66%). It was not surprising that the skit produced a high recall. Information in the skit was reinforced within the session as part of the popular education process.

Change in knowledge was assessed through a series of "si/no" and open-ended questions. An individual's change was assessed using McNemar's statistical test for correlated proportions (13). Because this test investigates changes between pre- and posttest answers, only those responses that differ at the two time points are given any weight; questions that are scored correct/incorrect at both time points are non-informative about whether a particular person improved his/her score.

All but one individual had insignificant p values. The lack of significance is due in part to the limited number of questions asked (5 open ended and either 15 or 16 "si/no") and the fact that many participants scored well on the pretest and retained the same answers on the posttest. This issue of low power can be resolved to some degree by focusing on the group's improvement instead of individual gains.

Table I shows there was some evidence suggesting that, as a group, participants from Nyssa experienced a positive effect from the information on the "si/no" questions ($p < 0.05$, permutation test) (14). Open-ended questions appeared to be more sensitive with two sites, Sandy and Nyssa, showing significant group differences ($p = 0.02$ and $p < 0.01$, respectively, based on a permutation test). Therefore, certain groups of parents did experience change in pesticide knowledge following their exposure to four methods of education.

Overall, testing the methods informed our project about the parents' preferred method, a video, and a rationale for this preference. More than three fourths of the parents could adequately recall information from the video, which indicated a video could be an effective learning tool.

Table I. Testing Methods: Percentage of Correct Answers on Pesticide Knowledge Test

Site	Pretest	Posttest	1-sided p-value
Si/No (percent correct)			
Sandy	94	98	0.25
Hermiston	—	—	—
Ontario	98	96	0.94
Nyssa	89	92	0.05
Open ended (percent judged correct)			
Sandy	82	98	0.02
Hermiston	80	94	0.06
Ontario	85	91	0.19
Nyssa	73	94	<0.01

STEP III: DEVELOPING THE SELECTED METHOD – VIDEO

Steps I and II provided important information on type of educational intervention, the actors, and the content to include in addition to the required content. A video needed to be developed with an expert as the information giver and with a family as the demonstrators so that the parents could see the application of the information in their daily lives. From the focus group information on beliefs and practices related to pesticides, the message was clear that the parents were most concerned about their children.

The development of the video began with identifying themes from the focus groups regarding beliefs, practices, and questions regarding pesticides, pesticide exposure, and pesticide exposure prevention. For example, one prevalent theme was the belief that only weak individuals can be harmed by pesticides. Weak individuals included those who were new to field work, those who had any type of handicap or deformity, or those who were ill in any manner. This theme and others were incorporated into the pesticide information that would be presented in the video. The pesticide information was developed cooperatively between members of the community and scientific staff (including pesticide experts on the project). From this outline, a script that delivered realistic information was developed by project staff. The script was translated to Spanish by the expert used in the video, a well-respected Latino male from Mexico who is actively involved in Latino community activities. He had transcribed the focus group tapes and was familiar with the project. At this point, two Mexican former migrant farmworkers then reviewed the information for practicality and appropriateness of presentation. And lastly, the script was presented to the research advisory committee of the project for their suggestions and comments. The final video contained pesticide information in the following general content areas: contamination of children by contact with parent, removal of shoes before entering living area, hygiene upon returning from work, separation of work clothes from family clothes, cleaning living area and children's toys, washing fruit and foods before consumption, proper use of pesticides and containers, storage of pesticides, and time requirement for entry into sprayed fields.

The project then contracted with Dogstar Productions from Portland, Oregon, to produce the video. Staff from Dogstar Productions helped project staff reduce and organize the script into scenes that were effective and easy-to-follow. For example, our project was uncertain how to best use the expert, the migrant farmworker family, and lifestyle scenes to impart the necessary information. Dogstar staff recommended a variety of methods be employed. At times, the expert would deliver lecture-type information as he stood in the fields or camp. In other scenes, members of a migrant farmworker family would demonstrate the point while the expert was explaining. And other times, the family would talk about a point while demonstrating. A local migrant farmworker family was recruited from the MHS program and had a child of an appropriate age for the video. Both the family and expert were paid for their services. Arrangements were made with a local grower to use his labor camp and fields for taping. Shooting of the video occurred over a 4-day period with project staff present to provide direction regarding realistic setups and to make decisions as necessary. Our project staff reviewed the preliminary tapes and a few changes were made. The video, *Un Lugar Seguro Para Sus Ninos*, was now ready to be tested.

To reinforce the information provided on the video, a simple brochure was created. This brochure had been a recommendation from an experienced health educator, at La Clinica del Carino in Hood River, Oregon. Five actual frames from the video regarding five major educational points were used as pictures for the brochure. The message beneath the pictures was stated briefly and at a most basic level. On the last page of the brochure, phone numbers for poison control and migrant health clinics in Oregon were listed.

STEP IV: ASSESSING THE EFFECTIVENESS OF THE VIDEO AS AN INTERVENTION

Effectiveness of the video was measured in three ways. We measured change in pesticide knowledge, satisfaction with the video, and self-reports of pesticide preventive behaviors before and after viewing the video.

Knowledge Change. The pesticide knowledge test that was administered before and after viewing the video as well as 1 week later, was developed from content on the video. Content was divided into single messages and worded into simple item statements. Half of the items were changed into false statements. The items were translated by a bicultural, bilingual Latino individual and reviewed by the community partners of the project. From the project's previous testing experience, a si/no response format was determined to be the most practical method for testing. MHS parents had appeared overwhelmed when provided with answer forms that were printed with questions and answers, even if the questions were read to them. Therefore, an answer sheet numbered from 1 to 22 with "si or no" next to each number was used. The items were separated visually so that the numbers were easy to follow. A bicultural, bilingual individual read each question twice and the parents circled si or no.

The knowledge test was piloted at one of the farm labor camps in Oregon. Based on the pilot testing, instructions to the parents were made more specific and husbands and wives were seated at separate tables.

Satisfaction. The satisfaction questionnaire measured overall satisfaction, length of the video, appeal, new information provided, and applicability to the parents' lives. A Likert rating scale was used from 1 to 3 with 1 being "mala" (*bad*), 2 "buena" (*good*), and 3 "excelente" (*excellent*). Each item (7 items) was read to the parents for them to circle their response on a numbered sheet.

Self-Reported Behaviors. A subset ($n = 12$) of parents was recruited from the study sample to answer two open-ended questions regarding behaviors to protect themselves and their families from pesticides. Prevideo viewing, the questions were 1) tell me what you do in the house (cabin) to protect you and your family from pesticides, and 2) tell me what you do while working to protect yourself from pesticides. Postvideo viewing, the verb tense changed to the future tense to indicate what they were going to do in the house and at work to protect themselves. At retesting 1 week later, the questions were again worded in the present tense to indicate what they do now.

The intent of these questions was to look for increases in the number of reported behaviors from pre- to postviewing of the video. An increase in self-reported behaviors may indicate positive integration of the video information into their own lives.

Intervention Testing

Two MHS centers in Oregon (Cornelius and Sandy) were selected to test the video. These centers were chosen because parents possessed similar demographic characteristics and work situations. The testing was scheduled for Sundays as per the information from the focus groups. Knowledge recall testing was done 1 week after the initial testing. The testing protocol began with interviews for demographic information. Eight parents from Cornelius and four from Sandy were asked to volunteer to answer the current self-reported practices questions. The knowledge pretest was then administered to the entire group of parents. The video was shown to all parents as a group, followed by the administration of the posttest and satisfaction test. The subgroup of parents was again asked the self-reported practice questions. Parents were reminded about the knowledge recall test that would occur 1 week later. The knowledge test then was readministered.

Results of Step IV

One hundred parents was the desired sample size and confirmed by the MHS centers as a realistic number. A systematic random sample of parents was recruited in order to avoid centers inviting the more actively involved parents. A list of all parents was printed and every 3rd or 4th family was chosen depending on the size of the center. Sixty parents were invited. Both parents from a family were recruited in order to improve the probability of attendance. MHS staff created the invitation and sent it home with the children. MHS staff followed up with a home visit to personally invite the selected parents. The invitation informed parents that they would be paid $60 to participate in both the intervention and recall testing.

Forty-one MHS parents participated in the intervention. Parents from the two sites were of similar gender, age, education, birthplace, family size, work, and residence characteristics (see Table II). However, the two groups differed in the language spoken at home and at work. Parents in Sandy more often spoke in Spanish and a dialect at home and work while the Cornelius parents more often spoke in only Spanish. Fourteen percent of the Cornelius sample also spoke a dialect at work. The language in the video was Spanish that could have caused comprehension problems in participants speaking dialects. However, our findings described ahead showed that language did not significantly impact the test results.

Knowledge Change

Logistic regression for binomial proportions was used to model and test the effect of the video after accounting for differences due to location (Cornelius vs. Sandy) and sociodemographic factors. Pre- and posttest performance did not differ between the two sites after accounting for age, sex, previous pesticide training, language spoken at home, and highest grade achieved (p values = 0.43, 0.27 for pre- and postscores, respectively). Retention-test scores for Cornelius and Sandy appeared to differ ($p = 0.05$); thus, comparisons of the first two time points (pre- and posttest) use aggregated Sandy/Cornelius data while any comparisons involving retention scores are stratified by site. Table III shows a summary of these results.

Overall pretest knowledge can be summarized in terms of an individual's age, sex, and highest grade achieved ($R^2 = 63\%$). Males and females of similar age and education had similar pretest performance ($p = 0.04$) although there was a trend for males to score somewhat higher. Older participants scored lower than younger participants of similar education and gender ($p = 0.003$). Odds of giving a correct answer decreased approximately 4% for each additional year of age (95% CI, 1.5–7.1%). For each additional year of education, the completed number of correct

Table II. Demographic Characteristics of the Intervention Participants

	Location	
	Cornelius ($n = 27$)	Sandy ($n = 14$)
Age	26.1 ± 0.74	27.6 ± 2.42
Years of education	4.1 ± 0.48	2.5 ± 0.45
Average family size	4.6 ± 0.24	4.1 ± 0.38
Works in fields	93%	100%
Gender (% male)	41%	43%
Lives in cabin/trailer	93%	100%
Language spoken at home		
Purely Spanish	44%	29%
Mixture	18%	36%
Purely dialect	37%	36%
Language spoken at work		
Purely Spanish	93%	57%
Mixture	7%	29%
Purely dialect	0%	14%
Place of birth		
Mexico	93%	10%
Central America	7%	0%
Other residence when working in Agriculture *(top two choices given)*		
CA	63%	100%
OR	41%	14%
Received pesticide training	70%	29%

Table III. Estimated Mean Knowledge Score, Expressed as Percentage Correct Out of 22, for Each of Two Locations at Three Time Points

	Pretest	Posttest	Retention
Cornelius			
n	27	27	16
Range	41–95	54–95	54–95
Mean	73	82	79
SEM	0.03	0.02	0.04
Sandy			
n	14	14	10
Range	38–91	47–95	44–100
Mean	72	80	78
SEM	0.04	0.04	0.05

responses increased 17% above the number of incorrect responses (95% CI, 9–25% increase).

Using each subject as his/her own control revealed a sizeable increase in overall pesticide knowledge after seeing the video ($p < 0.0001$). Following the presentation, the number of correct answers was approximately 1.73 times greater than the number of incorrect answers (95% CI, 1.36–2.21 fold increase). This video effect was not associated with any sociodemographic factors ($p = 0.35$); that is, for example, persons with more education did no better than less educated individuals.

Participants had insignificant decreases in the test scores 1 week after the video when compared to scores immediately after the video. Retention ability appeared unrelated to sociodemographic factors ($p =$ 0.79 and 0.81, for Cornelius and Sandy, respectively). Participants from Cornelius had significantly higher retention scores than their original pretest scores ($p = 0.003$). Participants from Sandy did not show a significant difference between pre- and retention-test scores. In the end, both sites exhibited a small but insignificant decrease in overall knowledge from the time of the posttest to the time of the retention test. For Cornelius, this decrease was small enough so that the retention scores were still significantly higher than pretest scores. Individuals from Sandy had retention scores that essentially drifted back to their pretest levels.

Each of the 22 test items from the knowledge questionnaire was correlated with an individual's overall score. Items for that the correct answer was inversely correlated with overall score revealed questions that were answered incorrectly by those individuals scoring highest while those with lowest overall score got the particular question correct. Four items (Q6, Q9, Q10, and Q11; see Table IV) had this unusual pattern at the time of the pretest; however, they were directly correlated with overall score at both the posttest and retention times. Apparently, these questions were difficult/ambiguous at the initial testing period but became clear at the subsequent time points. Question 16 (see Table IV) showed the unusual pattern across all three time points for participants in Sandy while those in Cornelius appeared to have problems only on the posttest. The remaining test items were directly correlated with the overall score at all time periods (correlations ranged from 0.05 to 0.90).

Satisfaction

Participants from both Cornelius and Sandy had favorable views about the video (see Table III). All participants rated the video overall as good or excellent with respect to clarity and ability to capture their attention. All participants from Sandy felt the quantity of new information about pesticides and the ways to protect their children from pesticides was good or excellent; as did nearly all of those in Cornelius (92 and 88%, respectively). Impressions about the duration of the video, information about home pesticides, and information about how pesticides can be harmful to children were favorable with at least 69% or more of the participants rating the video good or excellent with respect to these areas (Table V).

Self-Reported Behaviors

Comparisons between self-reported behaviors pre- and postvideo were assessed using exact significance tests based on the permutation distribution of all possible paired differences. Although computationally intensive, the idea behind such tests is simple: 1) calculate the average difference between the

Table IV. True/False Knowledge Items With Notable Pattern of Responses

Item	
6	Pesticides can be brought into the house on parents' work clothes.
9	Dust/dirt in the house can contain pesticides.
10	Mopping floor is the best way to remove pesticides from the house.
11	Toys on the floor in the house can transmit pesticides to children who play with them.
16	Hanging clothes that have just been washed outside in the sun can break down pesticides on them.

Table V. Percentage of Participants Rating the Pesticide Training Video Good or Excellent With Respect to Seven Attributes

	Location	
	Cornelius ($n = 27$)	Sandy ($n = 14$)
Overall rating	100	100
Ability to capture attention	100	100
Length/duration	96	92
Information about home pesticides	69	85
Information about dangers to children	77	91
Information about ways to protect children	88	100
Quantity of new information about pesticides	92	100

number of self-reported behaviors (postvideo − previdEo) for the observed data; 2) randomly exchange (permute) the number of postvideo behaviors with the same participant's previdEo behaviors; 3) calculate the average difference (postvideo − previdEo) between the number of self-reported behaviors in this permutation set; 4) if the average difference derived through random permutation is greater than or equal to the average found in Step I, count it, otherwise, ignore it; and 5) repeat Steps II–IV until all possible permutations of the data have been exhausted. The exact p value for self-reported behaviors corresponds to the number of average differences produced at random that are greater than or equal to the average difference observed in the original data divided by the total number of randomizations.

For Cornelius, self-reported behaviors at home significantly increased after seeing the video (1-sided $p = 0.023$) but those at work did not (1-sided $p = 0.969$). Similar tests for Sandy indicated a suggestive improvement for both work and home practices (1-sided $p = 0.0625$ for each).

With respect to the qualitative aspect of the participants' responses, postvideo self-reported behaviors were in general more specific than previdEo responses. For example, a parent stated previdEo that she washes work clothes or cleans the floors. Postvideo, the responses changed to "she would wash clothes in hot water" and "she would sweep and mop the floors."

DISCUSSION AND IMPLICATIONS

By the nature of the work they do and the housing in which they dwell in order to do their work, migrant farmworker families risk exposure to pesticides. Reducing exposure of these families to pesticides should be the goal of government (national and state), growers, community agencies, and the families themselves. The Reducing Pesticide Exposure in Minority Families Project is one effort by community partners to work with migrant farmworkers to increase their self-protection and the protection of their children. Our approach was an educational intervention with the goal of developing and evaluating a culturally appropriate tool derived from the needs of and input from MHS parents. From the information obtained from the parents through focus groups and the testing of existing educational methods, our project developed a video with an emphasis on protecting the children from pesticide exposure.

During the development of the video, no literature was available on the evaluation of existing educational methods with migrant farmworkers. The evaluation criteria that we used included appropriateness of information, comprehensibility, authenticity related to migrant farmworker situations, and ability to stimulate interest. Since that time, an extensive review of safety training materials for farmworkers has been done and reported in the Journal of Agromedicine. Recently, Quandt *et al.*, concluded that safety training materials suffer from several deficiencies (15). These materials underestimate the learning capacity of the audience and thus provide a minimal quantity of information, for example, rationale for behaviors is not provided. Further, the existence and locations of chemical residues are typically not covered, nor are health consequences of exposure to residues. Actors tend to be white and male rather than authentic Mexican and/or farmworkers and translations do not capture the language of the intended population. Finally, most materials are not based on the health beliefs of the farmworkers themselves. If these deficiencies are used as criteria for the evaluation of a pesticide exposure educational tool, our project video passes in all areas. Our video's development was grounded in the beliefs, practices, needs, and desires of the MHS parents. All required pesticide exposure information with rationale was provided. Translations were provided by Mexican individuals, many of whom had worked as farmworkers. Notably, the actors in the video were all Mexican-born and the migrant farmworker family was authentic.

The actual evaluation component of our project included satisfaction with the video, pesticide knowledge change, and self-reported behavior change before and after viewing the video. As reported previously, MHS parents were satisfied with the video and asserted that they had learned new and helpful information. While results indicated intervention posttest scores significantly exceeded the corresponding pretest score, these results must be considered cautiously. A smaller sample size and number of test questions did not allow for much variability in change effects. One could argue that a study design in which participants are randomly assigned to treatment and control groups, with the treatment group given the educational intervention, would permit better insight into the effectiveness of the intervention. Or, that other measures such as levels of home residues and/or observed preventive home behaviors could be assessed for the treatment and control group participants prior to and following the intervention. The residue amounts and behaviors could be assessed in relation to knowledge scores. However, each of these recommendations is problematic with respect to recruitment and feasibility.

The smaller number of test items, 22, on the knowledge questionnaire may also have limited the interpretation of the results. Having 22 items forced individual scores to change in increments of just under five percentage points for each right/wrong answer given. At the same time, longer surveys may not be practical for this community.

Lessons Learned

The process and the logistics of testing with migrant farmworker families is based on a variety of factors, most of which are not in the control of a research project. Attempts to control variability are often met with the reality of the migrant farmworker lifestyle and the resultant stress on the community agencies such as MHS that provide services to this population. Farmworker and staff fatigue, changing farmworker work schedules, weather, and family situations can cause unplanned changes for a research project. For example, a grower's decision on Friday afternoon that crops needed to be picked on the weekend postponed the viewing and testing of the video at the Sandy site for 1 week. However, that decision imposed considerable work on MHS to notify the parents of the new date. As it turned out, MHS outreach workers found themselves with extremely heavy workloads that week and participant size at the Sandy site was only 14 out of the original 50 invited parents. Workload can also affect staff communication with parents. For example, transportation was arranged by the MHS staff in Cornelius with a private company used previously; however, a lack of communication with the parents regarding this bus service resulted in parents not being willing to board the bus. The resultant sample size for Cornelius was 27 parents.

The novelty of individual testing presented itself during the pilot for the intervention. Ten parents were recruited to participate and were paid $10 for 1 h of participation. The project staff began by explaining that the testing was part of a pesticide study and the staff wanted to know how the parents would do on the test. She then gave instructions on answering and one example. She read each question, paused and repeated the question. After the first question was read, several parents shouted out their answer. The testing was stopped and instructions given about recording their answers on the sheet. As the test progressed, project observers noted that several women were copying their husbands' answers. Once again, the testing was stopped for additional instructions. Parents were asked about the wording of questions, the length of the test, and the process of circling the answers. They offered several suggestions on wording but otherwise believed the test to be satisfactory. These findings resulted in wording changes on the test and procedural changes during testing of the intervention. That is, men and women were seated at separate tables, instructions were given not to state aloud their answer or to copy their neighbor's answer, and monitors were employed to observe for copying. No parents were found to copy their neighbor's responses.

Valuable lessons were learned about the process of community involvement in research and several areas that need further exploration. For example, the staff of MHS may have benefitted from some basic training in research before the start of the migrant farmworker season. This may have improved their understanding of the need for parent and staff participation in the project before parent's workload increased dramatically. Better training of all project and MHS staff involved in testing and interviewing participant families may have decreased variability in their performance. There is a concern about the effectiveness of the tests. No data exist to indicate whether the knowledge tests were poor or ineffective in this population. However, our project would like to develop the best possible measures of knowledge while considering the practicality of testing with this population. Therefore, during the next year of our study, the design of the knowledge test will be varied and evaluated.

In addition, the video as an educational intervention will be reinforced by other means. One of these will be the presence of a trained individual to answer questions at midpoint during and following the viewing of the video. Another will be to develop strategies to encourage growers to provide families with the necessary preventive items mentioned on the video, such as marked laundry boxes and containers for shoes indoors. Future work will include behavioral change observation before and after viewing the video. The challenge with behavioral observation will be to minimize the effects of confounding factors, such as the knowledge of being watched on certain days or at certain times.

Currently, the video has been distributed to all MHS centers in Oregon and their staff have been trained regarding the use of the video with parents. Several centers have been selected for additional parental evaluation of the video. In addition, the video will be given to migrant health centers in Oregon to be shown in the waiting room. Clients will be asked their opinions regarding the usefulness of the information and if they will pass on the information to others.

In summary, migrant farmworker families must receive culturally appropriate information that will guide and motivate them to protect themselves from pesticide exposure. Based on the findings, the Reducing Pesticide Exposure in Minority Families Project has developed an effective video that can be used by MHS and other community agencies to educate migrant farmworker families regarding the prevention of pesticide exposure. Further evaluation is warranted and will occur in the future. While community-based research with migrant farmworker families can be challenging and the results must be viewed with caution, the rewards to all involved are numerous. Funding agencies gain insights into the difficulties and the possibilities of research with vulnerable populations that previously lacked input into such studies. University researchers and community agencies learn to work together and understand one another's realities and the reality of the migrant farmworker family. And most poignantly, the enthusiasm of the families that someone wanted their input and would be doing something with it was a lesson for all stakeholders. We hope the MHS families experienced active participation in our study and the relevance for research to improve their life.

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REFERENCES

1. U.S. Environmental Protection Agency, Office of Pesticide Programs: Pesticide Industry Sales and Usage: 1990 and 1991 Market Estimates. 1992
2. U.S. Environmental Protection Agency, Office of Pesticide Programs: Regulatory Impact Analysis of Worker Protection Standard for Agricultural Pesticides. EPA Contract No. 68-C1-0134, Work Assignment No. 1–3; 1992
3. Rios R, Poje GV, Detels R: Susceptibility to environmental pollutants among minorities. Toxicol Ind Health 1993; 7:97–820
4. Wilk VA: Occupational Health of Migrant and Seasonal Farmworkers in the US: Progress Report. Washington, DC: Farmworker Justice Fund; 1988
5. Moses M, Johnson ES, Anger WK, Burse VW, Horstman SW, Jackson RJ, Lewis RG, Maddie KT, McConnell R, Meggs WJ, *et al.*: Environmental equity and pesticide exposure. Toxicol Ind Health 1993; 9:913–959
6. Mobed K, Gold E, Schenker M: Occupational health problems among migrant and seasonal farm workers. West J Med 1992; 157:367–373
7. National Institute for Occupational Safety and Health: Report to Congress on Workers' Home Contamination Study Conducted Under the Family Protection Act (29 USC. 671a). Cincinnati, OH; 1995
8. Keifer MC: Human health effects of pesticides. Occup Med 1997; 12:203–401
9. Blair A, Zahm S: Cancer among farmers. Occup Med 1991; 6:335–354
10. Moses M: Pesticide-related health problems and farmworkers. Am Assoc Occup Health Nurse J 1989; 37:115–130
11. Sharp DS, Eskenazi B, Harrison R, Callas P, Smith A: Delayed health hazards of pesticide exposure. Annu Rev Public Health 1986; 7:441–471
12. United States Environmental Protection Agency: Pesticide Worker Protection Standard Training, 40 CFR Part 170.130. 1992
13. Agresti A: An Introduction to Categorical Data Analysis. New York: Wiley; 1996
14. Manly B: Randomization, Bootstrap, and Monte Carlo Methods in Biology. New York: Chapman & Hall; 1997
15. Quandt SA, Austin CK, Arcury TA, Summers ME, Saavedra RM: Agricultural chemical safety training materials for farmworkers: Review and annotated bibliography. J Agromed 1999; 6:3–26