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Evaluating the Effectiveness of a Lay Health Promoter-Led, Community-Based Participatory Pesticide Safety Intervention With Farmworker Families

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Abstract

Pesticide safety training is mandated for migrant and seasonal farmworkers. However, none is required for family members, who implement home sanitation to protect against pesticide exposure and need to control pests in substandard housing. Controlled studies have demonstrated the efficacy of pesticide education programs for farmworker families, but no carefully evaluated demonstration projects have shown effectiveness in public health settings. This project evaluates a lay health promoter program to improve pesticide-related knowledge and practices. Promotoras from six agencies recruited families with children to deliver a six-lesson, in-home, culturally and educationally appropriate curriculum. Independently conducted pre- and posttests evaluated changes in knowledge and practices. Adults in 610 families completed the study. Most were from Mexico, with low levels of formal education. Significant improvements in knowledge were observed for all six lessons. Significant improvements were observed in practices related to para-occupational exposure and residential pest control. Lay health promoters with limited training and supervision can have significant impacts on families' knowledge and practices. They represent a workforce increasingly recognized as a force for reducing health disparities by providing culturally appropriate health education and other services. This study adds to the literature by demonstrating their effectiveness in a public health setting with rigorous evaluation.

Keywords

community-based participatory research; lay health promoter; demonstration project; migrant and seasonal farmworkers; occupational health and safety; pesticide exposure

INTRODUCTION

Migrant and seasonal farmworker families are exposed to pesticides through occupational and para-occupational pathways (Fenske, 1997; Fenske et al., 1999; Quandt et al., 2004; Quandt et al., 2006). This population, largely born in Latin America and numbering upward of 4 million, experiences a disproportionate level of pesticide exposure, relative to the rest of the U.S. population (Arcury & Quandt, 2007). Research has established the health hazards of such exposure, including long-term effects such as cancer, memory and learning impairment, and sterility (Alavanja et al., 2003; Alavanja, Hoppin, & Kamel, 2004; Beane Freeman et al., 2005; Garcia, 1998; Hoppin, Umbach, London, Alavanja, & Sandler, 2002). Children and fetuses, because of small size and rapid development, are at special risk for adverse health outcomes, including birth defects and long-term effects on neurological development (Bouchard et al., 2011; Engel et al., 2011; National Research Council, 1993; Rauh et al., 2011; Zahm & Ward, 1998). Family members who are not farmworkers are at risk for significant exposure, because of their roles in the home (e.g., laundering work clothes, house cleaning) and residence near treated fields. Use of residential pesticides to combat pests in the substandard housing many farmworkers inhabit is another source of exposure (Arcury et al., 2012; Quirós-Alcalá et al., 2011; Vallejos et al., 2011). Despite the substantial potential for exposure to pesticides, the only mandated pesticide safety training is for pesticide applicators and field workers, through the Environmental Protection Agency's Worker Protection Standard (WPS). Safety training is not required or generally provided for family members unless they also are employed as farmworkers.

Providing health and safety information to farmworker families must take into account the generally low formal education levels of family members, their lack of English language skills, existing beliefs and knowledge, and the hidden nature of this frequently undocumented population (Arcury, Estrada, & Quandt, 2010), as well as their limited access to health services (Arcury & Quandt, 2007). Although farmworkers can receive information about pesticide safety at the worksite, farmworkers' family members live dispersed throughout the community.

The use of lay health promoters (in Spanish, *promotoras de salud*) to deliver health information and health services has been demonstrated to be an effective and economical way to extend existing health service delivery and to provide culturally competent services for minority, immigrant, and marginalized populations (Ayala, Vaz, Earp, Elder, & Cherrington, 2010; Rhodes, Foley, Zometa, & Bloom, 2007), particularly where existing health service personnel are inadequate and where the population has specific educational needs that do not require highly trained professionals (Balcazar et al., 2011).

The use of lay health promoters for improving occupational health and safety has been largely limited to farmworkers and their families (an exception is a program with Latino poultry-processing workers (Grzywacz et al., 2009)). Farmworker programs that target individuals or households have been shown to improve pesticide safety knowledge and behavior (Arcury, Marín, Snively, Hernández-Pelletier, & Quandt, 2009; Liebman, Juárez, Layva, & Corona, 2007) and promote eye safety (Monaghan et al., 2011). These have been conducted on a fairly small scale and some under randomized controlled conditions to test the efficacy of a particular educational program.

Although small lay health promoter programs for pesticide safety conducted under controlled conditions have been shown to be efficacious, large, carefully evaluated demonstration projects are needed to determine whether existing pesticide safety education programs can be applied in public health settings to improve pesticide safety knowledge and practices in farmworker families. Scaling up to public health settings can mean greater chance of decreased fidelity in the implementation of the program, resulting in less effect on targeted outcomes as well as inclusion of participants who may be less qualified or motivated than those included in efficacy studies.

These analyses report the results of a demonstration project conducted to translate an intervention based on previous community trials to a broader public health context. This intervention was designed to improve farmworker family pesticide-related knowledge and practices. The aims of this paper are to evaluate the effectiveness of the intervention to produce changes in farmworker families' (a) knowledge of pesticide dangers and methods to protect family members from exposure at home, (b) practice of WPS-recommended behaviors related to at-home exposure to agricultural pesticides, and (c) practice of behaviors related to residential pesticide exposure.

METHOD

Project Design

The demonstration project used an existing community-based participatory research partnership. The North Carolina Farmworkers Project (Community Partner) was responsible for implementing a lay health promoter-led educational program, and Wake Forest School of Medicine (University Partner) was responsible for the evaluation. All study procedures were approved by the Wake Forest School of Medicine Institutional Review Board.

The Community Partner implemented the project through six agencies serving 13 counties in eastern North Carolina. Agencies included three migrant and community health centers, one county government agency that operates a migrant farmworker health program, one Migrant Head Start Center, and one nonprofit organization that operates a migrant health clinic and provides social services to farmworker families. Each agency identified a staff liaison to the project staff. Liaisons and their agencies identified appropriate women to serve as promotoras de salud (promotoras). All promotoras were Hispanic and lived in the areas where they worked; most were former farmworkers. Each agency had one or two promotoras, depending on the number of farmworker families they estimated could be recruited in their area. The project goal was to enroll and educate participants from 600 families over 18 months (April 2009-September 2010). Community Partner project staff worked with each liaison to establish goals of 20 or 40 families to recruit and educate in a 6-month period.

The educational program, *La Familia Sana*, consisted of six lessons to be taught one-on-one in a minimum of five home visits, lasting 30 to 60 minutes. The program combined lessons and materials from two interventions with demonstrated effectiveness (Arcury et al., 2009; Liebman et al., 2007). Topics for the six lessons were the following: (a) protecting the family by knowing pesticide exposure symptoms and long-term consequences, (b) pesticide residues and para-occupational exposure pathways, (c) reducing exposure to agricultural pesticides at home, (d) integrated pest management at home, (e) pesticide risks for pregnant women and young children, and (f) convincing others to change behavior. These six lessons were designed to meet a set of knowledge and practice objectives. The content of the promotora pesticide safety intervention curriculum was conceptually guided by the health belief model (HBM; (Becker, 1974). HBM is a value expectancy theory that argues that individuals will engage in a targeted health behavior if the outcome associated with the behavior is valued and if the targeted behavior is believed effective in producing the expected outcome. Previous ethnographic research in this population helped inform specific content.

The content of each lesson focused on increasing participants' knowledge about pesticides and providing and practicing concrete strategies for reducing pesticide exposure. The "knowledge" content targeted several main concepts (italicized) in the HBM (Champion & Skinner, 2008). For example, material targeted *perceived severity* by highlighting the health risks of pesticide exposure for adults and children, and it addressed *perceived susceptibility* by showing participants everyday places children come into contact with pesticides and how to reduce that exposure. Similarly material addressed a common *perceived barrier* confronted by women in farmworker households, facilitating behavior change in the men living with them. The concrete strategies introduced in each lesson targeted *perceived benefits* that have strong face validity (if you deep clean a house, you can reduce pesticide exposure) or are advocated in WPS training (e.g., washing work clothes separately from nonwork clothes). Each lesson targeted *self-efficacy* through the liberal use of reflection points, role–plays, and activities designed to help participants integrate advocated pesticide safety practices into daily life. The intervention included strategies and activities that could create *cues to action* to promote pesticide safety behavior and reduce exposure. For example, one suggestion was to place a mat outside the door as a visual reminder (i.e., *cue to action*) that work boots should be removed before entering the home; and an activity had parents view the home from the perspective of toddlers so that what their child could see or reach became a cue to action when storing pesticides or placing pest control items.

Promotoras were trained by community partner staff, based on a standard training manual created by the project (Quandt, Trejo, Grzywacz, & Arcury, 2011b); each received a manual to guide her own activities (Quandt, Trejo, Grzywacz, & Arcury, 2011a). A 2-day training program held at the beginning of the program included substantive information on pesticides and health and preventing pesticide exposure, as well as recruitment, retention, adult education techniques, and personal safety. The community partner observed and provided feedback for one lesson/promotora every 6 months, and regularly reviewed implementation records. Refresher training was conducted 6 and 12 months after the initial training.

Recruitment of Farmworker Families

Promotoras were trained to screen potential participants for eligibility: participant age at least 18 years or married, self-identified as Latino or Hispanic, living in a household containing at least one farmworker employed in agriculture during the past year, and having no plans to move in the next two months. One adult in the household had to be pregnant or have a coresident child younger than 12 years.

To reach the most dispersed population possible, promotoras were trained to identify locations where farmworker families could be found, including farmworker housing, trailer parks, churches, migrant health outreach programs, common gathering places such as soccer fields, and *tien das* (places where Mexican food and other merchandise is sold). Promotoras were used as the main source of recruitment because they were part of the community where they recruited, and most were already familiar with locations where farmworker families could be found.

Evaluation

Pre- and posttest questionnaires were constructed with 68 items designed to elicit knowledge or self-reported practices related to the lesson objectives. Items were taken from evaluations used in the earlier controlled intervention in this farmworker population (Arcury et al., 2009). Items had been generated to reflect lesson content and objectives; all were pretested with members of the population. Translation/back translation and think-aloud techniques were used to be sure the intended meaning was conveyed. Items included both knowledge (e.g., "what are some symptoms of pesticide poisoning?") and behavior, where the answer was obtained by inspection (e.g., "please show me where you keep bug spray"). Correct answers to fixed-response items were determined a priori. Participant answers to items that did not fit the response options provided were rated as correct or incorrect by the investigators blinded to other information about the respondent. Other items obtained demographic and personal characteristics (pretest) and assessment of the promotora and program materials (posttest).

Pretest interviews were conducted with participants prior to any lessons. Posttest interviews were conducted after all lessons were completed. Participants received $10 after completing the pretest and $20 after the posttest.

Liaisons helped identify seven interviewers, several with prior survey interview experience. Training focused on understanding informed consent, confidentiality, professionalism, and personal safety. Training included detailed review of both pre- and posttest questionnaires and observation of practice interviews. Interviewers were supervised by the university partner staff and had little or no contact with the community partner and promotoras. The interviewer field-edited the completed interview before leaving the participant's home. University partner staff reviewed the interview with the interviewer when collecting it in the field. Interviews were reviewed again by two Spanish-speaking staff prior to data entry; any queries were returned to the interviewer to clarify.

Measures

Eighteen learning objectives were defined for which participants' *knowledge* should improve after completing the six lessons. The investigators determined a priori how many correct answers to specific questionnaire items were needed for the learning objective to be considered attained. The percentages that correctly met each learning objective for the pre- and posttests were calculated. The learning objectives were then combined to create one knowledge score related to each of the six lessons. The number of learning objectives varied by lesson, with four items combined for Lesson 1, three items for Lessons 2 and 3, five items for Lesson 4, two items for Lesson 5, and a single item for Lesson 6. For all lessons except Lesson 6, the percentage that correctly met each learning objective was averaged across the items that were combined for the lesson.

Four scores related to *WPS-recommended practices* were constructed, each based on a single item from the questionnaire. These included where workers changed out of work clothes, how long they waited to shower after work, where soiled work clothes were stored, and how they were laundered. These questions were asked for up to two farmworkers in the home. If either farmworker's action was "incorrect," the household was considered as not meeting the WPS-recommended practice. The percentage that met each of the four WPS-recommended practices for both the pre- and posttests was calculated.

Three practice scores related to *residential pest management behaviors* were constructed, as well as a total score. Three items were used to construct the first score of *Eliminating food and water sources for pests*. Each of the item responses was given a "correct" or "incorrect" score from a team of experts, and the percentage correct was calculated for each item. Then the average percentage correct was calculated across all 3 items to create a single percentage correct score for *Eliminating food and water sources for pests* in both the pre- and posttests. The same procedure was done for *Using nonpesticide solutions to eliminate pests* and *Preventing pests from entering the house*, with 4 and 3 questionnaire items being used, respectively. A total score was calculated using the average percentage correct across all 10 questionnaire items for both the pre- and posttests.

Data Analysis

Descriptive statistics (count, percentage) were calculated for characteristics of the study sample. For the knowledge variables in Lessons 1 through 5, the average percentages meeting the learning objective and standard deviation were calculated across the learning objectives that comprised each lesson for both the pre- and posttests. A paired *t* test was used to test for significant differences between the pre- and posttest average percentage correct values. Because Lesson 6 had a single learning objective, the percentage meeting the learning objective was reported; and the McNemar test was used to test for significant difference between pre- and posttests. Counts and percentages were reported within the pre- and posttests for those who met each of the WPS recommendations; and the McNemar test was used to test for a difference in pre- and posttest percentages.

For each of the pest management practices, the average percentage correct and standard deviation for each practice are reported for both the pretest and posttests; a paired *t* test was used to test for significant differences. All analyses were done using SAS Version 9.2 (SAS Institute, Cary, NC); *p* values of less than .05 were considered statistically significant.

RESULTS

A total of 658 participants completed a pretest. Of these, 610 completed both pre- and posttests. Of the 48 who failed to complete a posttest, 20 completed no lessons, 10 one lesson, 6 two lessons, 3 three lessons, 2 four lessons, and 7 six lessons. Failure to complete the posttest was because of migrating from the area before it could be completed or withdrawing from the project. The final sample of 610 was largely women and ranged in age from 15 to 63 (median = 30; Table 1). More than a quarter (26.9%) had a formal education of less than sixth grade, and only 11.6% were high school graduates. Most (92.3%) were born in Mexico. As adults, 99.3% reported speaking Spanish; 15.0% reported speaking

Mixteco or another indigenous language. In the final sample, the number of reported contacts with a promotora ranged from one to seven; 90% reported five or more promotora visits.

Pretest knowledge related to the six lessons ranged from a low of 5.4% of participants who knew ways to reduce exposure to agricultural pesticides in the home to a high of 55.7% who knew the risks of pesticides for pregnant women and young children (Table 2). Knowledge at the posttest was significantly higher for each lesson.

The percentage reporting appropriate practices related to WPS recommendations was high in the pre-test (more than 90% correct) for two items: storing and laundering soiled farmwork clothes separate from family clothes (Table 3). Percentages were lower for items related to changing out of work clothes outside the home (18.9%) and showering after work (60.0%). All showed significant improvement ($p < .0001$) at the post-test except changing out of work clothes ($p = .0502$).

The percentage of participants reporting appropriate residential practices showed significant increases ($p = .0026$ to $p < .0001$) for all three practices (Table 4). The proportion reporting practices related to eliminating food and water sources for pests and preventing them from entering the home were substantially higher than for using nonpesticide solutions to deal with pests.

DISCUSSION

This program sought to move from controlled efficacy studies to testing the effectiveness of a pesticide safety intervention in a public health context. As a demonstration project, there was much less direct oversight of participant recruitment, implementation, and delivery of the educational program by lay health promoters than was the case in the original efficacy studies (Arcury et al., 2009; Liebman et al., 2007). Control of the educational program rested with the community-based partner rather than with the research partner, although the partner carried out quality control measures as described above. At the same time, evaluation of the program was rigorous, with highly trained and well-supervised interviewers.

Comparison of pre- and posttest results show that, as a group, the farmworker family members who received these lessons had substantial changes in all three outcome categories: knowledge, WPS-related practices, and residential pesticide practices. Changes in knowledge and practices were significantly greater than in the original, randomized controlled intervention (Arcury et al., 2009). This may be because of differences in the implementation of the intervention and evaluation and differences in contextual factors. The original intervention was implemented over a 1-year period. Although that gave additional time for the information to be acquired and reinforced, the more rapid presentation of information here may have better developed the interest and resulted in heightened perceived susceptibility among the farmworker family members. Contextually, greater concern has been focused on pesticides among farmworker families because of recent births of babies to several farmworker women with serious birth defects; although the scientific literature and legal decisions have been reluctant to attribute these to pesticides (Calvert et al., 2007), popular opinion has not.

Although overall knowledge was low at baseline, several protective practices were not. For example, only 5.4% of participants had accurate knowledge of ways to prevent exposure to agricultural pesticides in the home, but more than 90% stored and washed work clothes separate from other family clothes. Similarly, although only 17.1% of participants knew integrated pest management approaches for the home, 77.7% practiced behaviors that eliminated food and water sources for pests, a key component of residential pest management. This suggests that factors other than pesticide knowledge (e.g., concerns about general contamination and cleanliness) may underlie positive behaviors and that these can be used to incentivize behaviors that reduce pesticide exposure.

The study findings suggest that lay health promoter–led educational programs can achieve significant changes in knowledge in hard-to-reach, minority, immigrant populations. Despite generally low levels of formal education, recipients of the pesticide education program maintained their participation over multiple visits from the lay health promoter and showed improvement on all study outcomes. Lay health promoters represent a workforce increasingly recognized as a force for reducing health disparities by providing culturally appropriate health education and other services (Balcazar et al., 2011). This study adds to the literature by demonstrating their effectiveness in a “usual care” situation with rigorous evaluation.

These findings need to be interpreted in light of their limitations. Evaluation items were collected by self-report and may have been subject to bias toward socially desirable answers. Although the items had been carefully developed and used in multiple studies, they had not been subjected to formal validation. Some test–retest bias may have produced a greater apparent effect of the intervention than was actually the case, though participants had few sources other than the intervention to acquire answers to the questions. No biomarker or environmental sampling data were gathered to measure the impact of behavior change. The study included only farmworker families in eastern North Carolina. Baseline knowledge and practices might differ in other regions. Finally, control of pesticide exposure ultimately is best addressed with higher level policy initiatives. However, these are very slow to occur because of ongoing disagreements among environmental, health, and business interests.

Nevertheless, the study has several strengths. It represents one of the first large-scale demonstration projects employing a lay health promoter approach to address a significant occupation-related public health problem in a vulnerable population. It shows that lay health promoters with limited training and supervision can have significant impacts on families’ knowledge and practices. The results show consistent effects across knowledge and practices. Future research should investigate the use of lay health promoters in other farmworker populations and for other health issues in this population.

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TABLE 1

Description of Study Sample (n = 610)[a]

	n	%
Female	592	97.2
Age, years		
15–24	111	22.1
25–29	128	25.5
30–34	119	23.7
35+	144	28.7
Education		
≤Grade 5	164	26.9
Grades 6–8	211	34.6
Grades 9–11	164	26.9
≥Grade 12	71	11.6
Country of birth		
United States	13	2.1
Mexico	563	92.3
Other	34	5.6
Languages spoken as an adult[b]		
English	62	10.2
Spanish	606	99.3
Mixteco	65	10.7
Other indigenous language	26	4.3

[a]Some categories sum to less than 610 because of missing data.

[b]Participants could report more than one language spoken.

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TABLE 2

Comparison of Correct Pretest and Posttest Knowledge for Learning Objectives Related to Each of Six Lessons

Lesson	Pretest, *n* = 610		Posttest, *n* = 610		
	Average % Correct	***SD***	**Average % Correct**	***SD***	p^a
Lesson 1: Protecting the family by knowing pesticide exposure symptoms and long-term consequences	52.4	25.9	89.1	16.8	<.0001
Lesson 2: Pesticide residues and para-occupational exposure pathways	12.3	22.4	75.8	27.0	<.0001
Lesson 3: Reducing exposure to agricultural pesticides at home	5.4	17.4	53.7	34.7	<.0001
Lesson 4: Integrated pest management at home	17.1	16.8	70.9	20.0	<.0001
Lesson 5: Pesticide risks for pregnant women and young children	55.7	42.6	97.1	13.3	<.0001
Lesson 6: Convincing others to change behavior	8.4	—	52.0	—	<.0001

[a] Lessons 1 through 5, based on paired *t* test; Lesson 6, based on McNemar test.

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TABLE 3

Practices Related to Worker Protection Standard Recommendations: Comparison of Correct Pretest and Posttest (n = 610)

	Pretest		Posttest		
Practice	***n***	**%**	***n***	**%**	p^a
Usually change farmwork clothes outside the home	115	18.9	141	23.2	.0502
Store dirty farmwork clothes separate from other family clothes	568	93.4	605	99.5	<.0001
Wash dirty farmwork clothes separately from family clothes	587	96.6	606	99.7	<.0001
Usually shower/bathe less than 15 minutes or right away after getting home from doing farmwork	365	60.0	527	86.7	<.0001

[a]McNemar test for only those who answered both pretest and posttest.

TABLE 4

Residential Pest Management Practices in the Home: Comparison of Correct Pretest and Posttest

	Pretest		Posttest		
Practice	**Average % Correct**	***SD***	**Average % Correct**	***SD***	p^a
Eliminate food and water sources for pests	77.7	31.3	91.9	20.1	<.0001
Using nonpesticide solutions to eliminate pests	31.8	23.8	35.2	24.5	.0026
Prevent pests from entering the home	63.9	40.5	71.7	39.1	<.0001
Total	55.1	20.9	63.0	18.7	<.0001

NOTE: N = 610.

[a] Paired t test.