Reducing Farmworker Residential Pesticide Exposure: Evaluation of a Lay Health Advisor Intervention

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The goal of this analysis is to evaluate the effectiveness of a promotora program for teaching women in Latino farmworker families about pesticide safety and increasing pesticide safety behaviors. Volunteer promotoras delivered a pesticide safety curriculum (intervention) and nutrition curriculum (control) to farmworker women residing in western North Carolina and Virginia. Pre- and postintervention interviews assessed differences in delivery of the intervention, recognition of the intervention, pesticide knowledge, pesticide exposures behaviors, and integrated pest management behaviors. Participants in the intervention group reported significantly more receipt of pesticide education and greater recognition of the key messages. However, their knowledge, pesticide exposure behaviors, and integrated pest management behaviors did not change. A more structured program is needed to be sure that the dose of interventions is large enough to overcome educational and cultural characteristics of immigrant communities. Policy changes are needed to address circumstances outside of farmworkers' control that affect pesticide exposure.

Keywords: *residential pesticide safety; lay health advisor; promotora; farmworkers; community-based participatory research*

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Residential pesticide exposure among farmworker families is an environmental health concern (Arcury et al., 2005; Quandt et al., 2004). Farmworker families are at double jeopardy for residential pesticide exposure. Farmworker families can be exposed to pesticides due to residential application (Arcury et al., 2005; Bradman et al., 1997). Because most farmworkers live in substandard housing, which is often infested with pests, their exposure to residential application pesticides could be extensive (Early et al., 2006). Farmworker families also experience para-occupational exposure due to pesticides brought home from work on the skin, clothes, and boots of workers and to pesticides that drift into their homes from application in nearby agricultural fields (Quandt et al., 2006). Complicating the potential for residential exposure among farmworker families is the limited knowledge of pesticides and cultural beliefs that farmworker families have about pesticides in their homes (Rao et al., 2007). For example, members of farmworker families often believe that the presence and strength of a pesticide is indicated by its odor and that, because no one in the family has become acutely ill, they have not been exposed to a pesticide.

The health consequences that adults and children experience due to residential pesticide exposure are difficult to document. Fortunately, severe, acute, unintended poisonings are relatively rare. However, the number of

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nonsevere, acute poisonings is not known because their symptoms are nonspecific (e.g., nausea, muscle ache, dermatitis), few health care providers are trained to recognize pesticide poisonings, and few states have a mandatory reporting system for pesticide poisoning (Calvert et al., 2004; Hiott, Quandt, Early, Jackson, & Arcury, 2006; Reigart & Roberts, 1999). The long-term effects of pesticide exposure, even low-level exposure, include delayed neurobehavioral development and neurological deficits as well as increased risk for several types of cancer, birth defects, and reproductive problems (Reigart & Roberts, 1999). However, making the causal linkage of specific symptoms or diseases to indeterminate pesticide exposures that occurred in previous years poses insurmountable challenges for even the skilled clinician.

Most existing interventions to reduce farmworker pesticide exposure are focused on occupational exposures. These include regulatory requirements such as the United States Environmental Protection Agency (1992) Worker Protection Standard, as well workplace intervention programs (e.g., Quandt, Arcury, & Pell, 2001; Vela Acosta, Chapman, Begelow, Kennedy, & Buchan, 2005). However, existing intervention and training materials do not address the residential pesticide exposure for farmworker families. McCauley, Beltran, Phillips, Lasarev, and Sticker (2001) and Thompson, Coronado, Puschel, and Allen (2001) have developed interventions to reduce the pesticide exposure of children who live in farmworker homes, but the content of these interventions or their evaluations have not been reported in the literature.

To address the need for a program addressing farmworker residential pesticide safety, a community–academic collaboration implemented a lay health advisor or *promotora* intervention program, La Familia: Pesticide Safety for Farmworker Families. The partners in this collaboration included the North Carolina Farmworkers Project, a nonprofit farmworker and service advocacy organization, and Wake Forest University School of Medicine. Lay health advisors can include individuals who vary in activities and training but generally are members of a community and serve a natural helping role in that community (Eng, Parker, & Harlan, 1997; Kegler, Stern, Whitecrow-Ollis, & Malcoe, 2003; Balcázar et al., 2006). The goal of this analysis is to evaluate the effectiveness of the La Familia promotora program in teaching women in farmworker families about pesticide safety and increasing residential pesticide safety behaviors.

METHOD

Communities

The La Familia promotora program was conducted in five counties of northwest North Carolina (Alleghany, Ashe, Avery, Mitchell, Watauga) and three counties of southwest Virginia (Smyth, Grayson, Carroll). Agriculture in this region is dominated by the production of Christmas trees, with some ornamental plants, burley tobacco, vegetables, and fruits being produced. Many Latino women in the area also work seasonally making Christmas wreaths. An array of insecticides, herbicides, and fungicides are used in mountain agriculture. As is the case in other parts of the Southeast and the nation (Carroll, Samardick, Bernard, Gabbard, & Hernandez, 2005), the majority of farmworkers in these counties are Latino immigrants and from Mexico (Quandt, Preisser, & Arcury, 2002).

The La Familia Promotora Program

The La Familia promotora pesticide safety program was directed at women in farmworker families, most of whom were not farmworkers themselves. The training program was based on formative research which showed that agricultural and residential pesticides were in virtually all farmworker dwellings, with a greater likelihood of being present if a house was located adjacent to fields; was judged difficult to clean; and had nonfamily residents (Quandt et al., 2004). Most farmworker family members had urinary organophosphorus pesticide metabolites levels above the 50th percentile compared to national reference data (Arcury et al., 2005). Presence of nonfamily residents and living in rental property were associated with greater metabolite levels. Ethnographic data showed that women had received little pesticide safety training and had limited pesticide knowledge, and traditional gender roles made enforcing desirable household sanitation practices among male residents difficult (Rao et al., 2007).

A multilesson residential pesticide safety curriculum was developed, to be delivered by the promotoras to individual women in farmworker households using adult education approaches and a variety of media (Arcury et al., 2004b). Conceptually, the intervention was based on the Theory of Reasoned Action (Ajzen & Fishbein, 1980). The intervention was designed to change pesticide safety behaviors within households by first providing information to women in these households about the health affects of pesticide exposure on family members, particularly children, as well as the sources of both residential and agricultural pesticide exposures. Finally, these women were instructed on the behaviors that would remove the sources of residential and agricultural pesticide exposure. The curriculum emphasized the creation and communication of norms and behaviors for protecting children from pesticide exposure. The lessons were designed to give women skills and knowledge to recognize which substances are pesticides, to reduce their families' exposure to take-home agricultural pesticide and drift, to implement integrated pest management in their homes, and to become more empowered to control the household contamination caused by other residents. A promotora-delivered multilesson nutrition curriculum was also developed for women in farmworker households who were part of a comparison group (Arcury et al., 2004a).

The promotoras were Spanish-speaking women living in the study area who were well connected within their local Latino communities. These women had experience living in farmworker households, even if they had not done farmwork themselves. Promotoras were volunteers who received an honorarium, but not a salary for their efforts, and who were reimbursed for their travel expenses. Each promotora was asked to recruit up to 20 participants to receive monthly health education lessons on pesticide safety or family nutrition. An eligible participant had to live in a household with at least one farmworker and at least one of her own children 13 years of age or younger. Generally, promotoras recruited women in their social networks or living nearby. Due to the low population density, most promotoras also went beyond their social networks and neighborhoods to identify participants.

To try to prevent contamination, the study area was divided into northern and southern areas, with half of the promotoras in each area. One area was assigned the pesticide curriculum for Year 1 by a flip of a coin. In Year 2, the promotoras who had delivered the pesticide curriculum changed to nutrition, and vice versa. At the beginning of Year 2, promotoras enrolled additional women who had settled in the area. The analysis presented here includes Year 1 data from all women enrolled who completed a pre- and posttest interview and Year 2 data from women newly enrolled in Year 2 who completed both a pre- and posttest interview in Year 2. Multivariate analyses were adjusted for year whenever possible to account for potential systematic differences over time.

A total of 115 women completed an initial interview, prior to receiving the pesticide safety or nutrition intervention, and completed a postintervention follow-up interview. Of these women, 65 participated in the pesticide curriculum and 50 participated in the nutrition curriculum. Each participant's pretest interview provided her baseline data. Participants were given a $20 incentive for completing each interview. The research protocol was approved by the Wake Forest University School of Medicine Institutional Review Board.

Program Evaluation

Pre- and posttest interviews were conducted by trained interviewers who did not participate in the promotora program. The questionnaires were translated into Spanish by native Spanish speakers and pretested with members of the target population to ensure that vocabulary was appropriate and that there was no loss of meaning. Interviews were conducted in Spanish or English based on the participant's preference. Background information on the participant and her family included personal characteristics, household composition, farmwork experience, social integration, and language preferences. A core set of questions about the intervention was repeated during pre- and posttest interviews to assess changes in knowledge and behavior due to the intervention.

Variables from five domains were measured as intervention outcomes: recalled delivery of the intervention, recognition of the intervention, pesticide knowledge, pesticide exposures behaviors, and integrated pest management behaviors. Recalled delivery of the intervention was based on the number of occasions reported in response to the questions, "Has anyone come to your home in the past 12 months and spoken with you about pesticide safety for your family? If yes, about how many times did they speak with you?" Recognition of the intervention was based on how many of five phrases presented in the intervention a respondent recognized and correctly defined. These phrases included *Pesticidas no los traigas a la casa!* (Pesticides: Leave them at Work!), *El Terror Invisible* (The

Invisible Terror), *Residuos de Pesticidas* (Pesticide Residues), *Plagas: No las dejes entrar!* (Pests: Keep them out!), and *Plagas: Mátalas de hambre!* (Pests: Starve them out!). Pesticide knowledge included four outcomes based on correct answers to questions on the meaning of *pesticide* (a substance used to control pests), where pesticides are used (homes as well as farms), the possible effects of pesticides on the health of children (rashes, cancers, neurodevelopment), and the number of components identified correctly on a pesticide label (product name, Environmental Protection Agency registration number, active ingredient list, storage instructions, package disposal instructions, emergency information). Pesticide exposure behaviors included the proper storage of bug sprays in the home (in a locked cabinet or closet vs. other), the location typically used by the farmworker to change out of his or her farm work clothes (outside the house vs. inside the house), and the time interval between the farmworker's arrival at home and showering (less than 15 min vs. 15 min or longer). Integrated pest management behaviors included the number of practices used, out of a possible 10 (e.g., taking out trash every day, using bug traps, not using bug spray in the house).

Data Analysis

Participant characteristics (including outcome measures evaluated at baseline) were summarized and compared between curriculum groups. Significance testing for differences between groups was performed, using the two-sample t test or Wilcoxon rank-sum test for continuous variables; chi-square or Fisher's exact testing was used for dichotomous variables. The finding $p \leq .05$ was considered statistically significant.

The pesticide curriculum was evaluated in comparison with the nutrition curriculum using both bivariate methods (as for baseline comparisons) and multivariate methods, as follows. Each outcome measure was used as the response variable in a multiple regression model (linear, Poisson, or logistic) after adjusting for covariates: the baseline value of the outcome, and indicators for the curriculum (pesticide, nutrition), year (1, 2), age (< 30 years, ≥ 30), education (at least high school, less than high school), employment status (employed, not employed), number of adults living in the home (< 3, ≥ 3), number of unrelated adults living in the home (0, ≥ 1), type of home (mobile/one-family detached home, other), and home ownership (own, rent). These covariates were selected as potential confounders a priori. Covariates were reduced in models when the number of participants in cells was low, preventing reliable inference; covariates were selected for removal if there was little evidence of association with the outcome in the bivariate analysis.

The pesticide curriculum was also evaluated by summarizing and comparing baseline and postintervention values for each outcome in the pesticide curriculum. Paired analyses were performed for hypothesis testing using Wilcoxon signed-rank test or McNemar's chi-square test. Multiple regression models (linear, Poisson, or logistic) were used to assess for predictors of those outcome measures that were statistically significant in the paired analysis, that is, those outcomes that changed significantly in the women who participated in the pesticide curriculum. Covariates in these regression models were the baseline value of the outcome, and indicators for the year (1, 2), age (< 30 years, ≥ 30), employment status (employed, not employed), number of adults living in the home (< 3, ≥ 3), number of unrelated adults living in the home (0, ≥ 1), number of children in home (< 3, ≥ 3), type of home (mobile/one-family detached home, other), and time period residing in the home (< 1 year, ≥ 1 year). These variables were selected a priori as potential predictors of the outcomes with the pesticide curriculum. All analyses were performed using Stata Statistical Software, version 8.2 (Stata Corporation, College Station, TX).

RESULTS

Participants

Promotora program participants ranged in age from 16 to 47 years, with over half being younger than 30 years of age (Table 1). About 90% were married or living as married. Over 90% were born in Mexico and had been in the United States for at least 1 year. About three fourths had been in their current home for at least 1 year. Few of the women had been educated to the equivalent of high school, and about 85% preferred using Spanish. About one third were employed, and about 90% had a spouse or partner who was employed. The households in which the participants lived were generally large, with over 40% having three or more adults, and over one fourth having three or more children. About 90% of the women lived in a mobile home or single-family detached house, and about 20% owned their homes.

More of those receiving the pesticide safety curriculum were employed (43.1% vs. 24.0%). More of those receiving the nutrition curriculum had unrelated adults residing with them (34.8% vs. 14.3%). Fewer of those receiving the pesticide safety curriculum lived in a detached dwelling (81.5% vs. 98.0%), and fewer owned their house (12.3% vs. 28.0%).

Evaluation

At baseline, the participants in the two curricula did not differ significantly in their recall of having been

TABLE 1
Baseline Characteristics for Pesticide Curriculum, Nutrition Curriculum, and All Participants

Participant Characteristics	*Pesticide Curriculum*[a] M ± SD *or* *Count (%)*	*Nutrition Curriculum*[b] M ± SD *or* *Count (%)*	*All*[c] M ± SD *or* *Count (%)*	p[d]
Age (in years)	27.7 ± 6.3	27.1 ± 6.1	27.4 ± 6.2	.61
16–19	6 (9.2)	3 (6.0)	9 (7.8)	—
20–24	15 (23.1)	14 (28.0)	29 (25.2)	—
25–29	18 (27.7)	16 (32.0)	34 (29.6)	—
30–34	17 (26.2)	12 (24.0)	29 (25.2)	—
35–47	9 (13.9)	5 (10.0)	14 (12.2)	—
Married or living as married	59 (90.8)	46 (92.0)	105 (91.3)	1.0
Born in Mexico	62 (95.4)	44 (88.0)	106 (92.2)	.17
Have lived in U.S. ≥ 1 year	61 (93.8)	48 (96.0)	109 (94.8)	.70
Reside in current house ≥ 1 year	51 (78.5)	36 (72.0)	87 (75.7)	.42
At least high school education	0 (0)	3 (6.0)	3 (2.6)	.079
Prefer Spanish language	56 (86.2)	41 (82.0)	97 (84.4)	.54
Employed	28 (43.1)	12 (24.0)	40 (34.8)	.033
Husband/partner currently employed	59 (90.7)	43 (86.0)	102 (88.7)	.42
No. of adults in house ≥ 3	24 (36.9)	27 (54.0)	51 (44.3)	.068
Any unrelated adults in house	9 (14.3)	16 (34.8)	25 (22.9)	.012
No. of children in house ≥ 3	19 (29.2)	11 (22.0)	30 (26.1)	.38
Mobile or one-family detached house	53 (81.5)	49 (98.0)	102 (88.7)	.0057
Own house	8 (12.3)	14 (28.0)	22 (19.1)	.034

NOTE: The sample sizes exclude 12 participants in the Pesticide Curriculum arm and 20 participants in the Nutrition Curriculum arm who did not complete the training.
a. $n = 65$.
b. $n = 50$.
c. $N = 115$.
d. The p values are for comparisons between Pesticide Curriculum and Nutrition Curriculum arms.

delivered the pesticide intervention, recognition of the intervention, pesticide exposure behaviors, or integrated pest management behaviors (Table 2). Significantly more of those receiving the pesticide curriculum knew the effects of pesticides on children than did those receiving the nutrition curriculum (76.9% vs. 58.0%). They did not differ significantly in the remaining three measures of pesticide knowledge.

Postintervention, those receiving the pesticide curriculum reported receiving more intervention visits focused on pesticides on average (4.6 vs. 1.7; Table 3). They recognized more of the pesticide safety messages on average (3.5 vs. 1.6). More of those receiving the pesticide curriculum knew the effects of pesticides on children than those receiving the nutrition curriculum (90.8% vs. 72.0%). The participants in the two curricula did not differ significantly in pesticide exposure behaviors, residential integrated pest management behaviors, or the other three of the four measures of pesticide knowledge.

When controlling for the baseline value of the outcome, cohort, participant age, education, current employment, number of adults living in the home, number of unrelated adults living in the home, type of home, and home ownership, the differences between pesticide and nutrition curriculum groups remained statistically significant for recalled number of pesticide intervention visits ($p < .001$) and recognition of the pesticide safety messages ($p < .001$). The difference in knowledge of the effects of pesticides on children was not significant in the regression analysis ($p = .057$). However, the greater number of pesticide label items recognized by those receiving the pesticide versus the nutrition curriculum on average (1.6 vs. 1.2) was statistically significant in the regression analysis ($p < .001$) after adjusting for the covariates.

The pesticide curriculum participants improved significantly on three of the measures between baseline and postintervention (Table 4). At the postintervention, pesticide curriculum participants reported receiving

TABLE 2
Baseline Comparison of Outcome Measures for Pesticide Curriculum and Nutrition Curriculum Participants

Outcome Measures	*Pesticide Curriculum*[a] M ± SD *or* *Count (%)*	*Nutrition Curriculum*[b] M ± SD *or* *Count (%)*	*All*[c] M ± SD *or Count (%)*	p
Delivery of the intervention				
No. of visits	0.6 ± 1.0	0.4 ± 0.7	0.5 ± 0.9	.42[d]
Recognition of the intervention				
No. of messages	1.1 ± 1.5	0.9 ± 1.3	1.0 ± 1.4	.70[d]
Knowledge				
Pesticide definition	26 (40.0)	20 (40.0)	46 (40.0)	1.00[e]
Pesticide usage	38 (58.5)	27 (54.0)	65 (56.5)	.63[e]
Pesticide effect on children	50 (76.9)	29 (58.0)	79 (68.7)	.030[e]
No. of label items	1.3 ± 1.9	1.2 ± 2.1	1.3 ± 2.0	.32[d]
Pesticide exposures behaviors				
Pesticide storage	2 (3.1)	6 (12.0)	8 (7.0)	.076[f]
Change out of work clothes	23 (44.2)	13 (33.3)	36 (39.6)	.29[e]
Shower after work	37 (71.2)	30 (76.9)	67 (73.6)	.54[e]
Residential integrated pest management behaviors				
No. of pest management items	5.2 ± 1.8	5.8 ± 1.8	5.5 ± 1.8	.12[d]

NOTE: The sample sizes exclude 12 participants in the Pesticide Curriculum arm and 20 participants in the Nutrition Curriculum arm who did not complete the training. The *p* values are for comparisons between Pesticide Curriculum and Nutrition Curriculum arms.
a. $n = 65$.
b. $n = 50$.
c. $N = 115$.
d. Two-sample Wilcoxon rank-sum test.
e. Chi-square test.
f. Fisher's exact test.

more pesticide intervention visits (0.6 vs. 4.6), recognized more of the pesticide safety messages (1.1 vs. 3.5), and more knew the effects of pesticides on children (76.9% vs. 90.8%). Although not statistically significant ($p = .078$), pesticide exposure behaviors also changed in that more of the participants reported properly changing out of work clothes at postintervention (59.3% vs. 44.2%). Regression models found that current employment was an independent predictor of number of intervention visits (estimated regression coefficient 2.04; 95% confidence interval = 0.14–3.94, $p = .036$), and number of pesticide safety messages recognized (estimated regression coefficient 1.21; 95% confidence interval = 0.26–2.16, $p = .013$) for the postintervention after adjusting for the baseline value of the outcome, cohort, participant age, current employment, number of adults living in the home, number of unrelated adults living in the home, number of children in home, type of home, and time period residing in the home.

DISCUSSION

Our analysis of La Familia promotora program indicates that the intervention was delivered; persons in the intervention group (pesticide curriculum) reported significantly more receipt of pesticide education than those in the control group (nutrition curriculum), and the participants in the intervention recognized the key messages. However, the analysis also shows that the intervention did not change the knowledge measures in general and did not change the pesticide exposure or integrated pest management behaviors.

The educational attainment of some participants may have limited their ability to understand the information presented in the curriculum. Some participants were illiterate in Spanish as well as English. Further, our formative research showed that the concepts surrounding pesticide exposure and safety were foreign to many members of this community (Rao et al., 2007). Our

TABLE 3
Postintervention Comparison of Outcome Measures for Pesticide Curriculum and Nutrition Curriculum Participants

Outcome Measures	*Pesticide Curriculum*[a] M ± SD *or* *Count (%)*	*Nutrition Curriculum*[b] M ± SD *or* *Count (%)*	*All*[c] M ± SD *or* *Count (%)*	p
Delivery of the intervention				
No. of visits	4.6 ± 3.0	1.7 ± 3.0	3.3 ± 3.3	<.0001[d]
Recognition of the intervention				
No. of messages	3.5 ± 1.9	1.6 ± 1.7	2.7 ± 2.0	<.0001[d]
Knowledge				
Pesticide definition	26 (40.0)	21 (42.0)	47 (40.9)	.83[e]
Pesticide usage	36 (55.4)	31 (62.0)	67 (58.3)	.48[e]
Pesticide effect on children	59 (90.8)	36 (72.0)	95 (82.6)	.0085[e]
No. of label items	1.6 ± 2.2	1.2 ± 1.8	1.4 ± 2.0	.56[d]
Pesticide exposures behaviors				
Pesticide storage	4 (6.2)	4 (8.0)	8 (7.0)	.73[f]
Change out of work clothes	32 (59.3)	22 (59.5)	54 (59.3)	.98[e]
Shower after work	38 (70.4)	32 (86.5)	70 (76.9)	.073[e]
Residential integrated pest management behaviors				
No. of pest management items	5.6 ± 1.5	5.4 ± 1.9	5.5 ± 1.7	.81[d]

NOTE: The sample sizes exclude 12 participants in the Pesticide Curriculum arm and 20 participants in the Nutrition Curriculum arm who did not complete the training. The *p* values are for comparisons between Pesticide Curriculum and Nutrition Curriculum arms.
a. $n = 65$.
b. $n = 50$.
c. $N = 115$.
d. Two-sample Wilcoxon rank-sum test.
e. Chi-square test.
f. Fisher's exact test.

development and presentation of pesticide curriculum used techniques for lower literacy and lower educational attainment adults (Doak, Doak, & Root, 1996). However, the pesticide safety concepts may still have been too difficult for some participants.

Adoption of pesticide safety behaviors may have been hindered by the beliefs of the Latino women. Many of the participants did not feel susceptible enough to harm to change their behaviors. Our formative research showed that Latino women really did not believe residential pesticide exposure to be an important problem (Rao et al., 2007). Further, other health beliefs may have played a part in limiting behavior changes. For instance, we have found adherence to humoral medicine beliefs among many Mexican immigrants in North Carolina (Weller, 1983). Within the humoral medicine system it is considered harmful to mix metaphorically "cold" and "hot" substances; for example, putting water, which is metaphorically cold (regardless of thermal quality) on a body that is hot from work. These beliefs might have affected the willingness of some individuals to change a behavior to shower immediately after work: If the cultural rule is to cool down, it may take more powerful intervention to overcome this than we implemented.

Gender roles may have also hindered intervention effectiveness. Women told us that they did not have the control or power to change the behaviors of other coresident adults, particularly men. We included a lesson in the pesticide curriculum to address this specific issue (Arcury et al., 2004b; "Pesticide Safety Lesson 6: Talking about Change!" / "Lección de Pesticidas 6: ¡Hablar sobre Cambio de Conducta!"). Although the participants indicated that they liked this lesson and found it useful, it is not clear if they were successful in its implementation.

The dwellings and households of the immigrant farmworker families did not allow some behaviors to change. Dwellings were usually small and crowded, making changing from work clothes and storing soiled work clothes difficult. It would also make the safe storage of pesticides impossible (Early et al., 2006; Rao et al., 2006).

Several methodological issues make it difficult for community interventions to show an effect, three of

TABLE 4
Baseline and Postintervention Comparison of Outcome Measures for Pesticide Curriculum Participants

Outcome Measures	*Baseline* M ± SD *or Count (%)*	*Postintervention* M ± SD *or Count (%)*	p
Delivery of the intervention			
No. of visits	0.6 ± 1.0	4.6 ± 3.0	<.0001[a]
Recognition of the intervention			
No. of messages	1.1 ± 1.5	3.5 ± 1.9	<.0001[a]
Knowledge			
Pesticide definition	26 (40.0)	26 (40.0)	1.0[b]
Pesticide usage	38 (58.5)	36 (55.4)	.85[b]
Pesticide effect on children	50 (76.9)	59 (90.8)	.035[b]
No. of label items	1.3 ± 1.9	1.6 ± 2.2	.38[a]
Pesticide exposures behaviors			
Pesticide storage	2 (3.1)	4 (6.2)	.69[b]
Change out of work clothes	23 (44.2)	32 (59.3)	.078[b]
Shower after work	37 (71.2)	38 (70.4)	.79[b]
Residential integrated pest management behaviors			
No. of pest management items	5.2 ± 1.8	5.6 ± 1.5	.19[a]

NOTE: The sample size ($n = 65$) excludes 12 participants in the Pesticide Curriculum arm who did not complete the training. The *p* values are for comparisons between baseline and postintervention.
a. Wilcoxon signed-rank test.
b. McNemar's chi-square test.

which are pertinent to our promotora program. First, participants may not have received the full "dose" of the intervention. Due to conflicting employment (the unanticipated availability of short-term jobs) and family (women having the major responsibility for child care) demands among promotoras and participants, the promotoras may not have been able to deliver the curriculum to the community participants as planned. Some participants may not have received all of the lessons; other participants who did receive all of the lessons may have had these lessons in fewer than the planned number of sessions (i.e., a promotora contacted a participant on four occasions instead of six and delivered the information for multiple lessons at each meeting). Second, a secular trend toward greater pesticide safety may have occurred in the region. Service providers may have increased their emphasis on pesticide safety in the region. A new migrant clinic was established in the region during the course of the study, and the clinicians were interested in pesticide safety. North Carolina cooperative extension agents began a Spanish-language pesticide safety training program after learning about our intervention. Finally, contamination may have occurred. Although the two arms of the intervention were geographically separated, the mobility of the Latino population in the region along with the limited number of social events may have brought individuals from the two arms together. These methodological problems were reported by Thompson, Coronado, Chen, and Islas (2006) in a community intervention to increase cancer prevention behavior among Latinos in Washington State.

CONCLUSIONS

The use of promotoras is an effective method for getting health education materials on pesticides, and probably other topics, into the homes of Latino immigrants in rural communities. However, a more structured model is needed to be sure that the duration and dose of the intervention are large enough to overcome educational and cultural characteristics of the population. At the same time, some life circumstances common among residents of low-income communities, such as substandard housing, cannot be improved by a health education intervention and can limit the effectiveness of such interventions. Higher level policy changes (e.g., requiring payment of a living wage, provision of low-income housing) are needed to address these life circumstances.

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