Pesticide Safety Training Among Farmworker Adolescents from Starr County, Texas

E. M. Shipp, S. P. Cooper, D. J. del Junco,
J. N. Bolin, R. E. Whitworth, C. J. Cooper

ABSTRACT. *This study of adolescent farmworkers describes employer compliance with pesticide safety training, a requirement of the EPA-mandated Worker Protection Standard (WPS), and identifies variables associated with having received training within the prior five years. Data are from "A Study of Work Injuries in Farmworker Children," a three-year cohort study of high school students living along the Texas-Mexico border in Starr County. Data were collected using a web-based, self-administered, confidential survey. Of 324 students who participated in field work between January 1 and September 30, 2003, 68 (21.0%) reported ever receiving pesticide safety training. Overall, the 61 (18.8%) students who reported training within the prior five years also reported that their most recent instruction covered at least three key WPS areas (i.e., entry into a recently treated field, pesticide-related injuries/illnesses, and emergency care for pesticide exposure). Based on a multiple logistic regression, students who were male (OR = 1.97), worked only outside of Texas (OR = 2.73), worked only for commercial growers/owners (OR = 4.35), worked only for contractors (OR = 3.18), worked corn crops (OR = 2.93), and worked potato crops (OR = 3.11) were more likely to report receipt of training within the prior five years. Results suggest that increased enforcement may be needed, especially in Texas, and special educational efforts may be needed to reach female farmworker youth.*

Keywords. *Farmworkers, Hispanic, Migrant, Pesticides, Training, Youth.*

An estimated 1 to 4 million farmworkers support food production and the agricultural economy of the U.S. (U.S. GAO, 1992). There are approximately 197,393 migrant and seasonal workers in Texas alone (Larson, 2000a). This vulnerable population of migrant and seasonal workers is largely foreign-born (78%) and unauthorized (53%) (Carroll et al., 2005). Although agriculture is one of the most hazardous industries in the U.S. (Hard and Myers, 2006; NRC, 2007), many farmworker families are impoverished, and only a small minority of 23% have some form of employer-provided health insurance (Carroll et al., 2005). The median annual family income is less than $17,500 per year (Carroll et al., 2005), and an estimated 73% of migrant farmworker children, under the age of 14, live below the poverty level (Davis, 1997; Gabbard et al., 1994). Driven by economic necessity, many children labor as farmworkers (Mines et al., 1993).

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The authors are **Eva M. Shipp,** Assistant Professor, **Sharon P. Cooper,** Professor and Head, and **Deborah J. del Junco,** Associate Professor, Department of Epidemiology and Biostatistics; **Jane N. Bolin,** Assistant Professor, Department of Health Policy and Management; **Ryan E. Whitworth,** Research Associate, Department of Epidemiology and Biostatistics; and **Charles J. Cooper,** Assistant Professor and Director of Informational Technology, Department of Epidemiology and Biostatistics, Texas A&M Health Science Center School of Rural Public Health, College Station, Texas. **Corresponding author:** Eva M. Shipp, 1266 TAMU, College Station, TX 77843-1266; phone: 979-845-5434; fax: 979-458-1877; e-mail: emshipp@srph.tamhsc.edu.

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Although a current estimate of the size of this young workforce is not available, 4% of authorized and 8% of unauthorized hired migrant and seasonal farmworkers, who participated in the 2000-2001 National Agricultural Worker Survey (NAWS), were 14 to 17 years old (Carroll et al., 2005).

Under the U.S. Department of Labor (DOL) Fair Labor Standards Act (FLSA, 1999) and Texas child labor regulations, children can legally work in agriculture under conditions that allow for substantial exposure to pesticides. Children 14 years of age and older are allowed to work independently in nonhazardous agricultural operations for an unlimited number of hours if not required to be in school. Children younger than 14 years of age are allowed to work in the fields with some restrictions (table 1). For example, children ages 12 and younger, if accompanied or authorized by a parent, are allowed to work in the field in nonhazardous harvesting and planting operations where they may regularly come in contact with pesticides through various activities (e.g., drinking and eating in the fields, and performing job tasks). Regarding tasks and duties, children as young as 16 years are allowed to work in operations considered hazardous, including pesticide mixing and spraying. Child farmworkers may also be exposed to pesticides through direct spray or pesticide drift from adjacent fields.

Farmworkers are a primary population exposed to pesticides (U.S. GAO, 2000), and it is estimated that physicians in the U.S. diagnose at least 10,000 to 20,000 pesticide-related illnesses and injuries among agricultural workers each year (U.S. EPA, 1992a). A variety of agents are described as pesticides, and these include insecticides, herbicides, fungicides, and rodenticides (Ecobichon, 2001). Acute and chronic effects include contact dermatitis, eye irritation, fatigue, nausea, and upper respiratory tract irritation, cancer, neurological disorders, paralysis, and death (U.S. EPA, 1999; U.S. GAO, 2000). For farmworkers, dermal absorption is the dominant route of exposure. Other routes of exposure involve the respiratory and digestive systems (Fenske, 1997; U.S. EPA, 1999). Take-home exposures are also an issue for farmworkers (Curl et al., 2002; McCauley et al., 2001; Lambert et al., 2005). In this manner, family members can become exposed, including younger siblings who may be at an increased risk for pesticide-related illness and injury. Due to differences in size and metabolism in addition to rapid growth, young workers may be more susceptible to negative health effects compared to adults (NRC IOM, 1993). The long-term effects of pesticide exposure among children and adolescents are not entirely known. Because of the potential consequences of pesticide exposure, the Environmental Protection Agency (EPA) promulgated the Worker Protection Standard (WPA) in 1992 under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) (U.S. EPA, 1992b).

In full effect since 1995, WPS was designed to reduce the risk of occupational injury or illness due to exposure to pesticides used in the production of agricultural plants cultivated on farms, nurseries, greenhouses, and forests among farmworkers and pesti–

Table 1. Restrictions for the employment of children less than 14 years of age in agriculture under the Fair Labor Standards Act (FLSA, 2006).

1.	Youths 12 and 13 years of age may work outside of school hours in non-hazardous jobs on farms that also employ their parent(s) or with written parental consent.
2.	Youths under 12 years of age may work outside of school hours in non-hazardous jobs with parental consent, but only on farms where none of the employees are subject to the minimum wage requirements of the FLSA.
3.	Local youths 10 and 11 may hand harvest short-season crops outside school hours for no more than eight weeks between June 1 and October 15 if their employers have obtained special waivers from the Secretary of Labor.
4.	Youths of any age may work at any time in any job on a farm owned or operated by their parents.

cide handlers. As part of WPS, employers have the responsibility to provide pesticide safety training to workers who enter recently treated areas. Workers must be trained prior to accumulating more than five workdays in areas treated within the previous 30 days or where a restricted-entry interval has been in effect. The training must be repeated every five years and include information on eleven topic areas described by Arcury et al. (1999). In short, the training must discuss where and when pesticide exposure occurs while working, illness following exposure, entry of pesticides into the body, signs and symptoms of pesticide poisoning, emergency first aid measures, ways of obtaining emergency medical care, decontamination procedures, hazards from chemigation and drift, hazards from pesticide residues on clothing, warnings about taking pesticides or pesticide containers home, and other requirements (e.g., posting of warning signs and entry restrictions) (Arcury et al., 1999; U.S. EPA, 1992b). State governments may choose to strengthen WPS through additional legislation.

The enforcement responsibility for pesticide safety under WPS is separate from the enforcement responsibility of the child labor provisions of the FLSA or state labor codes, causing a "disconnect" in child protection and making it more complicated and difficult to protect child farmworkers. For example, enforcement of federal child labor laws under the FLSA is the responsibility of the U.S. Department of Labor (DOL), and enforcement of Texas child labor regulations occurs through the Texas Workforce Commission. Protection against pesticide exposure through enforcement of WPS is usually the responsibility of state agencies (e.g., departments of agriculture). Previous studies have highlighted problems and gaps in enforcement of WPS in light of separate enforcement of the FLSA and state child labor laws, allowing the employment of children in high-risk agricultural operations (Reeves and Schafer, 2003).

In order to address these gaps, legislation titled "Children's Act for Responsible Employment" (CARE) was introduced recently as HR 3482 in the 109th U.S. Congress and allowed to expire December 31, 2006. Through the CARE Act, legislators sought to establish a private right of action holding agricultural employers liable for lost wages and medical expenses for child farmworkers who are injured or become ill on the job. However, it allows for exemptions pertaining to children working on family farms. The goal of the CARE Act was to apply the same age and work hour standards to children employed in agriculture as applied to other forms of child labor. If passed, the CARE Act would have strengthened the FLSA and state child labor laws by prohibiting the employment of children younger than 16 in agriculture during school hours and in hazardous working conditions. The CARE Act also would have established a school dropout prevention program and provided additional funding to the Migrant Education Program (MEP, 2001) to support the completion of high school degree requirements and support interstate coordination of high school equivalency and farmworker youth programs for completion of schooling. Specific to pesticides, the CARE Act would have strengthened provisions on pesticide exposure in agriculture in order to address the unique and heightened risks that pesticides pose to children. Finally, the CARE Act would have linked WPS to FLSA and state labor laws, as shown in table 2. Given a history of prior introductions in 1998, 2000, and 2001, subsequent attempts to pass the CARE Act may be forthcoming.

To date, the few studies available suggest that compliance with WPS as well as enforcement is lacking across the nation (Arcury et al., 2001; Jackson, 2002; McCauley et al., 2002; Shipp et al., 2005; Villarejo et al., 2000). Although child and adolescent workers 12 years old and older are covered by WPS, only a handful of published research addresses pesticide safety training or knowledge in young farmworkers (McCauley et al., 2002). The present study examines pesticide safety training among farmworker adolescents who participated in field work, largely in Texas, in 2003.

Table 2. CARE Act legislation, HR 3482 (Children's Act for Responsible Employment).

1. Amends the Fair Labor Standards Act by bringing the age and work hours standards for children working in agriculture up to the standards set for all forms of child labor.
2. Establishes a nationwide dropout prevention program to help minors who work in agriculture complete their education.
3. Increases the civil and criminal penalties for child labor violations.
4. Establishes a private right of action holding employers liable for lost wages and medical expenses for children injured on the job.
5. Strengthens pesticide preventions for women and children who work or are present in the fields.
6. Authorizes adding 100 inspectors to the Department of Labor's Wage and Hour Division.

Methods

The data for the present cross-sectional study were collected in 2003 as part of "A Study of Work Injuries in Farmworker Children" (U50 OH07541), a three-year cohort study designed to determine the incidence of and risk factors for acute farmwork-related injuries among adolescent farmworkers from Starr County, Texas. The study was reviewed and approved by TAMU-IRB. Starr County (pop. 53,597 in 2000) is located along the Texas-Mexico border and includes three public high schools (Rio Grande City, Roma, and San Isidro) (U.S. Census, 2004). In 2004, 99.7% of students in the county were Hispanic, and 87.5% were economically disadvantaged (Texas Education Agency, 2004). Eligibility criteria included enrollment in an English class in one of the public high schools in Starr County and return of a signed parental consent form. The response rate was 70.8% (n = 2,536) overall, with the highest participation (83.9%) in Roma (n = 1,247), followed by 67.6% (n = 46) in San Isidro, and 61.2% (n = 1,243) in Rio Grande City. Of these students, 324 participated in some form of agricultural field work between January 1 and September 30, 2003.

The data collection instrument was an internet-based, self-administered, confidential survey. Approximately 50 items were displayed in either Spanish or English depending on each student's preference. Overseen by at least one bilingual staff member per classroom, students completed the survey during one English class period in fall 2003. The majority of survey items were adopted from a previous cohort study of migrant farmworkers (Cooper et al., 2006) and referred to January 1 through September 30, 2003 (a nine-month recall period) to capture the usual migration period of farmworkers from Starr County. The survey was pilot tested by native speakers, interviewers, and high school students from the Texas-Mexico border. Each student received a school spirit towel for returning a parental consent form (irrespective of consent or refusal) and a spirit shirt for their participation.

The dependent variable was reported receipt of pesticide safety training within the prior five years. It was assessed using a series of seven items describing the most recent training with respect to year, training method and language, and whether three key areas mandated by WPS (e.g., entry into a treated field, pesticide-related injury/illness, and where to go for treatment) were covered. The independent variables of primary interest were demographics, job location (e.g., Texas), employer type, crop, and task that corresponded to the period January 1 to September 30, 2003.

In this cross-sectional study, Intercooled Stata v.9.0 (Stata, 2005) was used to complete the data analysis. Frequency distributions were computed as well as cross-tabulations for the outcome with each independent variable. Unadjusted odds ratios and 95% confidence intervals for each independent variable and for having received pesticide safety training within the prior five years were computed using logistic regression. Using forward selection, variables significant at the $p < 0.25$ level were entered one at a time

into a multiple logistic regression. Variables significant at the $p < 0.05$ level or those inducing a 20% or greater change in the odds ratio for another significant variable in the model were allowed to remain (Rothman and Greenland, 1998). Then, previously eliminated variables, including variables not significant at the 0.25 level in the univariate models, were entered one at a time to ensure that all important variables had a chance to appear in the final model. Next, all first-order interaction terms were tested one at a time. The final model included significant main effects (at the $p < 0.05$ level), confounders (those inducing a 20% change in the odds ratio of another variable), and effect modifiers (interaction terms significant at $p < 0.05$ level).

Results

Table 3 displays the distribution of demographic characteristics. Of the field workers (n = 324), the majority were male (58.1%). Corresponding to the age distribution of the field workers, each of the four grade levels (i.e., 9th to 12th grade) included about one quarter of the sample. The majority were born in the U.S. (73.3%). In terms of verbal communication, 38.1% reported their preferred language for speaking was an equal combination of Spanish and English. The majority (89.5%) took the survey in English. Although Spanish is frequently spoken in this population, students indicated that English is preferred for tasks that involve reading.

On average during the nine-month recall period (Jan. 1 to Sept. 30, 2003), field workers were employed by 2.1 farm employers (range: 1 to 6), worked 8.6 hours per day

Table 3. Demographic characteristics of adolescent field workers from Starr County, Texas, in 2003 (n = 324).

	Variable	n (%)[a]
Sex	Male	188 (58.1)
	Female	132 (41.9)
School grade	9th	74 (23.5)
	10th	88 (27.9)
	11th	71 (22.5)
	12th	82 (26.0)
Age	<14 years	43 (13.7)
	15 years	84 (26.7)
	16 years	70 (22.2)
	17 years	82 (26.0)
	>18 years	36 (14.4)
Country of birth	U.S.	231 (73.3)
	Mexico	83 (26.4)
	Other	1 (0.3)
Language most comfortable speaking	Spanish only	33 (10.5)
	Spanish more than English	103 (32.7)
	English only	16 (5.1)
	English more than Spanish	41 (13.0)
	Both equally	120 (38.1)
	Other	2 (0.6)
Language selected for survey	English	290 (89.5)
	Spanish	34 (10.5)

[a] Numbers may not sum to 324 due to missing values; percentages may not sum to 100% due to rounding error.

(range: 0.5 to 15), and worked 5.3 days per week (range: 1 to 7). Additional job characteristics are displayed in table 4. Field workers were employed by small owners/growers only (38.1%), commercial owner/growers only (13.8%), contractors only (25.5%), and combined or other employer types (22.6%). Approximately half were employed only in Texas or in conjunction with other states, while the remaining field workers were employed only outside Texas (44.8%). In addition to Texas, worksites were commonly in California, Illinois, Michigan, Minnesota, Nebraska, North Dakota, Oklahoma, and Washington. The most frequently worked crops were asparagus, beans, corn, cotton, onion, peanut, potato, watermelon, and other types of melon. The most prevalent job tasks were cleaning, clearing, cutting, detasseling, harvesting by hand from the ground, and hoeing.

Of the 324 field workers, 21.0% (68) reported having ever received pesticide safety training, and 18.8% (61) reported receipt of pesticide safety training in the prior five years. With respect to their most recent training within the prior five years, the majority (>72%) reported that their training covered three of the key WPS areas (e.g., safe entry into a recently pesticide-treated field, illness/injuries related to pesticide exposure, and who to contact or where to go for emergency medical care following exposure to pesticides). Field workers (n = 61) reported that the training involved one or more of the

Table 4. Work characteristics of adolescent field workers from Starr County, Texas, in 2003 (n = 324).

	Variable	n (%)[a]
Employer type	Small owner/grower only	121 (38.1)
	Commercial grower/owner only	44 (13.8)
	Contractor only	81 (25.5)
	Combined employer types and other types	72 (22.6)
Location of job	Texas only or Texas and other state	179 (55.3)
	Outside Texas only	145 (44.8)
Payment type[b]	Hourly (individual)	220 (67.9)
	Hourly (family)	30 (9.3)
	Piece rate (individual)	27 (8.3)
	Piece rate (family)	19 (5.9)
	Other	25 (7.7)
Common crops[b]	Cotton	140 (43.2)
	Corn	70 (21.6)
	Peanut	48 (14.8)
	Watermelon	39 (12.0)
	Melon (not watermelon)	36 (11.1)
	Beans	34 (10.5)
	Asparagus	25 (7.7)
	Potato	24 (7.4)
	Onion	24 (7.4)
Common job tasks[b]	Clear	118 (36.4)
	Cut	109 (33.6)
	Hoe	89 (27.5)
	Clean	54 (16.7)
	Detassel	35 (10.8)
	Harvest from the ground	34 (10.5)

[a] Numbers may not sum to 324 due to missing values; percentages may not sum to 100% due to rounding error.

[b] Categories are not mutually exclusive.

following forms of instruction: video (38.3%), talking to someone in the field (16.7%), book/pamphlet (15.0%), classroom lecture (3.3%), audio cassette (1.7%) and other (11.7%) (9 missing values). The training was delivered most frequently in English (49.2%), following by Spanish (27.9%), a combination of Spanish and English (18.0%), and other languages (3.3%) (1 missing value).

Based on a multiple logistic regression, five variables were significantly associated ($p < 0.05$) with having received pesticide safety training in the prior five years. Males were 1.97 times more likely to report recent training. Field workers employed entirely in states other than Texas were 2.73 times more likely to report training compared to field workers employed within Texas for at least one of their farm jobs. Field workers employed by only commercial owners/growers (OR = 4.35) or only contractors (OR = 3.18) were more likely to report recent training compared to those employed by only small owners/growers. In addition, there were elevated odds ratios for those working corn (OR = 2.93) and potato crops (OR = 3.11).

Discussion

In our study, the proportion (18.8%) of field workers reportedly trained in the prior five years or ever (21.0%) was lower than that reported by other studies of adults and youth, which ranged from 32.0% to 64.5% (Arcury et al., 2001; Jackson, 2002; McCauley et al., 2002; McCauley et al., 2004; Shipp et al., 2005; and Villarejo et al., 2000). The single most frequent method of training was a video, similar to other reports (Arcury et al., 1999). Because there are relatively few published studies in this area, especially among youth, further evaluation with other WPS research is limited.

In our study, males were more likely than females to receive pesticide safety training in the prior five years. The reason for this gender inequality is unclear given the available data. The majority of other studies are based on largely male samples, and the prevalence of training by gender is not reported. Among studies of farmers and their children, there is evidence that knowledge of farm safety is less likely to be imparted to women and daughters compared to their male counterparts (McCoy et al., 2002). This study could be replicated, and if confirmed, the reasons for the discrepancy could be illuminated so that appropriate interventions targeting females can be developed.

Young field workers in our sample who were employed only outside of Texas were also more likely to report training within the prior five years. Our earlier report based on migrant farmworker mothers revealed a similar discrepancy with respect to field sanitation. Of the 77 mothers employed outside of Texas, the proportion (67.5% to 84.2%) who had access to various forms of employer-provided field sanitation (e.g., water for drinking/washing, toilet paper, and toilet facilities) was strikingly higher compared to 25 mothers employed in Texas (12.0% to 28.0%) (Shipp et al., 2005). The prevalence (33.1%) of training among those youth working only outside of Texas in the present study was comparable to other research on youth. The proportion of trained migrant Latino farmworkers ages 13 to 18 years who were employed in Oregon was 32.4% (McCauley et al., 2002).

There was an association between employer type and recent pesticide safety training. Compared to youth employed by only small owners/growers, youth working for only commercial owners/growers or only contractors were more likely to report training. The association was strongest for commercial owners/growers. As described by Larson (2000b), fewer small employers may be providing training for reasons including access to fewer resources for hiring trainers and documenting compliance with regulations. Larson also notes that smaller employers may not be aware of WPS requirements because

they are less likely to join agricultural or crop associations that disseminate information regarding these regulations. Anecdotally, larger employers state a preference for hiring through contractors so that they are not saddled with the burden of providing training (Larson, 2000b).

Finally, youth working with corn or potato crops also were more likely to report recent pesticide safety training. In 1997, among the most common crops in the U.S., the largest volume of pesticide active ingredient was used with corn (225 million pounds) and potatoes (111 million pounds) (Gianessi and Marcelli, 2000). Based on available data describing the pounds of active ingredient of pesticide applied to common field crops nationally, corn producers and potato producers account for the greatest proportion of herbicide and fungicide use, respectively (USDA, 1997). Since the greatest volume of pesticide use is for corn and potato crops, these employers may be more sensitive to or aware of the need for required pesticide safety training or more likely to be monitored by state enforcement entities.

Limitations of the present research include possible recall bias resulting from the use of self-reported data. Report of training may be most affected by recall bias since it involved up to a five-year recall period, whereas work factors associated with training involved a shorter recall period of nine months. The low prevalence of training could be due to underreporting. However, the prevalence for the farmworkers working outside the U.S. was comparable to other research (McCauley et al., 2002). Similarly, odds ratios (table 5) could be biased away from the null if recall bias influenced reporting of training to a much greater extent than the reporting of potential farmwork factors (i.e., location, employer type, corn crop, and potato crop). Untrained field workers also may have worked in areas exempt from WPS (e.g., pesticides were not used in the prior 30 days). However, many farmworkers in this study and in our prior research with migrant farmworker families from the same geographic region reported contact with pesticides on the job (Cooper et al., 2006). Few if any of the farmworkers from our study population work with organic farmers, based on anecdotal evidence. Irrespective of WPS, it would be only prudent to provide pesticide safety training on an annual basis to young agricultural workers engaged in field work. Another limitation was the inability to ascertain pesticide knowledge or behavioral changes among the trained versus untrained (e.g., handwashing prior to eating/smoking). Highlighted by both researchers and advocates, training that

Table 5. Final multiple logistic regression model identifying variables associated with pesticide safety training within the prior five years among adolescent field workers from Starr County, Texas, in 2003 (n = 324).[a]

	Variable	OR	95% CI	p-value
Sex	Female	1.00		
	Male	1.97	1.02-3.81	0.044
Location	Texas only/Texas along with another state	1.00		
	Outside Texas only	2.73	1.40-5.33	0.003
Employer type	Small owner/grower only	1.00		
	Commercial grower/owner only	4.35	1.69-11.20	0.002
	Contractor only	3.18	1.36-7.43	0.007
	Combined employer types/other types	1.97	0.79-4.93	0.146
Worked corn crop	No	1.00		
	Yes	2.93	1.51-5.71	0.002
Worked potato crop	No	1.00		
	Yes	3.11	1.16-8.36	0.024

[a] 15 records with missing values.

simply satisfies WPS requirements may not be sufficient if the goal is to decrease pesticide exposure through adoption of safety behaviors (Coronado et al., 2004; FWPP, 2005; McCauley et al., 2002; Quandt et al., 1999).

This study also has important strengths. Data were collected directly from farmworker youth, a recommendation from a prior cohort study of migrant farmworker families that utilized maternal respondents for gathering data on their families (Burau et al., 2006). Further increasing the validity of results, work patterns were similar to those reported in the above cohort study using adult female respondents (Cooper et al., 2006). This study is unique in that the sample was diverse with respect to work location and crop types and included a substantial proportion of females. Consequently, we were able to examine demographic as well as work-related variables and their association with training within the prior five years.

Conclusion

This study documents a lack of pesticide training among farmworkers youth that corroborates the findings of other studies of adults and youth (Arcury et al., 2001; U.S. GAO, 2000; Jackson, 2002; McCauley et al., 2002; Villarejo et al., 2000). Results further highlight the need for educational materials tailored for migrant, hired, young, and especially female laborers (Parrott et al., 1999; Quandt et al., 1999; McCauley et al., 2002). Safety and health information targeting youth is critical. Current agricultural labor standards in some states such as Texas permit adolescents as young as 14 years old to work unlimited hours per week and those as young as 16 years old to handle pesticides among other hazardous tasks (U.S. GAO, 1992). Furthermore, the vulnerabilities of young farmworkers were not specifically addressed by WPS since it was designed to protect adults, although youth as young as 12 years are covered by the regulation (U.S. GAO, 2000). Considered within this context, these results indicate a need for coordination of state and federal labor and environmental laws such as the CARE Act. In the absence of improved regulations that take young workers into consideration, alternate delivery of education that justifies the importance of pesticide safety to young farmworkers and precipitates their adoption of preventive behaviors is needed. In addition, educational efforts should target small owners/growers to ensure that this group of employers is aware of WPS requirements and the necessity for pesticide safety for themselves as well as their employees.

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