Wash Day Blues: Secondhand Exposure to Agricultural Chemicals

James I. Grieshop, Ninfa E.Villanueva, and Martha C. Stiles

ABSTRACT: *The issue of personal cleanliness for farm workers exposed to pesticides is a significant health problem. One area that requires more attention centers on the issues of handling and laundering of clothing suspected of being contaminated by pesticides. This exploratory research focused on the handling and laundering behaviors of California farm workers with pesticide contaminated clothing. Of particular interest was the phenomenon of "secondhand" exposure that may result from improper handling and unsafe laundering practices.*

Members of farm worker families (N=109) were interviewed at two California health clinics that serve a large portion of low income farm worker families. The sample was divided into three groups based on exposure to pesticides: direct exposure, indirect exposure, nonexposed. The findings revealed the least safe handling and laundering behaviors were reported by the group most at risk from first hand exposure (i.e., handlers, loaders, applicators). Also, secondhand exposure to pesticides appears to be related to storage and laundering practices reported by those who are directly or indirectly exposed to pesticides.

The findings revealed the actual laundering practices of farm workers and their knowledge of what constitutes unsafe laundering behavior, including "secondhand" contamination. This information can help to identify realistic safe laundering practices for farm worker families who come in contact with pesticides in the field or at home.

The issue of human exposure to chemical pesticides, especially related to agricultural uses, has been a focus of attention for decades. The topic has been addressed by concerned scientists and citizens (Grieshop & Stiles, 1992; Hawkes, Pilisuk, Stiles, & Acredolo 1984), the popular press (Bashin, 1989; Edelstein, 1988; Meier, 1987; Ottoboni, 1984; Wasserstrom & Wiles, 1985), activists (Cox, Mull, & Rottenburg, 1992; Weir & Shapiro, 1981), as well as by state and national governments (Runyan, 1993; Sutter, 1993). Pesticide exposure is much more than a political issue; it is one with human health consequences for farmers and farm workers who use the wide range of available chemicals. Significant efforts have been made to reduce the risk associated with exposure through regulatory actions (e.g., limiting the materials available and re-entry times for fields treated), by engineering better technologies (e.g., safer handling methods and equipment), and by educational efforts (e.g., organizing and requiring worker training programs).

One area that requires more attention centers on the issues of contamination of and laundering of

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clothing suspected of pesticide exposure. Some significant research has been carried out on the effects of laundering of cloth and clothing (Laughlin, Easley, Gold, & Tupy, 1981; Laughlin & Gold, 1988), residue analysis (Nelson, Laughlin, Kim, Rigakis, Raheel, & Scholten, 1992), and the relationships of various types of chemical pesticides and laundering (Chiao-Chen, Reagan, & Bresee, 1988). Results seem to suggest that, in general, laundering is an important variable in determining whether contaminants are removed. Other studies have researched how farmers and their families handle the risk of pesticide exposure (Rucker, Branson, Nelson, Olson, Slocum, & Stone, 1988) and how such families launder contaminated clothing (Nelson, Rucker, Olson, Branson, Slocum, & Stone, 1988). These latter issues have not been systematically studied from the point of view of farm workers who often are exposed to chemical pesticides as part of their work.

This exploratory research focused on the handling and laundering behaviors of farm workers with pesticide contaminated clothing. Of particular interest was the phenomenon of secondhand exposure to contamination that might be a result of improper handling and unsafe laundering practices. Secondhand exposure refers to the outcome of the process through which members of a household are exposed to the chemicals even when they do not directly come into contact with the materials in the field. The issue of personal cleanliness for those exposed to pesticides is significant from a health perspective. Young children, along with adults, may be affected by exposure to contaminated clothing both immediately and over time. It is important to determine at what steps in the handling of contaminated clothing might other members be at risk through secondhand exposure. Of interest in this study were factors, along with the reported behaviors, that might increase the risk of exposure by household members.

The issue of farm workers and pesticides in California is of great magnitude. It is estimated that more than one million farm workers—permanent, seasonal, and migratory—provide the labor for California's 83,000 farms (Martin, 1992). While most workers are not exposed to pesticides, many are. The Environmental Protection Agency estimates that as many as 10,000 poisonings occur annually on the state level, but that only about 28 percent are job related (Runyan, 1993). In California, poisoning cases reported by ground applicators, mixers, loaders and field workers account for the largest number of cases. Dermatitis is the most frequently reported occupational disease in agriculture. According to the Division of Labor Statistics and Research (1992) most skin disease cases were caused by exposure to plant toxins; however, 16 percent were due to agricultural chemical exposure. In California for 1987 alone, nearly 2,900 physician-reported agricultural occupational pesticide illnesses were confirmed (Edmiston & Richmond, 1988). Some exposure is direct when mixing, loading, or applying the chemicals; larger numbers are exposed less directly as they cultivate and harvest crops treated with chemicals. Scientists and government health agencies generally agree that farm worker pesticide related illness is drastically under-reported (National Safety Council, 1989).

Many cases of pesticide exposure and consequent health effects are preventable. Safe applicator and handler practices as well as the use of appropriate protective clothing are sure means to reduce exposure (Putnam, Willis, Binning, & Boldt, 1993). Federal regulations currently are very prescriptive regarding the type of protective clothing and equipment required (Runyan, 1993), although enforcement often may lag behind the law. Wearing unsuitable clothing can result in increased exposure as the garment absorbs the chemical and is held close to the skin. In cases of pesticide contaminated clothing, its proper laundering can reduce the likelihood of contracting a skin disease from pesticides (Lavy, Mattice, & Flynn, 1983).

If an individual is faced with the situation of contaminated clothing, what constitutes proper laundering? Pesticide labels generally provide recommendations on what actions to take if the substance is swallowed or comes in contact with skin as well as what to wear (e.g., goggles, safety glasses, or a face shield as well as a long-sleeved shirt) when applying pesticides. Labels may advise that the user wear clean clothing daily, wash hands and face thoroughly after handling pesticides, and launder contaminated clothing. But, labels do not inform the user what to do with clothing after it may have been contaminated. Recommended procedures are sometimes published advising on the storage, washing, and other handling practices with clothing (Marer, Flint, & Stimmann, 1988). However, if such procedures are not followed, the risk of extending the contamination will probably increase.

This pilot study assessed an aspect of improper treatment of contaminated clothing, particularly the phenomenon of secondhand exposure, by noting and evaluating reported handling and laundering behav-

iors of California farm workers. Of special interest were the behaviors of workers and their families reporting exposure to chemicals. This study was partially motivated by the belief that such assessment would begin to provide an understanding of the processes used to treat contaminated clothing and of the risk of secondhand exposure.

The data collection for this research was carried out as part of a systematic needs assessment process designed to guide the development of agricultural health and safety programs for California farm workers. A component of these safety programs was the development and implementation of educational interventions related to field sanitation, including the reduction of exposure to pesticides. For this component, reported handling and laundering behaviors with work clothes believed to be exposed to chemical pesticides were examined. The aim was to determine, record, and evaluate the use of, and direct and indirect exposure to, pesticides by California field workers and household members. Storage of contaminated clothing as well as methods and frequency of laundering these clothes were examined as potential points for the occurrence of secondhand exposure.

Method

The subjects interviewed for this study were members of Spanish-speaking farm worker households and families, both female and male, who laundered and/or were familiar with household laundering practices. A total of 111 persons representing the same number of households were interviewed in person in Spanish. A total of 109 cases were usable for this study. The interview schedule was developed, pretested, and modified for use as the data collection instrument. Principal question categories included who uses and is exposed to agricultural pesticides, handling (i.e., storage) practices with reportedly contaminated clothing, and laundering practices (i.e., by whom, frequency, types of facilities, etc.) with these same clothes. Interviews were conducted at two separate health clinics in California with one interviewer per site. Responses were recorded in writing during the 10- to 20-minute interviews.

Clinic 1 was in the Sacramento Valley region and Clinic 2 was located in the San Joaquin Valley area. Both clinics serve large numbers of low income farm worker families who work in one of the most agriculturally productive areas in the world. Clinic administrators assisted in the identification of best times for accessing large numbers of families. Nights were identified as best for the first clinic, whereas weekend days were optimal for the second clinic.

The sample was a convenience sample selected from clients present during the interview periods. The primary requirement for participation was that each respondent was either a household launderer or was able to report household laundering practices based on personal knowledge. Only one interview was conducted at any one time. Interviews were conducted in an office in Clinic 1 and in the clinic waiting room in Clinic 2. Because the subjects were awaiting appointments, the time frame within which data could be collected was limited. Essential items for the needs analysis study were included and questions outside the scope of the study were eliminated. Even though time was limited, no interviews were interrupted or left incomplete.

Results

The final 109 respondents (Table 1) were typical of the estimated 900,000 to 1.5 million farm workers who compose this population in California (Martin, 1991; Palerm, 1991). Based on 1989 data from the California Employment Development Department (EDD), the average age of California farm workers was 34.9 years (the study sample was 32.8 years), 87 percent of the total was born in Mexico (the study sample was 93.7%), and average years of schooling was 5.9 years (the study sample was 6.0 years) (Alvarado, Riley, & Mason, 1990). In addition, the same EDD data indicated that 78 percent spoke and read Spanish only (the study sample was 75%). Finally, regarding dwelling situations, the EDD sample compared with this sample was as follows: single family home, 53 percent versus 46 percent; labor camps, 9 percent versus 10 percent; apartments, 20 percent versus 30 percent; and duplex and mobile homes, 11 percent versus 13 percent. These comparison data indicate that the study sample was typical of the larger population of California's farm workers.

Most of the study sample respondents were female (71%) and married (94%). More than one half (53%) of the total were farm workers, whereas 45 percent were wives of farm workers. Some of the wives previously had been farm workers. Clinic 2 respondents were older (an average of 36 years versus 29 years for Clinic 1) and had worked more years in agriculture (an average of nine years versus five years for Clinic 1). However, Clinic 1 respon-

Table 1. Exposure to Pesticides and Charactersitics of Farm Worker Repondents.

Characteristics	Total 111[1]	Class of Exposure (N=109) Directly Exposed 26 (24%)	Indirectly Exposed 45 (41%)	Not Exposed 38 (35%)
Site				
Clinic 1	53 (48%)	17 (65%)	28 (62%)	6 (16%)
Clinic 2	58 (52%)	9 (35%)	17 (38%)	32 (84%)
		df=2	X2=22.583	*P*=0.0001
Gender				
Male	32 (29%)	16 (62%)	2 (4%)	13 (34%)
Female	79 (71%)	10 (38%)	43 (96%)	25 (66%)
		df=2	X^2=27.348	*P*=0.0001
Age mean=32.8	mean=36.0	mean=30.9	mean=33.0	
		df=8	X^2=5.737	*P*=0.6766
Marital Status				
Married	104 (94%)	24 (92%)	44 (98%)	34 (89%)
Single	2 (2%)	1 (4%)	0 (0%)	1 (3%)
Other	5 (4%)	1 (4%)	1 (2%)	3 (8%)
		df=4	X^2=3.174	*P*=0.5291
Occupation				
Housewife	49 (45%)	2 (8%)	33 (73%)	13 (34%)
Farm worker	58 (53%)	24 (92%)	10 (22%)	23 (61%)
Other	2 (2%)	0 (0%)	2 (5%)	2 (5%)
		df=6	X^2=40.219	*P*=0.0001
Type of Work				
Permanent	38 (38%)	8 (32%)	19 (44%)	20 (65%)
Temporary	63 (62%)	17 (68%)	24 (56%)	11 (35%)
		df=10	X^2=5.292	*P*=0.8709
Mean Years in Agriculture	mean=7.3	mean=12.4	mean=4.5	mean=7.4
		df=8	X^2=24.747	*P*=0.0017
Housing Type				
Single family type	65 (59%)	15 (58%)	23 (51%)	25 (66%)
Multihome type	46 (41%)	11 (42%)	22 (49%)	13 (34%)
		df=2	X^2=1.82	*P*=0.4025
Mean Number in Household	mean=5.1	mean=5.5	mean=4.7	mean=5.6
		df=4	X^2=7.521	*P*=0.1108
Mean Years Education	mean=6.0	mean=5.2	mean=6.6	mean=6.0
		df=6	X^2=7.499	*P*=0.2772
Who Washes				
I wash	84 (76%)	14 (54%)	44 (97%)	25 (66%)
Others wash	27 (24%)	12 (46%)	1 (3%)	13 (34%)
		df=2	X^2=20.955	*P*=0.0001

(Table 1 continued on facing page.)

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Characteristics	Total 111[1]		Class of Exposure (N=109) Directly Exposed 26	(24%)	Indirectly Exposed 45	(41%)	Not Exposed 38	(35%)
How Washed								
By hand	6	(6%)	0	(0%)	1	(2%)	4	(11%)
Washing machine	89	(80%)	23	(88%)	37	(82%)	28	(74%)
By hand and machine	16	(14%)	3	(11%)	7	(16%)	6	(16%)
			df=4		X^2=5.332		*P*=0.2549	
Where Washed								
Home	51	(46%)	11	(42%)	20	(45%)	19	(50%)
Apartment/labor camp	31	(28%)	8	(31%)	15	(33%)	8	(21%)
Public laundromat	29	(26%)	7	(27%)	10	(22%)	11	(29%)
			df=4		X^2=1.774		*P*=0.7773	
Washing Frequency								
Twice a week	79	(71%)	19	(73%)	33	(73%)	26	(68%)
Once a week	30	(27%)	6	(23%)	12	(27%)	12	(32%)
Less than every two weeks	2	(2%)	1	(4%)	0	(0%)	0	(0%)
			df=4		X^2=3.699		*P*=0.4483	

1. A total of 111 respondents were interviewed. However, two respondents gave incomplete information that required their elimination from the group, leaving 109 represented in three classes of exposure.

dents had, on average, more years of formal education (seven years versus five years for Clinic 2). A majority of the combined sample reported receiving their formal education in Mexico (88%). The literacy level was relatively high with 78 percent reading and writing in Spanish. Although the largest percentage of the combined sample lived in single family units, a larger proportion of the Clinic 1 respondents (23%) lived in labor camps than did Clinic 2 subjects. Both groups reported similarly sized household units (Clinic 1 averaged five persons and Clinic 2 averaged six persons per household).

Data collected to determine reported exposure to and contamination by agricultural pesticides and subsequent handling and laundering were primarily categorical data. Categorical data require use of nonparametric statistics. Due to the nature of the categorical variables, all data were appropriately analyzed using nonparametric statistics, in particular the *chi* square and Hierarchical Log Linear analyses (Norusis, 1985; SPSS X Inc., 1986) to identify relationships among the variables. *Chi* square statistics were used for ease of reporting *P* values and Hierarchical Log Linear analyses were conducted because it is considered more rigorous and robust. Variables of interest to the study included exposure to pesticides, storage of contaminated clothing, laundering practices, as well as background variables such as gender, education, etc.

Three groups of respondents were identified based on exposure to pesticides:

1. **Direct Exposure** (n=26; 24%): Respondents who reported direct exposure due to mixing, spraying, handling, or other contact with pesticides in their work.

2. **Indirect Exposure** (n=45; 41%): Respondents who reported a household member as directly handling the chemicals.

3. **Nonexposed** (n=38; 35%): Respondents reporting no contact with chemical pesticides, either directly or indirectly from others in the household.

Results describe behaviors of the combined sample (n=109) and on the basis of reported exposure (n=71) either direct or indirect (Table 1). It is these

Table 2. Simple *Chi* Square Analysis of Laundering Practices and Degree of Exposure.

Laundering Practices	Direct			Indirect		
	Percent	(N)	*Chi* Square *P*	Percent	(N)	*Chi* Square *P*
Storing						
Separate	46.1	(12)	0.0007	84.4	(38)	0.0007
With other laundry	53.9	(14)		15.6	(7)	
Outside	3.9	(1)	0.0149	27.3	(12)	0.0149
Inside	96.1	(25)		72.7	(32)	
Laundering						
Separately	61.5	(16)	0.0536	82.2	(37)	0.0536
With other clothes	38.5	(10)		17.8	(8)	
Same day of exposure	15.4	(4)	ns*	17.8	(8)	ns*
Within 1-2 days of exposure	30.8	(8)		40.0	(18)	
Within 3-6 days of exposure	53.8	(14)		42.2	(19)	
By hand	0.0	(0)	ns*	2.2	(1)	ns*
By machine	8.5	(23)		82.2	(37)	
Both	11.5	(3)		15.6	(7)	
Normal Washing						
Two times per week	73.1	(19)	ns*	73.3	(33)	ns*
One time per week	23.1	(6)		26.7	(12)	
1-2 times per week	3.8	(1)		0.0	(0)	

* ns=not significant

latter respondents whose behavior is the principal focus of the study.

Table 1 presents the *chi* square statistics including probability values for sample characteristics descriptors. The three subgroups exhibited similar background characteristics. No statistically significant differences were found among them on education, age, type of housing, number of persons in household, marital status, and temporary or permanent work. Statistically significant differences were noted for number of years in agriculture and by clinic site. The former appears to be due to the fact that a large proportion of the indirect exposure group had not worked in agriculture and was principally women. In the case of site differences, 32 of the 38 respondents (84%) who reported no exposure were from Clinic 2. More germane are the relationships between the exposure variable and the dependent laundering behavior variables. Among the three groups' factors, "who washes clothing" and "how wash is done," were statistically significant. In the case of "who washes," a large majority of launderers were women. In the case of "how wash is done," a greater than expected number laundered clothing using a machine rather than by hand. No other significant relationships were found for the three groups for washing frequency or where laundering was done (i.e., in home, in camp, or in public facilities).

Direct exposed and indirect exposed groups were those who reported potential contamination and were those at possible risk of both exposure and secondhand exposure. Consequently, their results are much more important in terms of potentially risky behaviors. *Chi* square analyses and limited Hierarchi-

Table 3. Simple *Chi* Square Analysis of User Characteristics and Degree of Exposure.

Characteristics	Direct			Indirect		
	Percent	(N)	*Chi* Square *P*	Percent	(N)	*Chi* Square *P*
Use Pesticide at Work						
Daily to 1 time per week	58.3	(14)	ns*	71.8	(28)	ns*
1-3 per month	29.2	(7)		12.8	(5)	ns*
Once a month	12.5	(3)		15.4	(6)	
Permanent/Temporary						
Permanent	32.0	(8)	ns*	44.2	(19)	ns*
Temporary	68.0	(17)		55.0	(24)	
Site						
Clinic 165.4	(17)	ns*	62.2	(28)	ns*	
Clinic 234.6	(9)		37.8	(17)		
Who Does Laundering?						
I do	53.8	(14)	0.0001	97.8	(44)	0.0001
Household members	46.2	(12)		2.2	(1)	
Gender						
Male	61.5	(16)	0.0001	4.4	(2)	0.0001
Female	38.5	(10)		95.6	(43)	
Years in Agriculture						
0 years	8.0	(2)	0.0006	62.2	(28)	0.0006
1-6 years	28.0	(7)		11.1	(5)	
7-15 years	32.0	(8)		15.6	(7)	
16-24 years	20.0	(5)		6.7	(3)	
25-49 years	12.0	(3)		4.4	(2)	

* ns=not significant

cal Log Linear analyses were utilized. *Chi* square values are reported in Tables 2 and 3. No significant differences were noted between the observed and expected results for the two subgroups on the basis of clinic site. A statistically significant difference was revealed on years in agriculture, for the same reasons noted above. Direct exposure and indirect exposure groups differed significantly on gender and "who washes clothing" contaminated clothing. In both cases the significance is due to the proportion of women indirectly exposed (81%) compared to men (11%). In contrast, far fewer women (38%) than men (62%) are directly exposed. Gender differences in launderer role is due to the fact that more women do laundry than men.

In relation to direct and indirect exposure and handling behaviors, significant differences were revealed for storage of clothing ("store separate from other wash" or "with other wash") and storage outside the home versus inside the home. In both cases, those individuals directly exposed were more likely to store contaminated clothing with other household wash and store it inside the house. Both are unsafe practices and are cautioned against in prescribed safe handling procedures (Table 4). The least safe storage behavior was reported by the group most at risk from firsthand exposure. Also, differences in terms of direct and indirect exposure and "how wash is done" were significant. Again, the least safe were direct users who were more likely to wash

Table 4. Techniques for Washing Pesticide-Contaminated Clothing.

1. Keep pesticide contaminated clothing separate from all other laundry.
2. Wash only small amounts of clothing at a time. Do not combine clothing contaminated with different pesticides—wash these in separate loads.
3. Wash contaminated clothing daily. Always wear clean protective clothing daily when working with pesticides.
4. If not washed immediately, place contaminated clothing in a clean plastic bag until it can be laundered.
5. Do not handle contaminated clothing with bare hands: wear rubber gloves or shake clothing from plastic bag into washer.
6. Before washing, presoak laundry.
7. Wash garments in a washing machine using the hottest water temperature at full water level and normal wash cycle.
8. If garments have pesticide odor, visible spots or stains before washing, rewash one or two times.
9. Clean washing machine before using for other laundry by repeating step five, with no clothing.
10. Hang laundry clothes on clothesline to avoid contaminating automatic dryer.
11. Always wear all required protective clothing when working with pesticides.

Source: Marer, P.J., Flint, M.L., & Stimmann, M.W. (1988). *The safe and effective use of pesticides.* Davis, CA: University of California Statewide Integrated Pesticide Management Program.

clothing with other household wash (38%) than were the indirect exposed group (18%).

Hierarchical Log Linear statistics were used as a statistical tool to determine if multivariate relationships between exposure and handling and/or laundering behaviors and demographic variables were significant. A backward elimination technique (Norusis, 1985; SPSS^X Inc., 1986) was used and confirmed the above findings. This technique produces the best model through backward elimination of variables (not unlike multiple regression). The Hierarchical Log Linear statistic confirmed that only two three-way sets of variables (not shown in tables) were statistically significant: (1) exposure, years in agriculture, and number of persons in the household ($P<0.01$), and (2) exposure, store separately, and who washes ($P<0.04$). As noted above in the *chi* square analyses, these findings show gender based differences. Other statistically significant findings were related to who washes (i.e., the women) and exposure, gender, years in agriculture, site, age, and number in household (Tables 2 and 3). These findings are all due to the gender of the person doing the wash. Age was also found to be significantly related to who washes, storage place, and when washing is done, as well as to gender, years in agriculture, and education. Only one other relationship, how washing is done and the permanent or temporary nature of the work was nearly significant. In relation to age, handling, and washing behaviors, it was found that the older the respondent, the more likely he or she was to be less safe.

Discussion

Two sets of findings emerge from this study. First, those individuals who appear to be at direct risk from exposure to pesticides (i.e., handlers, loaders, applicators) are the least safe in terms of storing contaminated clothing. Second, the phenomenon of secondhand exposure to pesticides appears to be well founded in relation to storage and laundering practices reported by those individuals who are directly or indirectly exposed to agricultural pesticides. The routes that secondhand exposure follow are multiple. These routes are by the storage of contaminated clothes with noncontaminated clothing inside the house, by otherwise unexposed launderers (primarily women) handling contaminated clothing, and by the intermediate host of the washing machine that is used for household laundry.

In the first case, the direct user group is at greatest risk because members have the most direct contact with pesticides. The probability of residues contacting the skin and clothing is high because they handle, mix, and apply the materials in workplace settings. If clothing is stored with noncontaminated clothing and inside the home, the risk of exposure to other household members is increased. In both cases of storage with other clothing and in home settings, the direct user group was more likely to act unsafely than persons not reporting direct exposure. This direct user group should be a prime target for educational campaigns emphasizing the adoption of safe laundering practices.

In the second case, women, who are not directly exposed to pesticides but who are launderers, are subject to exposure from improper storage and washing practices. They do the wash of the users and in the process are potential recipients of secondhand exposure. To extend the exposure chain, launderers, through unsafe practices, increase the probability of exposure to others in the households. Significant differences were indicated in terms of how the clothing was laundered. Direct and indirect users washed contaminated clothing with noncontaminated clothing in higher than expected numbers and in almost all cases in machines, thereby extending the potential exposure to other members of the household. If the machines were not cleaned after washing contaminated clothing, the contamination, albeit in diluted form, could be spread further.

Both years of experience in agriculture and age influenced safe and unsafe practices. It appears that individuals with less experience in agriculture are safer. Older workers and launderers and those with more agricultural experience practice unsafe laundering procedures. Increased experience appears to result in fewer precautions taken. Other factors, those of education, household size, or type of work, were not significantly related. It may be that the younger, less experienced members, who also may be newer to the issue of pesticides and risks, exercise more precautions such as those involving storage and laundering practices.

Surprisingly, number of members in the household revealed no significant differences in relation to the cautionary behaviors or, for that matter, in relation to other factors except for who does the washing. In relation to work use or exposure to pesticides, number of household members was significant only in combination with years in agriculture, a finding that was probably affected by the high number with no experience in agriculture.

The key results of this exploratory study are surprising and suggestive. The fact that the more experienced the worker and the more potential for direct exposure, the less cautious they are in terms of postexposure practices is unexpected. The surprise is that the issue of pesticide exposure and farm workers has been a major issue for years and great attention has been focused on it. At the same time, this finding is not surprising because other research has suggested that the more experienced a person may be with a hazard, the less cautious he or she tends to be (Grieshop & Stiles, 1989; Hawkes & Stiles, 1986). On a governmental level, major efforts have been made to direct workers toward proper behaviors. However, such efforts may not be reaching the targets. The messages, if labels and other warnings are indicative, seldom incorporate the topics that were the concern of this study. The fact is that laundering is not a dramatic act, despite the fact that the issue is the one closest, in several senses, to the workers. If the findings are valid, they suggest much more needs to be done in terms of extending the message.

The results are surprising in other ways. The findings indicate that the direct users are the least cautious, but also that those individuals indirectly exposed are also exposed in large numbers. In addition, although they report being more cautious in some ways, they profess not following safe procedures in the handling and laundering of clothing. Thus, large numbers of workers who are and/or who perceive themselves to be exposed to agricultural pesticides are not protecting themselves from potential risks. Indeed, their behaviors lead to secondhand exposure for others in their households.

Despite the limited nature of this study and some limitations in the procedures (e.g., limited time with subjects, the need for more powerful data collection procedures such as *in situ* verification in addition to self-reporting of procedures), the findings suggest a number of actions that could be taken to cope with the situation represented by this study. If exposure is as extensive as reported by these workers, more vigilance and enforcement is needed for reducing exposure. Much more must be done to inform and sensitize workers and, as appropriate, their spouses to the hazards and the proper (or safe) procedures for storing and laundering contaminated clothing. These steps have been spelled out for some time (Table 4). However, this message is either not being communicated, not received, not understood, or not believed (or a combination of these possibilities). Each situation deserves attention and different responses. For example, some individuals may well understand what the message communicates (e.g., store separately, wash separately, etc.), but simply do not believe it. This scenario may describe the case of the direct users. Another possibility may be that the message is sent—in English—and the receivers read only Spanish (75% in this sample). Other common situations are those in which the message is never received in the locales in which the targets are found, e.g., laundromats, on detergent literature. Obviously, attention must be given to the message, its credibility, and acceptability to the receiver, as well as its appropriateness.

The situation is not so simple that proper message design and delivery will resolve it. As has been pointed out by others (Note 1), the farm worker population is comprised of people with limited resources. To follow procedures judged to be safe and adequate requires resources, including a sufficient number of changes of clothing, a washing machine in the house, and hot water (140° F). All these require financial resources that may be beyond the means of many worker families. If a machine is not available and a public laundry facility is used, then proper procedures call for washing contaminated clothing separately, sometimes for rewashing, and for rinsing the machine after use. Even if a person were disposed to follow these steps, each step adds significant costs to the laundering. Today, machines cost up to $1 or more per load and these steps rapidly escalate the cost. The reality is that there are numerous factors that work against prescribed behaviors. It is not just a matter of economics, but factors of convenience and credibility enter into the decision to act as prescribed.

Despite these obstacles, steps must be taken. The problems of exposure, both firsthand and secondhand, exist. The issue is not the lack of useful information on what handy steps can be taken in the case of contaminated clothing (Note 2). The issue is delivering the message in a fashion that gets to the receiver in bold and appropriate ways. Messages in laundromats in languages of the users is one step. Recognizing that the target for the messages may often not be the farm worker but a spouse begins a process for getting the point to where it should be delivered. The use of media other than print provides another avenue. Attention is required to the point of developing credible messages. If the receiver believes the message, a major hurdle is overcome. Nevertheless, other hurdles, as represented by economics and availability of machines, also have to be met. A major issue then becomes: Who is responsible for the issues of economics? Should those individuals or corporations who use any pesticides be required to ensure that clothing exposed is laundered on the premises? Or, should they be required to provide work clothes? Such suggestions most likely will be met with opposition by those who say it is not their responsibility or that the problem is not large enough to deserve such steps.

This problem exists at the human level, and a host of contributors can be identified. Its solution is not solely the responsibility of the agricultural producers, although in large part it is. Solutions are also the responsibility of the larger system of agricultural enterprises. Public agencies, through governmental action, also play roles. The solution is also in the realm of public health officials and educators as well as farm-worker advocates. Finally, a major contributor to the solution must be the farm worker and his or her family through their individual behaviors that can avoid the part of the problem represented by secondhand exposure.

Notes

1. The authors acknowledge and thank an anonymous reviewer for offering pertinent suggestions.
2. For example, two effective ways for reducing secondhand contamination are through the use of plastic household gloves and by prerinsing clothes with cold water. The latter can be done outside (away from food and children) with a garden hose.

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