Preventing Eye Injuries Among Citrus Harvesters: The Community Health Worker Model

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Objectives. Although eye injuries are common among citrus harvesters, the proportion of workers using protective eyewear has been negligible. We focused on adoption of worker-tested safety glasses with and without the presence and activities of trained peer-worker role models on harvesting crews.

Methods. Observation of 13 citrus harvesting crews established baseline use of safety eyewear. Nine crews subsequently were assigned a peer worker to model use of safety glasses, conduct eye safety education, and treat minor eye injuries. Safety eyewear use by crews was monitored up to 15 weeks into the intervention.

Results. Intervention crews with peer workers had significantly higher rates of eyewear use than control crews. Intervention exposure time and level of worker use were strongly correlated. Among intervention crews, workers with 1 to 2 years of experience (odds ratio [OR]=2.89; 95% confidence interval [CI]=1.11, 7.55) and who received help from their peer worker (OR=3.73; 95% CI=1.21, 11.57) were significantly more likely to use glasses than were other intervention crew members.

Conclusions. Adaptation of the community health worker model for this setting improved injury prevention practices and may have relevance for similar agricultural settings. (*Am J Public Health.* 2011;101:2269–2274. doi:10.2105/AJPH.2011.300316)

Agricultural work is one of the most dangerous occupational fields.[1] Although many injuries are preventable, barriers to safe practices exist. These barriers are especially evident in the citrus harvesting industry and include a piece-rate pay scale that fosters a rapid and potentially hazardous pace of work; a crew leader system that obscures employer–worker relationships; language and literacy barriers that impede safety training; cultural barriers that contribute to entrenched resistance to using safety equipment; an illegal work status that encourages hazardous job employment; and a dearth of occupational safety and health enforcement.[2]

Florida's $1 billion citrus harvest is almost entirely handpicked. Harvesters use 20-foot ladders and canvas bags weighing up to 90 pounds when full to pick about 3 tons of fruit daily.[3,4] Environmental conditions are challenging. During picking season, the groves are typically wet and humid in the morning and hot and dusty in the afternoon. Harvesters confront eye injuries from tree branches, dust, chemical residues, biting insects, sunlight, and falls.[5–11]

Citrus industry managers recognize that eye injuries are the most frequent causes of clinic visits, and that transportation, lost time, and paperwork contribute significantly to harvesting costs. More than 90% of eye injuries are preventable by protective eyewear.[12] However, use of safety glasses requires availability, a monetary outlay, adoption by reluctant workers,[13] and a change in workplace safety culture that is difficult to influence and measure.[14,15] Although most companies provide harvesters with free glasses, use is deterred by fears that they impede efficiency and productivity, resulting in lower wages. The workers also believe glasses are uncomfortable, too hot to wear in warmer months, require breaks for cleaning or adjusting, come into contact with tree branches, and distort vision, thereby increasing risk of falls. Thus, the proportion of workers wearing safety glasses is negligible (~2%).[11]

One method of encouraging behavior change that has not been widely disseminated at the worksite is the use of community health workers (CHWs).[16] Whereas CHWs have been used extensively throughout Latin America, Africa, and Asia,[17,18] their activities are usually limited to home visits. In the United States, most CHWs are women serving as cultural bridges between health care providers and members of economically disadvantaged communities.[19] The CHW approach has been useful in reaching Hispanic populations in rural areas where English usage is uncommon.[20] Because they know local norms, CHWs can make personal connections more effectively than traditional health care providers can, as well as disseminate health information.[21]

Relevant worksite health promotion interventions are beneficial in that they offer the possibility of combining policy, organizational, and individual behavior change strategies, thereby increasing intervention potency.[22–25] Moreover, ongoing interactions among workers provide social support that may enhance intervention effect by motivating persons who might otherwise not participate.[26] Lastly, beyond adoption of desired health behaviors, worksite interventions can increase morale and productivity.[27,28] We assessed the utility of a CHW approach for increasing the acceptance and use of safety glasses among citrus harvesters.

METHODS

Community-based prevention marketing is a data-driven planning framework that combines community organizing principles, prevention research techniques, and social marketing's conceptual format to design, implement, and evaluate health and safety promotion interventions.[29,30] Using community-based prevention marketing, personnel of the Florida Prevention Research Center (FPRC) developed an eye injury prevention program to meet Florida citrus harvesters' needs. The program arose from an evidence-based project

developed by the Great Lakes Partnership for Agricultural Safety and Health for Hispanic farmworkers in the Midwest.[31]

The Great Lakes Partnership for Agricultural Safety and Health project created a train-the-trainer curriculum and educational materials for a low-literacy, Spanish-speaking, farmworker population. Researchers of the FPRC and the Partnership for Citrus Worker Health, a stakeholder group that includes growers, migrant service organizations, worker coalitions, and local health department personnel, conducted surveys and focus groups with citrus workers and industry representatives, leading to a marketing plan to tailor the program for citrus harvesters.[8,11,32]

Citrus Industry Participation

Two citrus companies that agreed to participate represented some of the largest producers in the state with both in-house crews and outside contractors. More than 100 companies produce 169 000 acres of citrus in 5 southwest Florida counties that comprise the Gulf Citrus ;Growers Association. One company (Company A) had collaborated with the Partnership for Citrus Worker Health during the project's pilot phase and participated in the community advisory board. Before collaboration, Company A had no significant history of workers wearing safety glasses.[8,11] Perhaps because of exposure to the Partnership for Citrus Worker Health and pilot-testing, a modest proportion of Company A workers wore them at the start of the actual intervention. The second company (Company B) was typical of others in the citrus industry in that it had never made a systematic attempt to promote use of protective eyewear.

Peer Worker Recruitment, Training, and Implementation

Recruitment for CHW candidates began by asking crew leaders and employers about harvesters most respected by their peers. This procedure typically resulted in identification of candidates who were superior harvesters on a particular crew. Workers who declined the invitation to undergo CHW training also were asked to recommend coworkers, usually a more experienced worker they sought out for advice. Candidates had to be willing to commit time to training during evenings and weekends. Because of the lack of worker leisure time, this commitment deterred some potential candidates. All harvesters who agreed were men living and working among their fellow crew members. The 20-hour training of CHWs was conducted in Spanish and covered eye hazards specific to citrus harvesting, eye diseases, first aid, and methods for distributing, fitting, and promoting use of safety glasses. To ensure fidelity, FPRC personnel and the migrant service organization oversaw training. Each crew had 1 to 3 individuals selected to complete the training so that effects of turnover would be minimized.

At the end of training, the research team selected the individual on each intervention crew who had performed the best during the training. In addition to the piece rate they were paid for the amount of citrus harvested, CHWs received a stipend (equivalent to 10 hours/week of piece-rate work). The CHWs were required to spend several hours conducting outreach and performing first aid in addition to keeping records of their activities and meeting with the coordinator. Weekly records included logs of educational encounters, numbers of injuries treated and safety glasses distributed, and any problems that arose. Records were used for CHW evaluation and follow-up with injured crew members. The CHWs were supplied with a backpack containing extra safety glasses, educational tools, and first aid supplies.

The intervention consisted of the following CHW activities:

- Modeling safe behavior by wearing the protective glasses at all times during harvesting,
- Distributing glasses to the entire crew and encouraging use,
- Educating every crew member at least once during the season on eye safety and benefits of protective eyewear,
- Administering eye washings or other first aid to crew members as needed,
- Recording each incident or interaction with crewmates, and
- Meeting biweekly with the field coordinator of the project.

During meetings with the FPRC field coordinator, CHWs reviewed records and activities performed and restocked supplies of eyewash and replacement eyewear. The CHWs played an important role in evaluating and adapting the training to fit worker needs and preferences by field-testing safety glasses and providing feedback on features that enhanced comfort and performance.[8] To verify CHWs' use of glasses, FPRC staff made unannounced visits to the field.

Evaluation Design

Participants in the control and intervention (CHW) crews were provided with safety glasses at the beginning of the harvesting season. Replacement eyewear for lost or damaged glasses was available on buses that transported workers to the fields, and for intervention crew members, from CHWs as well. We evaluated the CHW program during 2007 with a prospective, quasi-experimental, time series design to determine if the presence and activities of a CHW on a harvesting crew were associated with increased use of protective eyewear compared with control crews that received eyewear but had no CHW. The evaluation had 2 major components: (1) repeated observations of workers during harvesting; and (2) interviews with workers on all crews near the end of the harvesting season. Both components addressed behavior change measurement in the field and distinguished consistent use from temporary adoption of behavior because of social desirability response.

The research team comprised FPRC and migrant service personnel, the same individuals who conducted CHW training and supervision so crew members understood and accepted their presence in the field as they walked among the trees with a clipboard. Although workers on ladders could anticipate observers' arrival, they did not stop harvesting to put on glasses. In fact, harvesters selecting not to wear glasses usually did not bring them to the field.

Because of restrictions placed on researchers by participating companies, the 13 crews could not be randomly assigned to intervention or control conditions. Company A workers lived in 1 large camp maintained on the company property. Thus, a mixing of members of intervention and control crews would likely have created a diffusion or contamination effect.[33,34] Therefore, all Company A crews received the CHW intervention. Whereas some Company B crews received the intervention,

crews assigned to the control group all were from Company B because it had no central camp.

Baseline and Follow-Up Data Collection

Before completion of CHW selection and training, research team members observed workers (n=278) on all crews (n=13) repeatedly on 3 separate days over an 8-week period to increase the validity of the baseline use measure. The evaluation compared safety eyewear adoption among 9 crews with a CHW to 4 control crews receiving safety glasses but having no CHW.

The CHWs conducted outreach activities for the duration of the season. Follow-up data collection tracked the use of safety eyewear on all crews. Among intervention crews, use of glasses was monitored from 4 weeks of CHW exposure up to 15 weeks of CHW exposure. To improve estimates of adoption by workers, and because environmental conditions in the grove change dramatically during the workday, CHWs observed the harvesters 4 times daily during data collection periods to assess user consistency. Two observational points were made through the grove in the morning to count how many workers on the observed crew wore glasses. Working in pairs, researchers started at opposite ends of the grove and walked up and down the rows, comparing results at the end of the observation. Workers harvest independently and are usually separated from one another during the day; for example, a row of trees 1 quarter mile long may have only 1 harvester. After lunch, the process was repeated twice. The level of analysis was "crew" as individual workers could not be identified or tracked during the day. Researchers also verified adoption through their familiarity with the crews and periodic corroboration by CHWs. Because there was no penalty for refusing to wear safety glasses and no enforcement by the crew leader, those who adopted them did so voluntarily. As noted previously, harvesters choosing not to wear glasses did not bring them to work.

The second evaluation component was a face-to-face survey of all workers consenting to participate. On the third day of observation, preintervention, and postintervention, observers used 1 of the 4 observation walk-bys to ask each worker 10 questions related to demographics, work history, experience with eye injuries, and opinions about wearing safety glasses. For intervention crews, they also asked if workers knew their CHW's name and if they had received any assistance or first aid from him. When interviewers asked the questions, they noted whether the harvester was wearing glasses. The proportion of workers wearing glasses during the observational pass when the survey was administered was not significantly different from the other 3 observations for that day.

Data Analysis

The software package S-PLUS 6.2 (MS Miami Software, Miami Beach, FL) provided analyses that included univariate statistics for all variables; paired sample *t*-test or Pearson χ^2 test as appropriate to compare crews, control versus intervention groups, the effects before and after the intervention, and the association between crews' protective eyewear use and CHW presence; Spearman's rank correlation statistic to examine exposure time to CHWs with use of glasses; and logistic regression to test the effects of CHWs on use of glasses when work experience and age were considered, producing odds ratios (ORs) and 95% confidence intervals (CIs).

RESULTS

Harvesters were seasonal workers, male (100%), primarily of Mexican origin, aged between 20 and 40 years, and with at least 1 year of harvesting experience (67.0%). These demographics are comparable to ones reported by Roka and Cook[4] in their comprehensive report of Florida seasonal farmworkers.

Observed Use of Safety Eyewear

Field observations demonstrated that crews with CHWs had significantly higher rates of eyewear use than control crews (t=−3.070; P=.012). The data in Table 1 show each of the field observations for the 3 baseline and 3 follow-up measures by crew. For intervention crews, the mean baseline percentage of protective eyewear users was 11.1%. The mean proportion of adopters across intervention crews reached a high of 35.5% on the last day of observation for a postintervention mean of 27.5%. Use among control crews was 2.4% over the course of the 3 preintervention observations. Postintervention use rates averaged 2.6%.

Among Company B participants receiving the intervention (crews 7, 8, and 10), adoption

TABLE 1—Baseline and Follow-Up Observations of Citrus Harvester Use of Safety Glasses in 2 Citrus Companies in Southwest Florida, 2007

	Baseline Use of Safety Glasses, %				Follow-Up Use of Safety Glasses, % (No. Weeks With Trained CHW)			
Crew Number	1	2	3	Overall	4	5	6	Overall
Control								
9	7	0	0	2	0	0	0	0
20	5	6	0	4	6	20	10	12
22	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0		0
Intervention								
1	10	47	21	26	22 (9)	73 (12)	63 (15)	53
2	32	38	42	37	30 (7)	35 (11)	41 (13)	35
3	20	19	33	24	38 (7)	41 (12)	35 (13)	38
4	0	0	0	0	10 (7)	22 (11)	27 (12)	20
5	16	0	45	20	54 (7)	57 (13)	87 (13)	66
6	17	12	12	14	13 (7)	42 (11)	65 (15)	40
7	5	0	0	2	4 (5)	30 (9)	12 (10)	12
8	1	0	0	0	0 (5)	56 (9)	39 (10)	32
10	0	0	0	0	5 (4)	9 (5)	10 (6)	8

Note. CHW = community health worker.

TABLE 2—Worker Survey on Effect of Community Health Worker Level of Contact With Intervention Crews in 2 Citrus Companies in Southwest Florida, 2007

	Worker Response, No. (%)		
	CHW Helped	CHW Did Not Help	CHW Not Known
Was worker wearing glasses at time of interview?			
Yes	44 (48.9)	21 (31.8)	6 (24.0)
No	46 (51.1)	45 (68.2)	19 (76.0)
Total no.	90	66	25

Note. CHW = community health worker. Pearson $\chi^2 = 39.00$; df = 3; $P < .001$.

rates steadily improved with each week of CHW presence. For 1 of the 3 crews (crew 10) overall use never exceeded 10%, with a mean of just 8% across observations. This modest response to the intervention likely was because of a turnover in the CHW position and only brief exposure to the CHW. Some intervention crews, particularly from Company A (crews 1 through 6), frequently had use rates that exceeded 50% on particular days. This result provides the strongest evidence that use of glasses could be widely accepted by citrus harvesters in the presence of a CHW. The more time the CHW spent with his crew, the greater was the observed use of glasses. When we used Spearman's rank correlation statistic, we found strong correlation between the time the CHW was in the field and the level of safety eyewear use among workers ($\rho = 0.77$; $P < .01$)

Worker Survey

For members of the intervention crews, we examined use of glasses and level of contact with the CHW (CHW helped, CHW didn't help, or CHW wasn't known; Table 2) and found a statistically significant relationship ($\chi^2 = 39.00$; $P < .001$). Nearly half of the workers who received help from the CHW (48.9%) were observed wearing glasses. Workers on crews who knew their CHW but did not receive help were somewhat less likely to wear glasses (31.8%), and just 24.0% of workers who did not know the identity of their CHW wore them.

The impact of the intervention can be seen more clearly through logistic regression, with control for years of harvesting experience and age group (Table 3). Examination of the parameter estimates for the individual categories showed that workers on intervention crews with 1 to 2 years of experience (OR = 2.89; 95% CI = 1.11, 7.55) and who knew and received help from the CHW (OR = 3.73; 95% CI = 1.21, 11.57) were significantly more likely to wear glasses than were other intervention crew members.

Regarding other variables, workers on intervention crews who were younger than 29 years (the mean age of the workers interviewed) were significantly less likely to wear glasses than were older workers (OR = 0.29; 95% CI = 0.14, 0.61). In this model, knowing the CHW was insufficient by itself to improve the use of glasses (OR = 1.68; 95% CI = 0.54, 5.25) as was having more than 2 years of experience (OR = 0.70; 95% CI = 0.31, 1.57).

DISCUSSION

This approach was effective in promoting the use of safety glasses among citrus harvesters. The impact of the CHW on using glasses was even more pronounced if he provided direct aid. The intervention succeeded despite challenges faced by CHWs. For example, the season was under way by the time they completed training, and many workers had already become accustomed to harvesting without glasses. There was attrition and turnover in crew membership, and workers arriving later in the season received less exposure to the intervention. Turnover rates for intervention and control groups were not significantly different (~50% each). Because high worker turnover is an industry norm and difficult to track,[4] these impediments to CHW effectiveness likely will be ongoing challenges. As an inside member of the harvesting community, the CHW is uniquely placed to address barriers and promote change. Despite differences between the 2 companies, CHWs were able to effect change over a period of weeks in previously unexposed crews of Company B and to increase use in Company A crews in which some workers had had previous exposure to the pilot-test version of the intervention.

Results of interviews with crew members help explain reasons for early adoption, but they do not definitively answer why individual behavior changes. Some CHWs have a greater impact on their peers than do others. The age of citrus workers and their length of experience also were related to intervention impact, suggesting that future interventions might be directed to distinct groups or audience segments.[35] For example, workers in their second year of harvesting have both an understanding of the risks of eye injury and, possibly, have achieved a comfortable level of piece-rate work and know how much they can earn. Novice workers might worry they

TABLE 3—Logistic Regression Results for Use of Safety Glasses by Members of Intervention Crews in 2 Citrus Companies in Southwest Florida, 2007

Parameter	B (SE)	OR (95% CI)
Experience, y		
1–2	1.062 (0.49)	2.89 (1.11, 7.55)
>2	–0.35 (0.41)	0.70 (0.31, 1.57)
Younger (<29 y)	–1.24 (0.38)	0.29 (0.14, 0.61)
Know CHW and received help	1.32 (0.58)	3.73 (1.21, 11.57)
Know CHW but received no help	0.52 (0.58)	1.68 (0.54, 5.25)

Notes. CHW = community health worker; CI = confidence interval; OR = odds ratio.

will not make enough income in their first year if they use glasses. Workers' age also influences their concerns about safety and providing long-term for their families. Other researchers have identified age as a potential moderating variable in health behavior adoption and maintenance.[36]

Certain elements of this study limit its generalization. For instance, crews could not be randomly assigned to intervention and control groups, so subtle differences among workers and company cultures were outside the control of the researchers. Moreover, members of some Company A crews had participated in the developmental phase of the intervention, including the pilot testing of safety eyewear; thus, they may have been more receptive to the intervention. Use of repeated observations in this study was a proxy measurement for adoption of the target behavior. Workers would have to be tracked over several seasons to confirm adoption maintenance.

Because this investigation was as an experiment in a natural setting, other independent variables could not be controlled. Crew sizes vary from 15 to 25 workers and may not be constant from week to week. Thus, the composition of crews and seasonal turnover introduce unknown variation to behavior change measurement. All CHWs may not have represented the typical worker by virtue of being experienced harvesters, holding a certain social status within their crews, and having at least an elementary education to enable their use of outreach materials. The amount of income from the stipend likely was insufficient to impact the CHW's influence over his peers (the crew would not be likely to adopt use just for the money received by the CHW); the CHW's stipend was based on performance of duties and not on the number of crew members that adopted safety glasses. It is impossible to quantify the competence or influence that a particular CHW had compared with another. The CHWs often lived in close quarters with a small subset of workers within and across crews that they could have influenced more strongly. In addition, each CHW had different social networks within the crew based on kinship, community of origin, age, and language. Finally, there is no way to guarantee that crews participating in this study are representative of other citrus harvesters.

Limitations notwithstanding, 2 important findings emanate from this study: (1) workers can adopt the use of safety eyewear previously considered to be incompatible with the demands of piece-rate harvesting, and (2) CHWs are key factors in modeling and encouraging behavior change. Thus, full-time citrus harvesters who have only a modest level of formal education can disseminate information on eye safety and effect behavior change.

The study has implications for employers seeking reduced harvesting costs and a healthier environment for workers. The CHW model also has significance for public health practitioners who struggle to address challenges faced by migrant workers. These findings corroborate those from other studies concerning the utility of CHWs as health promoters[16,19,28,31] and suggest that CHWs have value in occupational settings. Through adaptation of an evidence-based program for the conditions of citrus harvesters, CHWs fostered adoption of safety eyewear by workers to an average level of 27.5% (compared with 2.6% among crews without CHWs), administered first aid to workers, and acted as both a resource person and role model. In the final analysis, the CHW approach minimized the risk of major injuries and the impact of minor ones on worker downtime and challenged the myth that safety glasses impede harvesting efficiency. ■

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P.F. Monaghan, L.S. Forst, J.A. Tovar-Aguilar, C.A. Bryant, and R.J. McDermott conceptualized the study design, oversaw all study protocols, and contributed to initial and final drafts of the article. G.D. Israel, S. Galindo-Gonzalez, Z. Thompson, and Y. Zhu devised the data analytic schemes and prepared methodological descriptions and data interpretation for the article.

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Human Participant Protection

The University of South Florida institutional review board reviewed and approved study protocols for this project.

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