

More Than Training: Community-Based Participatory Research to Reduce Injuries Among Hispanic Construction Workers

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Background Workplace mortality and severe injury are disproportionately distributed among foreign born and Hispanic construction workers. Worker Centers (WCs) provide services and advocacy for low-wage workers and a way for investigators to reach them. The goal of this project is to prevent occupational injuries by increasing awareness of hazards and self-efficacy among foreign born, Hispanic construction workers and by expanding the agenda of WCs to include occupational health and safety (H&S).

Methods Investigators partnered with eight WCs in seven cities to train worker leaders to deliver a modified OSHA 10-hr curriculum to their peers.

Results Thirty-two worker leaders trained 446 workers over 3 years. There was a demonstrated improvement in knowledge, hazard identification, self-efficacy, and sustainable H&S activities.

Conclusions This study provides evidence for successful implementation of a training intervention for low wage, low literacy Hispanic construction workers using a community-based participatory research approach. *Am. J. Ind. Med.* 56:827–837, 2013.

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INTRODUCTION

Workplace mortality and severe injury are disproportionately distributed among foreign born and Hispanic

workers in the United States [Loh and Richardson, 2004; Friedman and Forst, 2008; Hersch and Viscusi, 2010; BLS, 2012]. This is particularly true for those who work in construction where jobs are hazardous and injury rates

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are high [Dong et al., 2011]. Residential construction has unique employment conditions that attract foreign born workers and also put them at increased risk for injury: it tends to be contracted to small and sometimes unstable businesses; it operates on temporary contracts which are poorly vetted by employment regulators; and, because of its transient nature, enforcement of existing safety and health regulations is challenging [Quinlan et al., 2001; Ahonen et al., 2007]. Furthermore, small businesses tend to have worse health and safety (H&S) records [Oleinick et al., 1995; Okun et al., 2001; Dong et al., 2011].

Worker Centers (WCs) have evolved over the past decade to provide services and advocacy for low-wage workers [Fine, 2006]. Springing up as grass roots organizations across the United States, many of the WCs have formed two major consortia [IWJ, 2012; NDLON, 2012], though they may target different worker groups; they also retain local goals and outreach methods. The social justice agenda of WCs has generally focused on wage and hour issues, including “wage theft” [Bobo, 2009]. Although workplace H&S concerns have not been highlighted by the majority of these centers, interest in worker H&S as an organizing tool and concern about workplace justice has emerged and has recently been encouraged by the Occupational Safety and Health Administration (OSHA) [Cho et al., 2007; Brown et al., 2008; OSHA, 2012a].

Public health agencies and researchers, alarmed by the numbers, rates, trends, and nature of injuries in construction, recognize the occupational health disparities for foreign born and Hispanic workers compared to US born and non-Hispanic workers. However, they lack direct access to these sub-populations. Reducing fatalities, non-fatal injuries, and illnesses requires a partnership with community-based organizations to reach these groups, which are widely dispersed, non-English speaking, low-educated, frequently unaware of their rights, and may be reluctant to come to the attention of authorities [Quandt et al., 2001; Forst et al., 2004; Cook, 2008; Schiller et al., 2010; Azaroff et al., 2011; Campe et al., 2011; Minkler et al., 2010; Lee et al., 2012; Quach et al., 2012].

H&S training is a widely used intervention for preventing injury and illness at work. Training effectiveness has been studied in a variety of sectors, including construction [Lipscomb et al., 2008; Sokas et al., 2009]. However, there is a dearth of evidence of training effectiveness, particularly among low wage, low literacy, immigrant, and temporarily employed construction workers [Kinn et al., 2000; Dong et al., 2004; Sokas et al., 2009]. Furthermore, there are only limited descriptions of the ways in which these workers utilize training [Ochsner et al., 2012].

The overall goal of this community-based participatory research (CBPR) is to prevent occupational injuries among Hispanic construction workers. Specific objectives

are: to increase awareness of workplace hazards and self-efficacy among foreign born, Hispanic construction workers; and to expand the agenda of WCs to include occupational H&S.

MATERIALS AND METHODS

This project used a “peer educator” model [Merrill, 1994; Kurtz et al., 1997; Lippin et al., 2000; Becker and Morawetz, 2004; Daltuva et al., 2007], whereby WCs recruited Worker Leaders (WLs) to deliver the OSHA 10 hr curriculum on construction H&S to their peers. The program was evaluated using mixed methods to determine successful implementation of the program, the number of workers reached, change in knowledge and behavior, and the impact on the WCs. This protocol was approved by the Institutional Review Board of the University of Illinois at Chicago under full review (Protocol # 2008-0928). The consent form was read aloud to participants for verbal consent, but signature was formally waived by the IRB; the signature would have been the only way to identify the participants, and the waiver was allowed to provide greater assurance of confidentiality.

Partners

University investigators partnered with two local WCs, plus a WC-university team of developers of an OSHA 10-hr curriculum for low literacy, Spanish-speaking construction workers [Williams et al., 2010]. The project was conducted in partnership with one of the WC networks to establish joint goals, specific responsibilities and appropriate budgeting arrangements. In brief, WCs assumed primary responsibility for recruiting WLs as well as workers to be trained, collaborating with training implementation, and partnering with evaluation procedures; the university partners assumed responsibility for human subjects protection, evaluation, design and implementation, identification of certified trainers to comply with OSHA requirements, and curriculum revision. Over the 3 year course of the project, WCs from six additional cities—three in the second year, and three more in the third year—were recruited at national conferences of WC networks, in collaboration with the initial WC partners: year 2 WCs were invited based on their relative proximity to Chicago, year 3 centers were clustered in the Southwestern US for potential synergy. Three trainers authorized by OSHA to deliver the course and issue a 10-hr card (certification) partnered in this program. In the end, our partnership included eight WCs in seven cities, two to seven WLs in each of the WCs (32, total), three OSHA-authorized trainers, and two university programs.

Worker Leaders

Each WC recruited at least two of their members to become trainers. They were asked to select Spanish speakers who demonstrated good leadership and communication skills, and who had extensive construction experience. The WLs served as recruiters, peer educators (trainers), and eventually some of them became actively involved in planning, training, and reaching out to other WCs in the project.

OSHA 10-Hr Curriculum and Training Methodology

OSHA has a list of topics to be covered in a 10-hr curriculum for injury prevention on construction sites [OSHA, 2012b]. One WC and University group on the East Coast developed a 10-hr course for variable literacy, Spanish-speaking, construction worker population over a 5-year period [Ochsner et al., 2008; CPWR, 2009; Williams et al., 2010]. Bound into a manual in Spanish and in English (available at geolib.org), this course contains instructions, diagrams, and exercises for sessions that cover the content and meet the time requirements mandated by OSHA; parts of the manual were approved by the OSHA Training Institute.

Adult learning [Wallerstein and Weinger, 1992; Mayo, 1999; Amuwo et al., 2011] and popular education [Arnold et al., 1992; Delp et al., 2002] techniques were utilized in train the trainer (TTT) courses and in the training itself. In addition to being an effective way to engage participants and deliver H&S content, these techniques were also selected to build leadership, teamwork, trust, and skills in communication and critical thinking.

The OSHA-authorized trainers conducted a 16-hr TTT course for the WLs in year 1 to introduce the materials and to mentor the WLs as they took turns training each other on sections of the curriculum. The day before each course, there was an additional ~3 hr refresher training session for WLs. There were two additional TTT sessions as new WCs and WLs were recruited; WLs from year 1 participated in the subsequent TTT sessions. Under the supervision of OSHA authorized trainers and investigators, WLs delivered three sessions the first year, and two sessions per site in the second and third years.

Worker-Participant Recruitment and Training

Recruitment of participants in their respective cities was conducted by WLs and other WC personnel. The WC discretionary budgets covered the costs of training, which included a meeting room, lunch, personal protective

equipment (PPE), and WL stipends; some offered a small amount of funding to replace lost wages of participants. They were expected to recruit 20 workers for each session.

The training sessions took place on the weekends, over 2 days. Tables for four to six workers were set up, and participants engaged in exercises as an entire class and in small group activities. Each segment of the course entailed participatory learning. The WLs directly facilitated the sessions with the presence and input of the OSHA-authorized trainers and one investigator.

Evaluation Tools

To evaluate the effect of training on worker participants, pre-training, post-training, and 3-month follow up questionnaires in Spanish were developed, piloted, implemented, and refined in each year of the study. The immediate pre- and post-training surveys queried demographics, work experience, safety climate perceptions, knowledge of hazards, and behavioral intentions. The 3-month follow up survey queried behavioral change, injury status, and how unsafe work activities had been handled since training. Two items, intended to better mirror the hands-on spirit of the training and address the needs of lower literacy workers, were piloted on pre- and post-intervention questionnaires beginning in the second year: a “what’s wrong with this picture?” item showed a construction worker on a ladder and required critique; a vignette describing a demanding boss on a roofing project asked, “what should Juan (the worker) do?” These pilot questions were further refined for the third year based on working analyses of second year data and advisory board feedback. The questionnaires were completed by the workers, with investigators reading the questions aloud and circling the room to assist workers in completing them.

Evaluation of WLs was dynamic in nature, so that improvements in training delivery could be implemented during the 10-hr sessions and over the duration of the project. WLs were engaged in open-ended discussions with the OSHA-authorized trainers during the TTT course and during their pre-training meetings. If WLs had problems, concerns, or ideas for changing presentation approaches, they were addressed immediately and a collective decision was made to either incorporate them or not, based on feasibility and fidelity to the program. Training was enhanced by the OSHA-authorized trainer during the training, de-briefed at the end of each course, and discussed again in the 3-hr preparation session. Each group of WLs worked with at least two different OSHA authorized trainers over the course of the study.

To evaluate WC perceptions of the strengths and limitations of the program, toward the conclusion of the project, an open-ended interview was conducted with a

representative from each WC partner that had been integrally involved with the project. Survey items related to the process of recruitment of participants, recruitment of WLs, the challenges or successes of the program within that WC, how burdensome the program was, and how the activity did or did not fit with their views about leadership development and the agenda of that WC.

Data Analysis

Pre- and post-training surveys

Data from the pre- and post-training surveys were entered and analyzed in MS Excel and SAS version 9.1 (SAS Institute, Inc., Cary, NC) for demographics, English language proficiency, work and training experience, injury experience, and factual knowledge. McNemar's non-parametric testing of matched pairs was used to determine the influence of training on knowledge about H&S.

For evaluation of the pictogram and story vignette, narrative responses to pre- and post-training questionnaires were used verbatim. Coding and categorization schemes for both questions began with a simple start list (Miles and Huberman, 2002, p. 58). Investigators developed "hoped for" answer categories, a priori, with a list of preventive strategies presumably learned in the training. These were applied to the data to assess whether such items might work in the given context. The method and results were presented to an advisory board, which provided suggestions for item improvement. Year 3 start lists for analyses were then more narrowly defined and utilized in the year 3 survey to permit inclusion of another form of evidence of participant learning. This evidence was considered on a pre-post basis. The analyst applied the start codes to the data to assess their general relevance and revise them. Revised codes and rules for applying them were finalized and applied to the data to assess the degree of general improvement in the content (simple counts of acceptable answers) and quality of answers (systematic, logical in order, use of strategies learned in training) prior to and following training, as well as to assess the usefulness of the item in future data gathering.

Three-Month Follow-Up Evaluation

Responses from a post-training survey item querying intended change in work practices were compared with what participants reported at the 3-month follow-up call. For year 3, start codes developed in year 2 were employed for both "intention to act" in the post-questionnaire and the 3-month follow-up. After initial review of responses, a small number of codes were added for a final list. Individual responses were coded at post and follow-up. Post-training survey responses are used verbatim. At follow-up,

responses are a summary of the respondent's answer noted during a telephone conversation by one of two interviewers, unless indicated by quotation marks. Responses could be composed of more than one code. Codes were then categorized into individual/procedural, relational/climate, and collective/structural categories to determine the type of effect the training session was able to have on work practices.

WC Evaluation

Interviews with WC leaders followed a semi-structured format, wherein a set of open-ended questions was used for each, but participant answers were allowed to proceed in any order and were not strictly limited to the scope of the question. In most cases, interviews were conducted by telephone.

The interviewer made notes during the conversation and filled them in immediately following the interview. These notes were then shared with the interviewee to assure accuracy and with two additional analysts, who used them to identify themes about the ways in which the project had affected the WCs. Themes were compared across the analysts and agreed to by consensus.

RESULTS

Worker-Participants and Training Sessions

Eight different WCs participated in a total of 25 OSHA 10-hr training sessions over a period of 3 years, with the goal to increase awareness of workplace hazards and self-efficacy among foreign-born Hispanic construction workers (Table I). A total of 446 workers participated in 2 days of training and earned the OSHA 10 hr card, and an additional 17 workers came to only 1 day (5+ hr) of training, totaling 4,545 worker-participant hours of training during the 3 years of this project. There was no difference in the number of participants recruited according to season.

Trainees were mostly male (88%), 37 ± 10 years of age, born in Mexico (87%), and had been working in the United States for a median of 11 years. Only one-third reported speaking English well or very well, and 61% had less than a high school education. Almost 18% had worked in the United States for less than 5 years, and 54% for more than 10 years. Over 80% had been employed in the 3 months prior to the training session. Among the year 3 trainees, 34% had not worked at all in the prior month, and 52% had worked at least 5 days. Among 270 participants in year 3 who responded to the question, 97 (35.9%) reported a work-related injury in the prior 12 months, for which 57 (58.8% of those reporting

TABLE I. Number of Trainees Receiving the OSHA 10-Hr Card, by Site and Chronology

	Number of participants			Total by site
	Year 1	Year 2	Year 3	
	Training 1; training 2; training 3	Training 1; training 2	Training 1; training 2	
Site1 (2 WCs in 1 city)	23; 19; 16	20; 17	15; 25	134
Site 2		15; 11	20; 9	55
Site 3		17; 10	13; 18	58
Site 4		12; 29	20; 18	79
Site 5			44; 14	58
Site 6			15; 14	29
Site 7			16; 16	32
Totals by year	58	131	257	Grand total 446

An additional 17 workers participated in 1 day (5+ hr) of training, and are not included in this table.

injuries, 21% of the total sample) sought medical care and 50 (52.1% of those reporting injuries and 18.5% of the total sample) lost work.

Some 42% reported having had some kind of training on their last job; 39% had ever had H&S training; and 62% of those reporting that they had had H&S training in English, but spoke little or no English. At one meeting with WLs, one pulled out a billfold with six OSHA 10-hr cards that he had been issued in English courses and reported that his co-workers—non-English speaking roofers—had been required to sit through these English language courses and had received OSHA 10-hr cards as well.

Pre- and Post-Training Surveys

There were four survey items on the questionnaire to test safety knowledge before and after the training; these items were selected based upon specific safety content required in the OSHA 10 hr program. There was a statistically significant gain in knowledge for the question regarding the best way to prevent falls (“guard rails;” $P = 0.0003$); however, only 23.1% knew that guard rails are preventive by the end of the training. Knowledge of the impact of “grounding” on the risk of electrical shock also improved from pre- to post-training (“reduces;” $P < 0.0001$). Here, the change went from 36.9% to 55.3% who demonstrated an understanding that “grounding” is not 100% protective. Two of the knowledge questions did not reach statistical significance: most participants (70%) knew that falls are the most common cause of fatality in construction before the training, and increase in knowledge was only to 72.9% ($P = 0.41$). The question about electrical injury depending on amps plus the amount of time the current passes through the body was correctly answered by 54.1% before and by 58.6% afterward ($P = 0.28$).

Results of the “what’s wrong with this picture?” (ladder safety) item suggest an increase of recognition of hazards from the pre-training responses to the post-training responses, as demonstrated by a clearer distinction among hazards and use of safety jargon from the course. Also notable is a greater emphasis on task-appropriate PPE.

Simple counts of answer categories and example answers for the decision-making vignette (“what should Juan do?”) are shown in Table II. Participants most commonly suggested, prior to training, that Juan should leave the job site or ask for what he needed, followed by general mentions of the importance of safety. Following the training, participants still emphasized the former two choices, but the third most frequent response type was to point out to the supervisor the problems at the work site. Answers also showed an increased ability to communicate about hazards after the training, as demonstrated by more assertive and systematic suggestions for action such as those presented in the course.

Three-Month Follow-Up Survey

All but a few of the participants provided telephone numbers for a 3-month follow up call; it was possible to reach 36% overall and 33% ($N = 84$) in year 3, for which data are presented here. In interviews, the topics of rights under OSHA, ladder safety, and electrical safety were listed as especially useful. Interviewees frequently reported feeling more aware of hazards at worksites—“estar más concienciado.” They more critically assessed worksites, working more slowly and deliberately, and they reported greater concern for fellow workers. Many also reported having increased confidence to address hazards with supervisors. Some reported referring back to the training manual and showing it to other workers. Many reported use of PPE.

TABLE II. Counts and Illustrative Answers From Decision-Making Strategies (“What Should Juan Do?”) Regarding Hazardous Work at Heights, Year 3 Participants

Code	Count pre^a (N = 242)	Count post^a (N = 240)	Example
Leave	54	42	“I would tell Juan to walk away. There are no safety measures in place. I don’t believe his employer will fix everything to make it a safe environment!”
Assess/remediate (self)	13	12	“They can begin to work on something else, for example, preparation, without going up the ladder and another day bring an adequate ladder and a harness or net.”
Ask for what you need	54	67	“First of all, look for a ladder that will work for that type of work and ask for all the protection that can help [. . .]”
Ask then leave	17	25	“Before starting the work, first he should ask the boss about the tools for his protection, and if there aren’t any then he shouldn’t work.”
Ask for what you need (specific task-appropriate materials)	11	10	“Tell the contractor that you need a larger ladder, a harness, guardrails and other safety articles and if he gets them to you, work, and if not, better turn in your resignation letter.”
Report	15	33	“Yes, talk to the supervisor and ask for improvements in his work environment, otherwise leave work and record it with OSHA.”
Safety is important (general affirmation that health and safety matter)	37	20	“He needs the proper safety if he should continue to work.”
Organize, ask, leave (talk to other workers at site, approach supervisor as a group with needs, if not, leave)	2	7	“Dialogue with the contractor to improve work conditions in the work area and if he doesn’t pay attention, tell the people he works with that they should support him to make the contractor understand that they have the right to a safe and healthy job.”
Organize, ask, report (talk to other workers at site, ask as a group for needs, if not, report)	1	1	“He can gather all the other workers for them in order to talk to the contractor about the safety issues. If the contractor doesn’t com[p]ly, report him to OSHA, then if no change leave the job for another.”
Remediate, non-specific (self, no specifics given)	11	13	“Correct the risks.”
Point out (drawing supervisor’s attention to problems)	28	42	“Talk to the contractor and let him know the dangers to which he’s exposing workers [. . .] depending on what the answer is, have a discussion.”
Get training (ask for help learning about the task)	13	6	“Get some safety training.” “Ask to be given more orientation.”
Be careful (general cautionary statement)	14	8	“He should be very careful.”

^aMore than one code can be applied to an answer, so number of answers does not equal number of participants.

In the 3-month follow-up, responses were categorized into individual/procedural, relational/climate, and collective/structural categories to determine the type of effect the training session was able to have on work practices (Table III). About half of workers reported taking the same type of action (individual, relational, structural/collective) that they expected to take immediately following the training; however, specific reported actions were not limited to those they predicted. Most frequent answers fell into the individual type, with workers citing non-specific safety practices such as “demand safe conditions at

work,” or “be more careful, protect myself more, bring adequate equipment.” Among those whose reported actions were of a different type at 3-month follow-up, about two-thirds described practices that moved them from no planned change to individual action type, or from individual- to relational-type categories. These workers described making other workers aware of hazards they observed, talking with supervisors about making worksites safer, asking for proper equipment, and taking on an informal safety leadership role. These workers expressed feeling responsible for others. For example, one worker

TABLE III. Intention to Act and Reported Action of Individuals Reached at 3 Months Post-Training, Categories Applied to Codes in Year 3

Individual/procedural	Relational/climate	Collective/structural
Critical assessment of worksite	Help train/advise a co-worker	Talk to someone at WC
Refuse to take a job	Ask for advice/training from a co-worker	Involve WC in action
Work slowly/deliberately	Identify hazards for a fellow worker	File a complaint
Specific safety practices, including PPE use	Talk with a supervisor about improving safety practices	
Not return to a worksite	Assume safety leadership	
Ask to be shown a task	Inform other workers about workers' centers	
Non-specific safety practices		

stated, “I feel more conscious—I feel more like a leader.” A handful of workers described collective action, like confronting a supervisor as a group, reporting violations to a WC or filing an official complaint, or organizing co-workers to walk off a job.

CBPR and WCs

Data from the telephone interviews of the WC representatives toward the end of the project were used to assess the methods and difficulties encountered in implementation, as well as their perception of the value of this program to the WC. By consensus of three data analysts, these were divided into three themes.

Implementation

Implementation challenges were described in terms of recruiting WLs, recruiting worker participants, conducting the training sessions, and evaluating the training. Recruiting WLs generally entailed talking with worker members who were either already active in the WC or had apparent leadership and teaching potential, as well as availability for the time commitment. Seven of the WCs described WL recruitment as relatively easy and very much in line with the WC's approach and goals, overall. One WC did not recruit WLs and the training was done by a VISTA volunteer and her husband. Recruiting participants ranged from word of mouth to advertising in churches, community centers, on street corners, and on the radio. The OSHA 10-hr card was a clear incentive, and some WCs paid participants a stipend to replace, in small part, lost wages; one WC offered a gift card to a grocery store. WCs frequently got commitments for participation, and then the workers did not show up at the training; the WCs cited workers getting hired as the reason for this. There was uniform enthusiasm for conducting the training itself. Most WCs liked the training manual and felt that it was easy to use; there were several criticisms of the colloquialisms in Spanish, and two WCs added activities that they felt would better illustrate the learning objectives. There were many comments about the hands-on approach being

critically important for this population of adult, low literacy workers with limited education; the words “respectful” and “accessible” were used. The cost of the training was, in some cases, higher than the budget provided. In these cases, WCs got PPE and/or meals donated and they did not have to limit the recruitment or the content of the training in any way. Most WCs were unable to wait for reimbursement until the end of the training (i.e., invoice for services after they were provided) because of their extremely limited budgets. Training evaluation changed over the study period. In the first year, the intention was to stagger enrollment and conduct surveys of participants every 3 months before and after the training, for around six surveys each (interrupted time-series design). WCs were unable to sustain this workload. When the design was changed to a simple before, after, and 3 months after survey, all of which were conducted by the investigators, the Site 1 WCs reported no further burden, and the evaluation component was not seen as difficult by the WCs that joined in the second and third years.

Value to the WCs

Several of the WCs reported coming to realize that H&S is part of the larger goal of worker/human rights as a result of this project. H&S was perceived as integral to supporting individual workers and promoting self-efficacy. Each of the WCs described its perspective on leadership development, and seven of the eight centers stated that this project was completely synergistic with their views. This project became a model for WL and member engagement in the WC, exploiting the iterative process that leads to participatory engagement and the sharing of experiential knowledge. They described this program as providing an opportunity to put leadership skills into action. The OSHA 10-hr card is an item of value that the WCs could provide to their target membership. The training method was described as multi-purpose (in one interview, “brilliant”) in that it met the goals of promoting leadership, fostering creativity, increasing knowledge, recruiting members, building community, conducting research, and reaching Latino construction workers who need this training.

Sustainability

Several of the WCs are continuing to focus more intensely on H&S. One WC now has a business, whereby it charges employers to train their Spanish-speaking employees on the OSHA 10-hr course; individual workers are recruited into the organization by being charged a nominal fee for participation. This same WC has worked to establish a new WC in another city and to work collaboratively with one of the other WCs in this project. Four of the WCs now work collaboratively with one of the two national networks on H&S training, with Susan Harwood funding from OSHA and a private foundation. Several of the WLs were able to take on training in the new grants because of their work on this project. Many of the WLs continue to train, informally, on H&S both in worksites and on street corners. Several have indicated that some contractors look to the WLs as knowledgeable people in H&S and request advice on worksites. Several of the WCs stated that their WLs are taking leadership roles in the WCs on various issues, and the combination of growth in community and self-efficacy have led to activism around national immigration policy. One WC no longer has personnel working there who participated in the project; the Executive Director stated that the WC is willing to participate in H&S work if it is funded, but that “wage and hour” issues are considered integral, while H&S issues are not.

DISCUSSION

This study demonstrates successful implementation of a participatory H&S program for Hispanic immigrant, construction workers in seven cities across the United States. At the most fundamental level, there were 32 workers (WLs) trained for 19–100 hr (the high end describes WLs trained in the first year that continued to be involved in the project in all seven cities); 446 workers participated in the 10-hr training, and another 17 received 5 hr of training within this course. In terms of cost, this far exceeds the OSHA Susan Harwood training program rule of thumb, where workers are expected to be trained for <\$500 apiece, and where training generally ranges from day-long, to hour-long to very short tailgate sessions. The uniformly delivered training, as verified by the same three OSHA-authorized trainers and researchers, demonstrated an increase in knowledge about prevention of falls and electrocution. The description of how this knowledge is being utilized on worksites around the country validates the quality of the course in a way that has not been done by OSHA or other training entities. Furthermore, some workers reported taking the initiative to protect themselves by talking to co-workers and supervisors about workplace hazards and refusing to perform dangerous tasks. The

training used in this project builds on these expressed concerns and the willingness, on the part of workers, to take action. These findings are consistent with several small studies that have found that at least a sub-group of immigrant Hispanic construction workers are concerned about job H&S hazards and are open to opportunities to learn how to conduct tasks more safely [Seixas et al., 2008; Ochsner et al., 2008]. It seems that a culture of safety is important to bringing about effective change.

There are many factors that make foreign born, Hispanic construction workers difficult to reach, including unstable employment, transient housing, limited English language capability, low educational attainment, concerns about legal status and lack of cultural competency and policy knowledge in the United States. In many cases, the workers and contractors are in collusion to maintain employment on a cash basis and to fly below the radar of governmental authorities [Valenzuela et al., 2006]. The notorious 2005 North Carolina incident in which the US Immigration and Customs Enforcement agency that posted information about a required workplace safety and health training session in order to capture undocumented workers reverberated through the immigrant community [Rathod, 2010], reinforcing the wariness of the workers, and keeping them at risk for severe workplace injuries. The ability to reach this vulnerable workforce for a training intervention requires being able to make contact and provide a safe environment for the training [Seixas et al., 2008; Williams et al., 2010; DeSouza et al., 2012].

Building on lessons from the New Labor/Rutgers OTEC partnership in NJ [Ochsner et al., 2012], this program utilized a CBPR approach that worked with community level advocacy groups, engaged the workers in designing and delivering the training, had workers recruit peers to training, sustained activities over a period of years, offered free 10-hr training and a valuable OSHA 10-hr card, and conducted a multi-faceted scheme for program evaluation that was responsive to the burden on community partners. The study demonstrates the value and synergy that can occur when the needs and assets of community-based organizations focusing on workers' rights can be matched with H&S knowledge, experience, and resources of university-based investigators. In this study, the intervention was part of the organizational missions of all partners.

Proof of training effectiveness has been elusive in the field of occupational H&S [Burke et al., 2006; Robson et al., 2012]. Survey items for low literacy or Hispanic workers have not been rigorously applied or evaluated. A mixed methods approach for evaluation provides a richer view of the knowledge, attitudes, and practices of low literacy workers and all-important social context of H&S training and evaluation cited by Lipscomb et al. [2009]. The pictorial and story vignette approaches used in this

study yielded interesting results and bear further exploration as strategies to test knowledge in ways it is expected to be used on the job.

Though there was evidence of training effectiveness in this study—an increase in knowledge, intention to change behavior at work, and descriptions of behavioral changes—it was not possible to determine the effectiveness of this program in reducing injuries in the workplace. Detecting such an impact would require longitudinal surveillance of workplace injuries among immigrant, Hispanic construction workers; this is not possible in the face of limited occupational surveillance in the United States and the states [Wolfe and Fairchild, 2010], limited funding for this research, reluctance of workers and employers to report occupational injuries, limited information on the number of Hispanic construction workers, and the irregular employment patterns in residential construction. Specific local interventions are showing promise with supporting training and subsequent practices through community partnerships [DeSouza et al., 2012; Ochsner et al., 2012]. A recent review of the effectiveness of occupational H&S training on knowledge, attitudes and beliefs, behaviors, and health outcomes found strong evidence of training impact on worker behavior, but insufficient evidence of impact on health outcomes [Burke et al., 2006; Robson et al., 2011]. Robson et al., as well as OSHA and international enforcement agencies still recommend and require H&S training as an integral component of prevention.

This study originally had a quasi-experimental, interrupted time-series design. However, the inability to gather data due to the transience of the population and the burden on the WCs made it impractical to execute. The change to a simple before and after design with one additional survey (3 months post-training), although limited, is as complex as is feasible. While the randomized controlled trial is the standard for demonstrating intervention effectiveness, there is a growing understanding that public health intervention studies cannot be isolated from social and political context; in fact, public health studies conducted in vivo, that is, within the communities for which the intervention was designed, are likely to engage the participation of stakeholders and thereby give a more accurate picture of effectiveness of community level interventions. In addition, it is best if intervention outcomes in public health meet the needs of stakeholders and are “utilization focused” [Rychetnik et al., 2002]. The success of this program is indicated by the reported value to the WC’s mission, the reported synergy of the program’s methods with those of the WCs, the sustained activity in the realm of H&S in seven of the eight WCs, and the further dissemination of H&S training using some or all of the elements of this program.

The influence of other national activities on the outcomes of this study is difficult to assess. OSHA has several

outreach programs for Hispanic construction workers and also convened stakeholders at a national conference in Houston during the time of this study. To our knowledge, there has been no impact assessment of these activities, but we are unable to say that they had no influence on WC engagement in this project. In addition, there are many other WCs and non-profit organizations that provide advocacy for this workforce; because of our work, we have encountered many of them. We are unable to discern their influence on these workers, WCs, or H&S on construction sites. A larger, longitudinal, time-series study would let us understand the influence of simultaneous activities.

CONCLUSION

This program occurred in a broad local and national context. The WCs have a well-defined mission and approach to leadership and intervention that completely harmonizes with the goals and implementation methods of this project. This made it a natural fit for CBPR. The value of the project to the WCs is well described in the interviews—there was significant leadership development, recruitment of members to the WCs, and a practical focus that gleaned very valuable short-term rewards. In addition, this project provided a basis for sustainability of H&S activities through success in obtaining grant support; in many cases, WCs continued the training in self-organized settings; in one case, it led to establishment of a business that delivers OSHA 10-hr construction H&S training to Hispanic workers and is now sought after by local construction contractors.

This study provides evidence for successful implementation of a training intervention for low wage, low literacy Hispanic construction workers using a CBPR approach. The methodology suggests a road map for OSHA, advocacy groups, and translation researchers seeking to reach underserved, at-risk working populations. Given the successes of this program and the continued high rate of fatality and severe injury among Hispanic workers, a pathway for authorizing peer trainers to issue the OSHA 10-hr construction H&S card should be explored. Furthermore, OSHA should re-consider its new post-training examination survey in light of validity issues uncovered in this research. Qualitative data gleaned from workers offers insights into the H&S issues they deem important, as well as their strategies to reduce risk. The pictorial and story vignette bear further exploration for evaluating training effectiveness among low literacy working populations.

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