Hazardous Materials on Golf Courses: Experience and Knowledge of Golf Course Superintendents and Grounds Maintenance Workers From Seven States

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Background *The golf course industry has a growing Latino work force. Little occupational health research has addressed this work force. This article examines golf course superintendents' and Latino grounds maintenance workers' pesticide knowledge, beliefs, and safety training. In particular, it focuses on knowledge of and adherence to OSHA Right-to-Know regulations.*

Methods *In person, in-depth interviews were conducted with 10 golf course superintendents in five states and with 16 Latino grounds maintenance workers in four states.*

Results *Few superintendents were in compliance with Right-to-Know regulations or did pesticide safety training with all of their workers. Few workers had any pesticide safety knowledge. Most safety training on golf courses was rudimentary and focused on machine safety, and was usually conducted in the off-season or on rainy days, not before workers were assigned tasks.*

Conclusions *More Right-to-Know training is necessary for superintendents and grounds maintenance workers. Culturally and linguistically appropriate Spanish language materials need to be developed or made more widely available to train workers. Better enforcement of safety and training regulations is necessary.* Am. J. Ind. Med. *© 2011 Wiley-Liss, Inc.*

KEY WORDS: pesticides; minority; occupational health; training; Hazard Communication Standard; Right-to-Know; Latino

INTRODUCTION

The number of immigrant workers, particularly Spanish speaking workers, in the United States continues to increase [Pew Hispanic Center, 2008, 2009, 2010]. Immigrant workers hold jobs in industries that often expose them to environmental hazards, creating occupational health risks [Pew Hispanic Center, 2010]. Immigrant workers are more likely than non-immigrant workers to experience occupational morbidity and mortality [CDC, 2008].

Anecdotal evidence suggests the golf industry is one area with a growing number of immigrant workers. Golf course workers are responsible for maintaining the courses as well as the grounds around the clubhouse. Their work includes mowing grass; trimming trees; and some mixing, loading, and applying of pesticides. Major environmental health risks on golf courses include pesticides and other chemicals, mechanical equipment, sharp tools, and being struck by golf balls [Duvall, 2001]. A large number of

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known immediate and long-term health effects are associated with pesticide exposure [Reigart and Roberts, 1999; Weichenthal et al., 2010].

Except in California, there are no public records of what pesticides are used on golf courses in the United States. However, a large number are approved for use. These include insecticides, fungicides, rodenticides, and herbicides. Included among these are pesticides in the organophosphorous and carbamate families, which have significant short- and long-term health effects, including eye and skin irritation, cancer, sterility, and neurological diseases. Re-entry periods for these pesticides can range from hours to days, and methods for worker protection can range from gloves and a simple face shield to a full-body suit.

Limited research has been conducted on the health effects of pesticides used on golf courses. Two studies have concluded that players on golf courses are exposed to more pesticides than non-golfers, but at levels that are probably not harmful in the long run [Murphy and Haith, 2007; Putnam et al., 2008]. In research on workers, there are correlations between pesticide contact and cancer levels in chronically exposed workers [Kross et al., 1996]. However, complicating factors make it difficult to determine causality with complete certainty [Knopper and Lean, 2004].

There have also been few studies conducted in industries similar to golf course maintenance like landscaping and lawn maintenance. Agriculture is an industry for which there is a large body of occupational research. This industry shares similar exposures and a large immigrant Latino workforce with golf course grounds maintenance. Research into farmworker pesticide beliefs and exposure [Quandt et al., 1998; Flocks et al., 2007] shows that, although farmworkers are routinely exposed to pesticides [Arcury et al., 2009a,b, 2010], they do not necessarily recognize those hazards. Farmworkers generally believe that their employers keep them safe, and they rely on their senses to identify hazards [Snipes et al., 2009]. Farmworkers often use non-biomedical explanations for occupational injury and illnesses [Baer and Penzell, 1993; Author, 2006; Flocks et al., 2007; Rao et al., 2007]. Research with agricultural supervisors shows they generally believe that protection from occupational health hazards, such as pesticides, is common sense. Often, they believe that there are few or no pesticide hazards in their industry [Quandt et al., 1998; Rao et al., 2004].

The major pesticide safety regulation for the golf course industry is the Occupational Safety and Health Administration's (OSHA) Workplace Right-to-Know Act, which is a part of the Hazard Communication Standard (HCS). The Right-to-Know Act requires that supervisors must (1) become familiar with the national rules as well any additional state regulations; (2) identify responsible staff; (3) identify hazardous chemicals in the workplace; and (4) prepare and implement a hazard communication program [OSHA, 1996]. For every chemical on site, there must be a Material Safety Data Sheet (MSDS), which lists the chemical properties, dangers, and first aid required after exposure; and this information must be available to all workers. Employees who may come in contact with hazardous chemicals as a part of their job receive information and thorough training about those chemicals before their initial assignment to work, and they must receive additional training as the chemicals change. All chemicals must be clearly labeled, and workers must be able to read those labels [OSHA, 1996].

The size of the golf course industry suggests that the number of workers potentially affected is not small. There are 15,979 golf facilities in the United States; Florida, California, and New York are the states with the most facilities [National Golf Foundation, 2010]. Each course superintendent supervises an average of 24 annual employees and 11 seasonal employees [GCSAA, 2009]. Using these data there are an estimated 383,496 annual grounds maintenance workers and 175,769 seasonal workers. The number of Spanish-speaking or Latino workers is not recorded.

This study was undertaken to assess the need for environmental health training curricula for golf course grounds maintenance workers, focusing largely on pesticide and chemical knowledge and training. As with farmworkers, working in an environment in which a large number of pesticides are stored, mixed, loaded, and applied places workers at risk for exposure through direct contact of various concentrations, drift, and secondary contact with touching tools and surfaces on which pesticides accumulate. Conducting formative research with Hispanic golf course grounds maintenance workers and with their supervisors, the researchers sought to describe and compare the knowledge, beliefs, and experience with environmental health hazards of golf course grounds maintenance workers and their supervisors, and identify issues to be addressed in worker training. The aims for this analysis are to describe pesticide exposure and safety beliefs, and knowledge of regulations for golf course superintendents and grounds maintenance workers, and to compare pesticide beliefs with other occupational safety beliefs and practices.

MATERIALS AND METHODS

Participants

Golf course superintendents from California, Florida, Illinois, North Carolina, and New York and workers from North Carolina, Florida, South Carolina, and Virginia were interviewed between 2005 and 2006 about their beliefs

and knowledge about pesticides and other safety issues on golf courses. Ten superintendents were interviewed, each from a different golf course. Two superintendents were interviewed in each state. Superintendents were from a variety of courses, including private and public courses, resort courses, and courses run by municipal parks and recreation departments. Superintendents were recruited with the help of each state's golf association, which provided contact information for possible golf courses. Each course was contacted to determine if it was eligible or interested, and interviews were arranged. Three superintendents refused to participate. Sixteen workers from 11 courses were interviewed. Workers were recruited through various sources. Some were recruited through local outreach groups, others through participating superintendents. Others were recruited in the same manner as superintendents, by contacting golf courses and assessing worker interest.

Data Collection

Data collection consisted of face-to-face, semi-structured, in-depth interviews. The interview guide for superintendents was designed to discover their knowledge of current regulations, beliefs about worker exposure to pesticides, beliefs about general worker safety, current approaches to training workers, and what kind of training materials they would like created. The interview guide for workers was designed to discover their beliefs and knowledge about pesticides, exposure to pesticides, safety training experiences, types of training desired, and specialized vocabulary used by golf course workers. The guide was written in English and then translated to Spanish by a native speaker familiar with Spanish as used in different areas of Latin America.

Superintendents were interviewed by one of two trained interviewers. The interviews were conducted in English. Worker interviews were conducted in Spanish by a trained interviewer who was a native speaker. Training sessions used discussion, instructor demonstrations, review of question-by-question specifications, and practice in securing cooperation and overcoming objections. The training sessions included a thorough review of participant selection and recruitment procedures, as well as data collection procedures, including asking open-ended questions, probing, and other interview techniques [Quandt and Arcury, 1997]. The elements and processes for obtaining informed consent in ethnographic research were also discussed. Interviewers conducted mock interviews while being observed by the investigators. Problems encountered in these mock interviews were discussed and resolved.

The study was explained to all respondents, and each gave informed consent, as approved by the Wake Forest University School of Medicine Institutional Review Board. Superintendent interviews were conducted at the golf courses and generally lasted between 1 and 2 hr. Worker interviews were conducted either at the golf courses or at a place where the worker felt comfortable. The interviews lasted about 1 hr.

Data Analysis

All interviews were transcribed and translated into English, if necessary, by a professional service and reviewed by members of the research team for accuracy. The investigators read each transcript and developed a list of topics pertaining to pesticide exposure beliefs, pesticide regulations, pesticide safety and training, and general occupational safety and training. The investigators reviewed each transcript and coded them for each topic. The coded transcript sections were compared to identify common and salient themes for superintendents and workers. Representative quotations were selected to illustrate each theme. Quotations are labeled with a code identifying the state in which the interview was conducted, whether it was with a superintendent or worker, and the code number of that person.

RESULTS

Description of Participants

Superintendents

All ten superintendents were born in the US. All had either an Associate's or Bachelor's degree, most commonly in turf management. Their work experience in golf courses ranged from 10 to 38 years with a median of 28.5 years, with their experience as a superintendent or golf course manager ranging from 4 to 35 years with a median of 11 years. They supervised 11–100 people with a median of 30. Their number of Latino employees ranged from 4 to 100 with a median of 24. With one exception, the majority of their employees were Latino. Nine superintendents spoke little or no Spanish, though one was fluent. Many superintendents used pocket size Spanish-English dictionaries that were specifically for golf courses.

Workers

Twelve of the 16 workers were born in Mexico, 1 in Puerto Rico, 1 in El Salvador, and 2 in Guatemala. All spoke Spanish, with one worker also speaking an indigenous language. All of the workers spoke a small amount of English, but only a few felt comfortable enough to carry on a conversation. Most workers said they felt more comfortable reading English than speaking. Their ages

ranged from 25 to 58 years with a median of 32.5. Their experience in golf courses ranged from less than 1 to 10 years with a median of 4.5. Workers' formal education ranged from first grade to some college, with 12 of the 16 having 9 or fewer years.

Superintendent Results

Knowledge of current regulations

In general, superintendents stated that they were unfamiliar with federal regulations concerning hazardous materials. When prompted, they recognized "Right-to-Know" as a federal regulation and stated that they had MSDSs. Most felt they were in compliance with Right-to-Know regulations but were unaware of any other specific federal regulations. Interviewers observed that there were few Right-to-Know stations where MSDSs and other pesticide safety information were available. Superintendents were also unfamiliar with the state organizations responsible for enforcing any federal regulations. Superintendents tended to be more knowledgeable about state and local regulations than federal regulations. Although few operated under any local regulations, they were aware of any differences between those and state regulations.

Both California superintendents felt that the regulations concerning hazardous materials in California were stricter than in the rest of the US:

> There's great products that you can use in Arizona that you can't use in California. Same as Florida. [Relative] is a [golf course] agronomist and we're always talking about different chemicals that are legal for Florida that are not legal for California yet. I think probably California has a very . . . tight program on allowing different chemicals into the state [CAS1].

One California superintendent said he stocked up on a specific pesticide before it was banned in California and still uses it for spot treatments. Superintendents in other states also said that they thought Florida and California had more regulations. A few of the courses were near or over local water sources, so their superintendents stated that they had to be more careful with chemical runoff. A superintendent on Long Island stated that there he had stricter regulations because of this:

> Most of all our water is derived from wells. So they, you know, they're cognizant of any run off or seepage into the well system. So certain pesticides that are registered throughout New York State wouldn't be registered on Long Island [NYS1].

In addition to these regulations, the New York superintendents stated that they submitted annual reports to the state's Department of Environmental Conservation (DEC). The DEC also did surprise inspections. Most superintendents said that their only inspections were from the state, and the ones who were inspected by OSHA said that it was rare for a golf course to have OSHA inspections. Because of the confusion between federal and local regulations and the ostensible absence of federal enforcement, the state was seen as the more important regulatory body:

> Ah, you know, the state is a more regulatory body [than the federal], you know, they do come around once in a while and do some inspections every now and then, they kind of, you know, unexpectedly. You have to file a pesticide report—we have to report every pesticide we spray on a chart and then we have to hand it in at the end of the year. So they watch that [NYS2].

Beliefs about worker exposure to pesticides and other hazardous materials

In general, superintendents did not believe workers were exposed to pesticides while working on the golf course. As only licensed applicators mixed and applied pesticides, they felt that other workers did not come into contact with pesticides regularly. Some superintendents believed that workers were inevitably exposed to some pesticides due to the nature of golf work:

> See, on a golf course I don't think most of them are going to get too involved with pesticides. I mean, there is always the hazard, I mean, once an area is sprayed, that they might have to walk through it or this or that, I mean, you try to usually wait 'til it dries [NYS2].

All believed that they took precautions to protect their employees, such as careful pesticide application, observing re-entry periods, and keeping workers away from pesticide storage areas. Superintendents said that when workers were mowing, they generally did not spray at the same time. A few said that they alternated mowing and spraying on their courses, so that on a day when a hole was sprayed, it would not be mowed:

> They, for the most part, aren't really coming in contact with it, like for example, we strategically spray areas like greens and/or tees in times when they're not there, you know, like you know, we spray fairways on Tuesdays and Thursdays and

> typically we're not mowing on Tuesdays and Thursdays, or we'll, you know, wait to mow until the day after. And . . . when we spray greens, typically the sprayer comes in after the greens mower and the cup cutter were there and gone, and then the product has, you know, time to dry on the greens, in most cases, and/or sit there for a while before anybody come nearby [ILS2].

One superintendent compared worker exposure on golf courses to that in farm work, saying that any contact with pesticides would be minimal as opposed to picking up a vegetable covered in pesticides. Some superintendents expressed that when they had workers apply pesticides, they did not use dangerous pesticides. Most said that the only pesticide that workers applied was glyphosate. One superintendent said that, if applied correctly, none of the pesticides used on that course were particularly dangerous:

> When it's done properly, it's, I mean, most of the statistics are an aspirin is a more harmful thing than drinking out of our spray tank, you know, the stuff that we're putting in there is, you know, there are a couple of professors that do this talk, but when we apply [Daconil] for dollar spot, [chlorothalonil], when you spray your foot with desenex you're using a more potent fungicide in a higher concentration than we would ever use on a golf course, you know [ILS1].

Beliefs about general worker safety

Superintendents believed that their workers generally followed safety procedures. Many stated that they report very few injuries. Few believed that golf course work was not dangerous, but most recognized inherent dangers, such as machinery. Many could cite incidents from the past few years that occurred either at their course or another course nearby. Many superintendents said that PPE was optional or "common sense" for workers, while others expressed more concern for enforcing PPE use among workers:

> I preach more common sense and safety in being alert as opposed to, you know, I've always—and maybe this is just a rationalization, I just tell people, you know, if you put a hard hat on a guy, he's just going to feel more confident in being unsafe, you know, like a football player is going to feel better about ramming somebody head first, even though that's a bad thing to do to your neck, if he has a helmet on. I'm just . . . maybe that's old fashioned, I don't know, but I just don't want to put helmets on them if they don't want to wear them [ILS1].

In most cases, workers were told what PPE to use for each job and were provided with that PPE, but use was left to the individual worker's preference. Some superintendents said that it would be a good idea to make certain PPE, such as hard hats, mandatory but had not done so. Many superintendents were concerned about enforcement. For some, any punishments they could think of seemed too harsh. For others, it was a simple issue of practicality:

> I mean, we're spread out over 300 acres, it's hard to keep up with, you know, 35, 40 employees that are scattered over a 300 acre piece of land to make sure everybody is wearing their gloves and wearing their safety glasses and things like that [NCS1].

Current approaches to training workers

The most common approaches to worker training were through videos and hands-on training. Most training videos came with new equipment. Other approaches involved combinations of these approaches with quizzes and posters, or hiring outside companies to structure curriculum and supply educational materials for training. Both California superintendents, for example, hired a third party to provide "Right-to-Know" and hazardous materials training. Most superintendents did not train workers on pesticides, and many stated that their workers knew nothing about pesticides used on the course.

Time, money, and the language barrier were identified as barriers to training. Training was often relegated to a rainy day or the off-season. Many superintendents said they trained their English and Spanish speaking workers differently. Superintendents often said that they themselves prefer to learn and to train using written resources. However, due to language barriers and low educational attainment in their Spanish-speaking workers, they might not provide those resources to the Spanish-speaking employees. One New York superintendent who had Spanish-speaking employees for the first time the past season said:

> Yeah, and I'll take them driving around the golf course, and you know, you stay with them or put somebody with them for awhile 'til he learns the course and learns what he's doing. With the Spanish speaking guys we didn't do that so much, didn't really drive them around the course. I mean, they were always under supervision, though [NYS2].

Most superintendents had a way to manage the language barrier, but, in general, supervisors could not communicate directly with all of their workers.

Superintendents often said that they needed some evaluation or proof-of-training for any training method. Some used quizzes after videos. One superintendent said that he showed videos in English and Spanish and gave quizzes in English and Spanish regardless of the workers' English level to encourage his workers to learn English. Others said that quizzes were given to the group and were not necessarily an evaluation. Many superintendents had workers sign off that they had been trained or had supervisors sign off that they had trained a worker. One superintendent took photographs of his workers as they completed a hands-on training:

> When it comes to tractor safety, we go through all the tractor stuff and we will actually take pictures and put it in your folder of you sitting on a tractor with your seat belt on with a roll bar, with you pointing at the roll bar and holding your seat belt up, we'll take your picture on a Polaroid or a digital, we'll put it in your folder. That way if you ever roll a tractor and you don't have your seat belt on we can say, no, he demonstrated that he knew that there was a roll bar and he had his seat belt on, he knew the danger associated [FLS2].

Superintendents said that they did not train their workers about pesticides and other hazardous materials because they felt that the workers did not come into contact with them:

> Ah . . . like I said, basically, ah . . . they don't handle the [pesticides] or anything like that, so . . . more or less . . . we just . . . keep them away from it. So there's really no . . . no training really, unless we . . . may ask one of them to put out some fertilizer or something, but that's not a—as far as what I would be concerned is a really hazardous material or what have you [NYS1].

Others said it would cost too much to translate their current materials and train workers who would not come into contact with pesticides. Most provided some information about pesticides, but a few did not want to train even that much. Their view was that it would be safer for their workers not to know where chemicals were even stored if they did not have to use them. Others said that they often gave information about pesticides more for horticultural reasons than for worker safety.

Worker Results

Belief and knowledge about pesticides

Workers generally had little knowledge about pesticides, except that they are chemicals used to kill weeds or insects. Although all believed that pesticides were dangerous, most did not believe that pesticides used on the golf course were dangerous. Most workers believed that some chemicals were more dangerous than others. In particular, they believed that fertilizers were not as dangerous as pesticides:

> Well, about the job and the chemicals, they have a special person for that. All of the other workers don't mess with the chemicals, just when we have to fertilize, but that's not dangerous. The specialized person who is here to do that sprays those more complicated chemicals . . . Sometimes, we fertilize, but that's not as dangerous. They do let us do that, but not the chemicals. We don't know what one thing is for or another thing—nothing about those chemicals . . . A lot of pesticides are bad for you. Furthermore, all of them are bad for your health. I understand that all of them are bad. That's why I think they don't let us work with them here [VAW1].

Workers tended to differentiate the more dangerous chemicals from the less dangerous by observing the applicator's PPE or by smell:

> When they told us it was more dangerous, they gave us protective equipment, such as masks and glasses because, sometimes, the liquid smells and it gets into your eyes and burns. They just gave us protective equipment when it was dangerous. When it was for the insects, they didn't give us anything. I noticed that that didn't harm people and that's why they didn't give us any protective equipment [NCW3].

Others said that the chemicals with a re-entry period must be very dangerous. Few could name any pesticides that were used on the golf course where they worked.

Most workers believed that they did not have contact with pesticides on the course, despite describing situations where they were probably exposed (e.g., working in an area where someone was applying pesticides). They generally believed that there was no exposure if the person applying pesticides was behind them on the course or a few minutes ahead of them. They usually said that people who applied or mixed pesticides were at risk for exposure, but since their jobs were generally mowing or similar jobs,

they thought they were safe. Because they were not allowed to use most of the chemicals, they thought that what chemicals they could use, such as glyphosate and fertilizer, were not very dangerous. Use of PPE depended on the individual and the company. Few used PPE to protect themselves from pesticides, although more used eye protection or helmets to protect themselves from trauma dangers in their normal activities.

Some workers said that it was necessary to be informed about pesticides. However, few workers said that they were told anything about pesticides at work:

> They've never told us that chemicals are dangerous or, ''Look, this chemical will do this or that to you.'' They haven't told us about the consequences which they have. They've just told us to do the job and nothing else. They don't care about the consequences which those have. They just care that the job gets done . . . I have asked, I have asked, ''Is this dangerous for me? Is it bad if I breathe it? Is it bad for my skin?'' I ask that of the person in charge of the chemicals and my boss. They tell me that it's not dangerous, that it's just food for the grass, and that it's just vitamins for the soil. What else can I ask? If they say there's no problem, then there's no problem because I don't even have any written information. If there is, it's not in Spanish. That information isn't given to us [VAW4].

Some workers had received information from sources other than their employer about protecting themselves from pesticides, mostly from word of mouth. A few workers said that drinking cold milk would stop pesticide poisoning. Others had been told about some illnesses caused by long-term exposure to pesticides, while others only knew that there were long-term effects. Many workers had learned about preventing transmission to their families:

> He told me that the clothing I used around chemicals should be left outside my house because the chemical was very strong and when it's taken inside your house, it could affect your children because they are weaker [NCW3].

Safety training experiences

In general, workers were more likely to discuss their regular job training (e.g., how to cut the grass or use machinery) than to discuss training specifically related to safety. Many explained that skills they had developed in other jobs were transferable to their job on the golf course:

> I told you that I've worked on farms and on the farms you work with machines and tractors. So then, when I got here, it wasn't hard for me to run the machines because, as you know, if you don't have any experience using a machine, it can be difficult, but if you have experience, it's all a lot easier and you are not afraid to do it . . . So when I got here, I learned. I didn't learn everything in one day, but I learned quickly [VAW1].

The quality of training at golf courses was variable. All workers had some form of hands-on training. This ranged from someone guiding the worker through each task before they did it, to being asked to do a task and forced to learn by watching others. Most workers said if their training was good or poor. Some workers were shown videos as part of their initial training. Usually these were videos about the machinery provided by the company. Often, workers who had been working at a course longer had received more safety training. These workers also trained new workers.

Workers reported receiving very little safety training, especially related to pesticides or other chemicals. Most training was rudimentary:

> Yes, they have told us that we have to be careful with the pesticides, but the people who know about them are the ones who use them. [They told us] we should be careful with those and if we used them, we should be careful not to kill the good grass instead of the bad. Also so that we wouldn't be harmed when we were using them, we shouldn't smoke because we could absorb it all [SCW2].

Although a few expressed interest in learning more about pesticides and other chemicals, most were disinterested because they believed that that training was unrelated to their specific tasks on the course:

> They show us the videos, but like I told you we don't have a lot of contact with the chemicals. We have seen videos about how we should stay a certain distance away from the chemicals even if we are not using them and that we should cover ourselves with plastic suits and gloves if we are going to touch them. But we don't really mess with those very much. I've told them that right now, I'm not very interested in having anything to do with them . . . maybe in the future, I will. [I

> am not interested] because we don't spray or anything like that. They have given us brochures which tell us how to avoid sicknesses caused by pesticides—I think. I really don't remember, but I have seen them. But since we don't have any contact with that, I'm not interested. But if they were machine maintenance, then I would be very interested in them [NCW1].

Florida workers reported having received the most safety and pesticide safety training. Most had received some form of pesticide training regardless of whether or not they worked with pesticides. All had received training with either videos or brochures in English and Spanish. Hands-on training was more thorough than in other states:

> When I arrived here, there was a supervisor who was with me and when we went to cut the greens, he went personally. He explained things to me step-by-step, each step that needed to be done [FLW2].

They had received training with specific machines and were informed of the dangers involved with the machines:

> For example, they give us training about how to use each piece of equipment. They show us videos about how to use the machines and how we should protect ourselves so that we won't have an accident, and about what the most dangerous thing about each of those machines is because even though the little machines won't cause you any problems, the big ones could even kill you. For example, when we operate a tractor, we have to use our seatbelts and not go too fast because that is what causes accidents. Also for when we are cutting grass and there is a lot of dust, they give us glasses to protect our eyes. They also give us earplugs so that our ears won't be hurt [FLW4].

Florida workers also reported receiving, and having access guaranteed to, more safety equipment. Workers reported being given ear plugs, safety glasses, gloves, hard hats, and access to equipment for specific tasks. Most workers said that they could ask for replacements for that equipment.

Most training and safety equipment was aimed at lowering occupational health risks in areas other than pesticide safety. Workers generally had access to safety equipment like goggles, earplugs, and hardhats, though many workers did not always use the equipment. Most did not like to use the ear plugs even though they were required:

> They do give us glasses and plugs for the ears. We just don't pay any attention to them. I mean, we don't wear them. I can't stand them. They aggravate me and I take them off. I feel that my ears are not being affected. I mean that I'm accustomed to the noise. Some people use them [VAW1].

Those who did use earplugs and safety glasses said that they were in the minority:

> Well, there are plugs for the ears, but Hispanics don't like to use them. Those have to be used when you are weed-eating because that's the only job that's noisy. They don't use them, but I do because after you've been weed-eating for four or five hours, your head hurts when you turn it off. I always wear them, but other people don't. It's because we are used to doing things that way in Mexico. At first, I wore them and didn't feel comfortable working with them on and I would take them off and throw them away, but bit by bit, I started realizing that when I didn't wear them, my head would hurt. When I wore them, it didn't hurt as bad. When I didn't wear them, the noise from the weed-eater caused my ears to ring. I've told a lot of them to wear them, but a lot of them don't want to [NCW1].

Communication Barriers

Workers and superintendents identified similar communication barriers. Most workers identified language as the main communication barrier. Primarily, this referred to their general lack of English skills. Workers said that they were unable to communicate with their superintendents or supervisors. It was also difficult for them to find reliable information about pesticides. Some said that they could not do certain jobs because of their lack of English. Conversely, some workers had more job security and more responsibilities because of their English abilities.

Most supervisors or superintendents did not speak Spanish, and most workers did not speak English. Though most said they could communicate in a broken Spanglish, it was not sufficient for thorough training. Most courses had a designated intermediary who spoke more of the other language. They would help with certain problems, generally work assignments and broken equipment. Many of the superintendents had a Spanish-English dictionary specific to golf course work.

In general, the courses required that all pesticide applicators be licensed. Since the courses are in English, most workers could not take them. Most labels are only in English, so workers cannot read them:

> I do all the jobs which are done on the golf courses—except for spraying because you have to know English in order to read the brochures which come with the fertilizers [FLW1].

Some workers said that they would not necessarily be able to read labels in Spanish since they had so little education.

Any outside safety information was difficult to access:

> Fortunately, I have the information [about pesticides], but a lot of people don't have it because they don't know how to read and write, or they simply don't have the information about how to apply those chemicals on hand [NCW4].

Though many organizations produce pesticide safety information, workers do not know how to get that information. When they do, they cannot necessarily use the information because they are not able to read it.

Besides problems with English, workers had trouble with golf course terminology in Spanish. Most words associated with golf course and golf course maintenance do not have a translation to Spanish. Certain activities could be approximated, but the words used depended on the native dialect of the speaker. Other words were said in English or in Spanglish. Terminology differed between golf courses. Some of the workers who were not Mexican differentiated between what they would call something and what the Mexicans called it. One said it was sometimes hard to communicate with other workers:

> But the thing is that in each country, people use different terms. And sometimes, I have to ask someone from Mexico who works with me because I don't know and I have to repeat it because a lot of them don't understand my Spanish. Sometimes, we can't understand each other because we all talk differently [FLW2].

DISCUSSION

This study collected data from superintendents and workers across a range of states and types of golf courses. Workers and superintendents generally had differing beliefs about training and views on practices, though there were some commonalities (Table I). Few superintendents were knowledgeable about or in compliance with federal pesticide safety regulation. Superintendents thought that most workers used safety equipment, though it was not

TABLE I. Summary of Findings (Beliefs and Practices) by Interviewee Status

Findings	Workers	Superintendents
Beliefs		
Practices are in compliance with regulations		++
Workers are not exposed to pesticides	+	++
Workers are exposed to pesticides	+	
Workers have less exposure to pesticides on a golf course than in agriculture		+
Pesticides are not dangerous		+
Pesticides are dangerous	++	+
Workers follow safety procedures	+	++
Workers use common sense to decide what safety equipment to use		++
Workers receive sufficient general training	+	++
Workers do not receive sufficient pesticide safety training	+	
Information about pesticides is not easily obtainable	++	
Dangerous chemicals are easily detectable by the senses	++	
Language is a major barrier in training and on the job	++	++
Practices		
Safety equipment is used consistently by workers	+	+
Safety equipment is provided for workers	+	++
Workers can ask for replacement equipment	+	
There is little enforcement of safety regulations		++
Latino workers receive different training from non-Latino workers		++

++, Widely shared belief; +, belief expressed by some, but not all workers or superintendents.

required because there had been few injuries reported. They believed the training provided was adequate or the best they could provide due to the communication barrier between them and their workers.

Workers wanted more information about chemicals they identified as dangerous, but superintendents did not want to give them that information, did not have the means by which to communicate that information, or did not think those chemicals dangerous. Workers received very little training in other areas of golf course work. Most training was on the job, though many workers reported being shown instructional videos that came with the equipment. These videos were sometimes in Spanish. Workers identified occupational health hazards based on word of mouth and sensory information rather than by training. They judged the strength of a chemical by its smell. Many workers did not use safety equipment, even it was provided.

Agriculture poses similar occupational health hazards to golf courses. More data are available about farmworker and grower knowledge, beliefs, and training than about golf course workers and their supervisors. In both industries workers are exposed to hazardous chemicals, motorized equipment, and sharp tools; and there are often substantial communication barriers between workers and supervisors. Golf course workers who had worked in agriculture said that they were better at their job and needed less training because they had worked in agriculture. Farmworkers and golf course workers share similar countries of origin, language skills, and educational attainment.

In agriculture, growers, like golf course superintendents, are responsible for training their workers; and training is based largely on regulations and growers' beliefs about workers' health risks. Rao et al. [2004] reported that North Carolina growers and extension agents, like golf course superintendents, do not believe their employees to be in a great deal of danger from pesticides. Both growers and golf course superintendents think that pesticides are not as dangerous as the general public believes. Both groups also think that those who do not apply chemicals are not exposed to them. Both growers and superintendents face the same training difficulties, and both say that PPE use is common sense.

Farmworkers rely on the same word-of-mouth and cultural knowledge base as golf course workers. For both groups, a chemical's smell is indicative of its toxicity [Quandt et al., 1998; Rao et al., 2007]. Both use milk as a folk remedy to treat acute symptoms of exposure [Rao et al., 2002]. Residual symptoms may be attributed to folk illnesses, like *susto*, which may indicate a more severe exposure [Baer and Penzell, 1993]. Like golf course workers, farmworkers often do not have access to information about pesticides [Flocks et al., 2007].

Because workers in both groups have little access to pesticide information, few workers know anything about pesticides beyond the fact that they are dangerous [Quandt et al., 1998; Flocks et al., 2007]. They trust that their supervisors keep them safe and know that they are not allowed to apply pesticides, so golf course workers thought that any chemical they worked with was not a pesticide and relatively safe. Therefore, they did not know to take post-exposure measures (i.e., showering immediately after work, changing out of work clothes before they went in the house). Because they thought that chemicals they handled were safe, they did not take precautions to prevent exposure (i.e., using a facemask, wearing a long-sleeved shirt).

Latino workers may take greater risks than some non-Latino workers. A common belief among farmworkers is that a person's strength and size are protective when the person is exposed to pesticides [Quandt et al., 1998; Rao et al., 2007]. Cultural expectations are that men, particularly strong men, can tolerate a certain amount of symptoms and illness, so many farmworkers do not follow all safety regulations, placing themselves at additional risk for injury [Hunt et al., 1999]. Many golf course workers said that younger men would not use provided safety equipment.

Federal regulations require compliance with OSHA Right-to-Know requirements as part of the HCS. Each workplace must have a written plan for training that describes how requirements for labels and other forms of warning, MSDSs, and employee information and training will be addressed. Supervisors must provide any information about a chemical that an employee requests. Each employee who may be exposed to hazardous chemicals when working must be provided information and trained prior to initial assignment to work with a hazardous chemical and whenever the hazard changes. Information and training may be done either by the individual chemical or by categories of hazard. Workers should learn to read and understand such information, determine how it can be obtained and used in their own workplaces, and understand the risks of exposure to the chemicals in their workplace as well as how to protect themselves. The training program should ensure comprehension [OSHA, 1996].

These results show that Right-to-Know regulations are not being followed by golf courses. All workers on golf courses are exposed to hazardous chemicals, so all workers should receive thorough pesticide training. All superintendents had an MSDS, but no workers mentioned anything like one when asked about pesticides. Only superintendents in California specifically did Right-to-Know training. Right-to-Know was the only federal regulation that most supervisors knew existed. Most thought they were in compliance with the regulations. However, few seemed to know much about what the regulations

required or who was responsible for enforcing the regulations.

Golf course superintendents need better training in Right-to-Know procedures and pesticide safety. Because they do not have this training, they do not know the mechanics of pesticide exposure. Workers do not receive training about pesticides or PPE because their superintendents do not know that they should be trained, so workers do not have the knowledge or equipment to protect themselves from pesticide exposure. Superintendents need to understand the risks posed by pesticides and other hazardous chemicals. Current training focuses primarily on equipment safety because the danger from equipment is more apparent. Most effects from pesticides are long term, and acute symptoms rarely occur while on the job [Baer and Penzell, 1993], so supervisors are not as aware of the danger posed by pesticides as they are of that posed by equipment.

Barriers to training must also be taken into account. Considerable communication barriers were demonstrated in this study and were part of the reason why Latino workers received as little training as they did. Appropriate Spanish language training materials must be developed or made more widely available. Superintendents should be made aware of these materials and other services to train their Spanish-speaking workers.

Coupled with better training is better enforcement. Superintendents must train workers before they are assigned work. Most who were interviewed relegated training to rainy days or to the off-season, and many workers said they started work during the summer. Training should be equal for Latino and non-Latino workers. All workers should receive the same information in a manner in which they understand, and training materials should include information on pesticides and hazardous chemicals. Many supervisors said that training their Spanish-speaking workers would be too difficult or expensive and that these workers now receive training that is different from their English-speaking workers. Enforcement should be great enough that supervisors are forced to find a way to train these workers.

An alternative to better pesticide safety training is pesticide elimination or using less toxic chemicals. In the case of elimination, no workers would be routinely exposed to pesticides as they are now. However, this is unlikely to happen in the near future, so better training should be adopted in the interim. Using less toxic chemicals, though seemingly beneficial, may not hold the promise that seems likely. When the city of San Francisco, California, switched to less hazardous chemicals for its public courses, it had to use a larger volume of chemical to have the same effect. So the benefits of using a less dangerous material may be nullified by increased exposure [Hawkes, 2010].

This research must be considered in light of the limitations common to qualitative research. Participants were not selected randomly, so caution must be taken in generalizing results. Each in-depth interview is somewhat different, and not all questions are asked of all participants in the same way. However, participants were recruited from several different states and many different golf courses. Interviewers were trained, and their interviews were reviewed for quality. This study focused on Latino workers, and so our conclusions and recommendations focus on this group of workers. This is not to suggest that non-Latino golf course workers are less at risk for pesticide exposure and other occupational health hazards. However, it is likely that different factors affect training and hazard exposure other workers (e.g., English-speaking workers), so our findings should be interpreted in light of this.

More research is needed. Though this study revealed general attitudes of golf course workers and superintendents, more specific information is needed on which to base educational materials for superintendents and workers. Culturally, linguistically, and educationally appropriate pesticide safety training programs need to be developed for golf course maintenance workers. Efforts are needed to inform golf course superintendence about the exposure risks of all of their employees and of the need for training all of their employees. Both further research and training need to be tailored to state-specific extensions of the federal Right-to-Know regulations.

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