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"I Think the Temperature was 110 Degrees!": Work Safety Discussions Among Hispanic Farmworkers

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ABSTRACT

Heat-related illness (HRI) among migrant and seasonal farmworkers is an occupational risk addressed through varying mitigation strategies by individual workers and supervisors. The purpose of this pilot study was to describe farmworkers' experience with HRI prevention strategies and assess HRI information seeking preferences, especially the feasibility of using mobile phone apps to access this information. Five focus groups were administered to Hispanic farmworkers in South Carolina. Questions included the following topics: health information seeking preferences; farmworkers' perceptions of occupational risks; coping strategies; past experiences with HRIs; water, rest, and shade practices; access to health care; and any employer-provided training received. There was consensus across the groups that the workers at highest risk for HRIs were either inexperienced or new workers in the fields. Farmworkers ascribed responsibility for one's well-being while working in the heat more as an individual factor than as an employer's responsibility. Farmworkers received training on the OSHA Heat Safety Tool app and provided positive feedback about the educational content and temperature information warnings. These findings suggest the potential for supervisors to take a more active role in heat safety education using mobile technology.

KEYWORDS

Cooling practices; farmworker; heat-related illness; Hispanic; hydration

Introduction

Since the 1970s, climate trends show average temperatures in the 48 contiguous U.S. states increasing at a rate of 0.26 to 0.43°F per decade, with unusually hot summer days and extreme heat events (heat waves) occurring more frequently in the last few decades.[1,2] Because of increased recognition that rising temperatures and increased frequency of heat waves pose a threat to worker's health, a growing number of studies of heat-related illness (HRI) among outdoor workers, such as migrant and seasonal farmworkers, have documented why these workers are especially vulnerable.[3–5] Farmworkers engaged in crop harvesting are a special population of agricultural workers who are at increased risk of injury and exposure to workplace hazards because of their occupational status.[6–8] Although exertional HRI is a preventable condition, it significantly affects farmworkers and can be fatal in rare instances of heat stroke.[9] Prevention education, symptom recognition, first aid assistance, and timely medical attention are all potentially effective strategies which can protect agricultural workers at risk for HRI; however, it is also acknowledged that structural conditions of the work environment present farmworkers with constraints that limit their agency to take control of their health.[10]

Farmworkers are a vulnerable occupational group because of the hazardous nature of their work, lack of health insurance, and low wage compensation; moreover, they encounter limited workplace protections, often live in poor quality housing, experience exposure to agrochemicals, and are characterized by a high proportion of undocumented workers from Mexico and Central America.[6,11] According to 2012 data from the National Agricultural Worker Survey (NAWS), 76% of farmworkers identify as Latino/Hispanic and 70% report Spanish as their native language.[12] Because farmworker wages are usually dependent on the ability to harvest crops quickly, taking water or bathroom breaks or slowing down negatively affects earnings and also increases the risk of HRI or other work-related injury.[13]

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In an agricultural environment, HRI occurs when an increase in a worker's core body temperature and subsequent changes in metabolic processes within the body exceed the capacity to dissipate heat and maintain equilibrium.[14,15] Environmental, work-related, individual and physical risk factors all increase farmworkers' susceptibility to HRI.[16] Examples of a work-related factors include duration of heat exposure, access to shade, and type of clothing.[17,18] Examples of individual and physical risk factors include pre-existing health conditions, hydration levels, heat acclimatization status, nutrition, work experience, and alcohol use.[19,20]

The primary study objective was to describe farmworkers' experience with HRI prevention strategies to identify gaps in health safety education. The secondary study objective was to assess HRI information seeking, including gauging farmworkers' interest in using mobile phones to obtain heat safety information and education. Few studies have examined how mobile phone applications, or apps, might be used by farmworkers.[21] This article reports on focus group data centered on the topic of heat safety. This study employed focus group methodology to collect qualitative data on HRI knowledge, attitudes, perceptions, and beliefs among this vulnerable population.

Methods

The research team facilitated five focus groups in trusted facilities serving Hispanic farmworkers, including two different clinics and a migrant head start facility in South Carolina (Johns Island, Lodge, and St. Helena). Facility staff assisted the research team in recruiting participants and arranging the conference rooms. For each focus group, the person who was in contact with farmworkers at each facility assisted the study team by recruiting six to 10 participants either in person or over the phone to attend the focus groups. In Johns Island and St. Helena, the farmworkers were seasonal workers who lived in their own housing (house or trailer). Participants attending the two focus groups in Lodge were migrant farmworkers who lived in temporary housing (barracks or trailer). Farmworkers at these three locations worked at different farms, but at the time of the research were primarily working with tomato crops. The focus groups occurred between October and December 2017. Each focus group was led by the same trained moderator using a structured focus group guide and assisted by a co-moderator who took detailed notes.

Upon arriving at the facility, participants completed informed consent procedures and then completed demographic data forms with the assistance of the moderators. All questions were based on self-report information. Researchers also asked participants to show them their cellphones, so they could record the type of phone and brand. Participants were introduced to HRI prevention using accessible written materials from the Occupational Safety and Health Administration (OSHA). The moderator and co-moderator assisted participants in filling out the forms and answered questions about the educational materials. The focus group began with questions about where to find reliable health information, followed by questions about farmworkers' experiences working with different crops. Next, there were questions about farmworkers' perceptions of occupational risks and hazards and coping mechanisms for working outside in the heat. Farmworkers were asked to discuss their past experiences with HRIs and other work-related illnesses or injuries. There were also questions about water, rest, and shade practices and any employer-provided training received. Finally, farmworkers were shown different types of materials educating workers about HRIs to indicate their preferences (radio, brochures, conversations with others, posters, handouts, photonovellas, and mobile apps). After the focus group discussion, the co-moderator provided a group summary with follow-up questions and then assisted participants in downloading the Spanish version of the OSHA Heat Safety Tool app to their mobile phones and demonstrated how to use it.[22] Language was not a barrier to using the app, since participants responded that they could read in Spanish either "Very Well" (83%) or "Fairly Well" (17%).

The co-moderator prepared notes of each meeting and the research team reviewed the notes to assess the value of the information provided in each focus group. After completing five focus

groups, the research team determined that no new information was being generated from the qualitative data collection (*i.e.*, thematic saturation). Participants received a $20 gift card incentive and food and beverages for their time spent participating in the research. The research protocol was submitted to and approved by the Medical University of South Carolina Institutional Review Board (IRB).

The focus groups were digitally-recorded, transcribed verbatim in Spanish, coded using MAXQDA (Marburg, Germany) qualitative data analysis software, and then reviewed by members of the research team. Two research team members fluent in Spanish independently coded the transcripts using established codes from a codebook. Next, through a series of meetings, each focus group transcript was reviewed in detail to resolve any coding discrepancies and to align coding agreement for all coded segments. There were some instances where it was appropriate for coded segments to have overlapping codes. Notes taken during the groups were also reviewed to check consistency of data transcribed. Data were analyzed in Spanish using a content analysis technique, which identifies emergent themes, or trends, from the written transcripts. Representative quotes were translated into English for this article. Analysis of data included a "mechanical" stage (organizing and dividing the data into a useful scheme using the coding system), and an "interpretive" stage (identifying criteria for organizing the codes into themes). The objective of this procedure was to corroborate interpretations and minimize the effect of any subjective interpretation of the data. Two coders developed a codebook using the following codes: training, weather, farmwork risk, descriptions of farmwork, use of personal protective equipment (PPE), healthcare seeking, finding health information, HRI knowledge, HRI symptoms, HRI treatment, bathroom access, water drinking, and opportunities for rest or shade. These codes were then grouped into four major themes: 1) farmworker risks and protection against risks; 2) HRI knowledge, symptoms and treatment; 3) water, rest, and shade; and 4) access to healthcare and health information.

Results

Demographics

Sociodemographic characteristics of the focus group participants (n = 29) are described in Tables 1 and 2. There was a similar number of male and female participants, and the average age was 35 years old. Most farmworkers were from Mexico and had been working in the U.S. for over 10 years. Only 14% of participants had completed high school or some form of higher education. Most participants preferred Spanish, with 83% responding they could read Spanish "very well," but only one participant could read "very well" in English. Almost one-third of participants spoke an indigenous language. Only two participants had health insurance, and more than three-quarters of participants had a BMI placing them in either the overweight or obese category, calculated from their self-reported height and weight measurements. All participants had cellphones, and most used apps on their phones, such as popular social media apps. There were at least

Table 1. Demographic characteristics of hispanic farmworker focus group participants (N = 29).

Item	*n*	(%)
Location		
Lodge (2 focus groups)	12	(41)
Johns Island (2 focus groups)	9	(31)
St. Helena (1 focus group)	8	(28)
Sex		
Male	15	(52)
Female	14	(48)
Age		
19–29 years	9	(31)
30–39 years	11	(38)
40–49 years	5	(17)
≥50 years	4	(14)
Country of origin		
Mexico	25	(86)
Guatemala	4	(14)
Permanent residence		
United States	24	(83)
Mexico	4	(14)
Central America	1	(3)
Years in the U.S.		
<5 years	3	(7)
5–10 years	10	(38)
>10 years	16	(55)
BMI		
Normal (18.5–24.9)	7	(24)
Overweight (25–29.9)	13	(45)
Obese (30+)	9	(31)

BMI, body mass index

Table 2. Language, education, housing and insurance characteristics of Hispanic farmworker focus group participants (N = 29).

Survey Item	*n*	(%)
How well can you read in Spanish?		
Very well	24	(83)
Fairly well	5	(17)
How well can you read in English?		
Very well	1	(4)
Fairly well	7	(24)
Not very well	16	(55)
Not at all	5	(17)
Do you speak a language other than Spanish?		
Yes	15	(52)
English	7	
Indigenous language*	8	
No	14	(48)
What level of education did you complete?		
Part of primary school	10	(35)
Completed primary school (6 years)	9	(31)
Part of high school	3	(10)
Completed high school (12 years)	3	(10)
Part of college or university	2	(7)
Completed college or university	2	(7)
Do you have any kind of health insurance coverage?		
Yes	2	(7)
No	27	(93)
What type of housing do you live in?		
Barracks	6	(21)
House	6	(21)
Trailer	17	(58)
Are you a H-2A visa worker?		
Yes	1	(3)
No	28	(97)
Do you live in the United States all year?		
Yes	24	(83)
No	5	(17)
Do you have a cellphone?		
Yes	29	(100)

* Indigenous languages included Maya, Mixteco, Popoluca, Tlapaneco. Tzeltal, Tzotzil, and Zapoteco

Notes. While participants were not asked specifically if they had a smartphone versus a flip phone, only one older male participant had a flip phone.

17 Android phones observed among participants, but only four iPhones. Only a few older flip phone models were observed. Many farmworkers had Verizon service because their cell phone coverage was known to be superior in rural areas compared to other carriers.

The qualitative findings below are presented by thematic category. The overview of the thematic categories with example quotations are presented in Table 3. To protect participant confidentiality, all participant names are pseudonyms.

Table 3. Key themes and representative quotes.

Themes	Quotes by Focus Group Number (FG #)
Farmworker risks and protection against risks	
Heat and sun	Risk of cancer if you spent too much time outside. (FG 1)
Pesticides	Why would they spray when we are walking around here? The wind would bring the chemicals to them and the chemicals were very strong. (FG 2)
Work arrangements	If they got too tired from working during the harvest time of piecework, then they would harvest as much as they could and then if they felt bad, they would leave and tell the bus driver. (FG 5)
Personal Protective Equipment	Most of the bosses tell them to protect themselves from the sun, use long sleeves and bandanas. (FG 2)
Heat-related illness knowledge, symptoms and treatment	
Weather	If it is over 105, it is better not to work. (FG 1)
Knowledge	The heat can make you feel dizzy, dehydrated, and feel bad, with headaches, dizzy spells, and vomiting. (FG 5)
Symptoms	Some people sweat or don't sweat, and it doesn't mean they are sick necessarily, it just depends on people's bodies. (FG 4)
Treatment	They used *sueros* (electrolyte solution) or Gatorade when feeling sick from the heat. (FG 2)
Water, rest and shade	
Water	When I have drunk too much water and I'm still thirsty, I will drink a beer and that will take my thirst away and I'll be fine for an hour or an hour and a half. (FG 2)
	The perfect temperature of water is cold, but not too cold, just fresh. (FG 5)
Rest and shade	When we finish our row…we all go into the brush…we look for shade under the trees to cool down a little…then when the crew leader says "OK fellows, your rest is over", we start a new row and at the other end we again look for shade…sometimes when it's too hot or the row is too long, we rest half way down the row… we get under the trucks…the trucks always have shade under them. (FG 2)
	When you feel fatigued by the heat, the first thing you should do is take a break. (FG 4)
Access to healthcare and health information	
Healthcare access	They would use household remedies first like water with lemon juice. If you were sick, you let the boss know and they would take you to the clinic (FG 4)
Health information	One could search for health information on the internet and find out about pills or medicines. (FG 3)

Note: A copy of the focus group guide is available upon request from the corresponding author.

Farmworker risks and protection against risks

Inexperienced farmworkers are more at risk for injury than more experienced workers; therefore,

training can help to reduce potential risks. To initiate discussion about heat safety, the focus groups began with a more general discussion about occupational risks and mitigation strategies. In focus group 1, Fernando explained more experienced workers trained new workers, who would usually lose a day of work because of the heat and humidity. Fernando said new workers would have to work slowly at first because if they worked too hard, they would be breathing heavily and could even experience a life-threatening event. In focus groups 2 and 4, participants explained they watched an hour-long video on pesticide safety and received handouts. The video also explained the importance of wearing protective clothing and employing proper hand washing hygiene prior to picking crops. In focus group 3, Edgar explained supervisors monitored workers to implement rest protocols, and Vicente said the workers trained themselves about how to protect themselves from both cold and hot weather. A few of the participants in focus group 5 explained they had received first aid training from firefighters as well as how to use a defibrillator. However, these workers were involved with maintenance jobs on the farms; the crop farmworkers said they had only received training on pesticide safety.

Farmworkers used a variety of personal protective equipment (PPE) including protective clothing, such as caps, gloves, long sleeve shirts and pants. In focus group 1, Celina mentioned she used sunscreen. However, in focus group 4, two women who worked together disagreed about whether they should use sunscreen. In focus group 2, Ignacio commented that just taking breaks in the shade provided sufficient sun protection, since they were all *morenos* or darker skinned. In focus group 4, Pablo cautioned that those who did not use any form of PPE would face consequences later. In focus group 1, Justicia said she wore sunglasses when working. In focus group 2, Maria said the supervisors advised the workers to wear long sleeve shirts, bandanas and hats to protect themselves from the sun. However, Ignacio said he did not like wearing bandanas because he felt asphyxiated, and others echoed this concern. Isabel explained to prevent dehydration, she used a wet cloth to cool down. In focus group 4, Pablo explained he used a *boina* or hooded shirt to protect himself from the sun. While most of the discussion of protective clothing focused on sun protection, in focus group 5, David explained he used protective clothing to protect himself from insects.

There were varied responses to the types of risk encountered in farmwork. Participants expressed worry about working in the heat for too long. For example, in focus group 2, Ignacio said if one did not cool off in the shade, a person could get dizzy from sweating too much. Working in isolation was also a risk. In focus group 1, Fernando explained because they would be working in areas with no cell phone coverage, crew leaders would have to carry radios to communicate in case of emergencies. However, in focus group 2, Ignacio was more concerned about pesticide exposure. He asked rhetorically, "Why would they be spraying when we are still working here?" because the wind would blow chemicals on them. Such experiences of pesticide exposure were voiced by Vicente in focus group 3 who shared an experience while picking tomatoes of having a headache and getting sick to his stomach. Armando explained when pesticides were being sprayed, a supervisor would tell them to work on the other side of the field. This topic was also raised by both Hugo and Pablo in focus group 4, who commented that spraying would occur alongside their work activities. Hugo exclaimed it could get to the point that "One couldn't stand it!" and the affected farmworker would have to leave the area. There was also the risk of working too hard when a farmworker was working at the piece rate, or *por contrato*, and the worker would need to take a saline drink additive, or *suero*, to stay hydrated. Hugo said that he had seen ambulances coming for workers who had fallen ill from working too hard or becoming dehydrated. In focus group 5, Victoria explained there were risks from working *por contrato*; for example, they would work hard but would leave the work site or inform the bus driver if they started to feel ill.

HRI knowledge, symptoms and treatment

All focus group participants were asked to discuss weather conditions. In focus group 1, Celina said

when it was too hot (over 100 degrees), it was better to just go home. Justicia stated the temperature had to be over 105 degrees for her to stop working. In focus group 3, Armando noted 110-degree weather could give someone a headache. In focus group 5, Miguel shared a story that after hauling watermelons in 110-degree heat, he ended up getting very sick for two days. Victoria described a strategy for working in the heat this way, "Find your pace, stay calm and don't start picking like crazy because you will get overheated and it's going to be warm today." In addition to human hazards, excessive heat could damage the plants, for example, on especially hot days, the tomato plants would dry out by mid-day, as some participants explained with the Spanish phrase, "*se secó la mata*."

Participants responded to questions about HRI knowledge, symptoms, and treatment. In terms of knowledge, some participants associated heat with skin cancer and other illnesses. These other illnesses were discussed by Victoria in focus group 5 as causing a person to feel dizzy, dehydrated, and nauseous. Several participants placed the blame of heat illness on those who worked hard in the heat and ignored their symptoms. In focus group 4, Pablo said some workers abused their bodies to earn more money and were at risk of having a cardiac event. In focus group 5, all participants agreed HRI could be fatal. Daniel believed if a worker was able to get enough sleep and eat well, the person would be more resilient against the heat.

Participants focused on physical symptoms from heat exposure. In focus group 4, these symptoms included vomiting, dizziness, headache, muscle cramps, weakness, irritated eyes, and heart problems. In focus group 2, common symptoms listed were stomach pain, nausea, and headaches. In focus group 1, Oswaldo noted that some workers experienced combined hot and cold body temperatures simultaneously, or *escalofrío*. This symptom was also mentioned by Victoria in focus group 5. In focus group 2, Ignacio commented that excessive sweating caused them to get rashes on their backsides, and sometimes even cause them to bleed from their noses. In focus group 1, Justicia related a story of a female co-worker who displayed heat illness symptoms at mid-day and was sweating excessively. An example of a person working too hard and getting sick was described where the farmworker was working *por contrato*, and the co-worker just doused herself with cool water and kept working. The woman's eyes then became bloodshot, so Justicia had to alert the truck driver to come get her where she then rested on the truck for an hour, and then went back to work. In some groups, there were misconceptions about the interpretation of not sweating. For example, in focus group 4, Hugo said whether workers sweat or not did not mean they were ill. Across several focus groups, participants commented that one reason for dehydration was excessive alcohol drinking during the previous evening and could cause the worker to not be able to work productively the next day. Underlying health conditions could also exacerbate symptoms. In focus group 5, Victoria explained that her diabetic condition made her feel even more tired, and Daniel, who had undergone chemotherapy for colon cancer but continued working, said one day he could not move his body at all for a half an hour.

In terms of treatment, participants ingested drinks with *sueros* or Gatorade combined with rest to recover from an HRI. For example, in focus group 3, Armando and Vicente would drink 8 or 9 bottles of hydration solution per day. In focus group 4, Pablo described receiving an injection of a vitamin hydration mix at the clinic. Farmworkers would also wet their hats or bandanas to lower their temperature but were worried about the effect on their kidneys from being overheated. In focus group 2, Maria and Lorna explained if they did not cover themselves or use creams, they would get rashes on their bodies or faces. Maria said she had consulted a doctor about her rashes and was told that the stomach ache was from the heat and the skin problems were caused by chemicals from pesticides. She was advised to wear long sleeve shirts. She also noted that occasionally she experienced symptoms such as heart palpitations, dizziness, and muscle spasms. In focus group 4, Selena discussed wetting her head with lemon infused water to help cool down. In both focus groups 4 and 5, participants talked about using over-the-counter medicines such as Tylenol or XL-3 (cough

medicine) to treat headaches and nausea. In focus group 3, Armando stated he was not aware of any treatment for HRIs.

Water, rest, and shade

Water. Rest. Shade. is the slogan for the OSHA Heat Illness Prevention campaign, and consequently, focus group questions covered these important prevention strategies. One of the most discussed issues was access to water for drinking, and farmworkers employed different methods to make sure they had water available. In some cases, farmworkers brought their own water since they did not like the odor or taste of the tap water at the worksite. They also mentioned cases when water had sediment in it. It was described as good water for washing dishes, but not for drinking. Some held the belief that drinking cold water could make you sick. For example, in focus group 2, Maria said, "I think that when a person is very hot and drinks cold water, that person gets sick." Participants in three focus groups talked about the dangers of drinking very cold water and explained they waited after taking bottles out of the cooler before drinking them. In focus group 2, drinking very cold water was associated with muscle spasms or cramps in the lungs. In focus group 3, Vicente believed drinking very cold water could cause a heart attack. One participant explained how drinking a beer could quench one's thirst if drinking water was not helping. In focus group 4, farmworkers reported that the crew leader would stock the cooler with beer when the workers were asked to work longer hours. Several workers reporting drinking Gatorade, although water was preferred, but it was not uncommon for coolers to be stocked with both water and Gatorade.

Length of breaks, whether for rest purposes or to use the bathroom, depended on whether the farmworker was working hourly or *por contrato*. When working *por contrato*, they tried to limit their breaks or take very short breaks to maximize earnings. In focus group 4, Adolfo and Pablo explained that when being paid hourly, only the boss decided when farmworkers could take breaks. In focus group 2, Ignacio explained when they were working very hard along their rows and got too tired or hot halfway through, they would rest under the trucks. Otherwise, if they finished the row, there were sometimes trees or brush to rest underneath. In focus group 4, Pablo noted the large companies always have hydration and rest stations for the farmworkers. These superior facilities included drinking water, handwashing stations, and a trailer for shade if no trees were nearby.

Access to healthcare and health information

Participants were asked to discuss what strategies they used to access healthcare services and where they could find health information. In focus group 1, participants discussed a free clinic in the area where they obtained medicines, but sometimes they would fill their prescriptions at the local Walmart. In focus group 3, Vicente said it was common practice to go online to check symptoms and see which pill they should take and where they could get it. Instead of going to the clinic after feeling heat symptoms, they would often just seek shade or rest. In focus group 4, Gladys commented that they only went to seek a doctor when they felt very sick. There was the fear of receiving a bill ranging from $1,500 to $5,000 if you went to see a doctor. Pablo replied that if you were sick, you would just tell the crew leader, and then you could get a ride to the clinic. In focus group 5, participants explained self-treating for colds and telling the bus driver that they could not work that day.

Participants also discussed seeking health information. While searching for information on the internet was a common response, in two of the groups, participants mentioned preferences for speaking to a doctor or a specialist to receive information on how to reduce risk from sun exposure. After the focus group discussion concluded, participants received training from the researchers on the Heat Safety Tool app and agreed that receiving weather information and education about the risks of HRI was something they would be interested in learning more about.

Discussion

This qualitative study collected focus group data on Hispanic farmworkers' perceptions of

occupational risk and mitigation strategies related to working in the summer heat. There was consensus across the groups that the workers at highest risk for an HRI were either inexperienced or new workers in the fields since they had not had time to acclimatize to the weather conditions. While farmworkers discussed different risk reduction strategies to protect themselves, there were some functional limitations noted for the use of protective clothing. For example, farmworkers wanted to use bandanas or some type of cloth to cover their faces to protect their lungs from inhaling pesticides; however, they felt they could not breathe. The Environmental Protection Agency (EPA) Worker Protection Standard (WPS) provides guidance for workers and handlers on wearing protective clothing to reduce exposure to pesticides, but farmworkers in this study only reported receiving a training video on pesticide safety.[23] Farmworkers discussed wearing long sleeve shirts, pants, and caps, which has been reported in other HRI studies with farmworkers.-[24,25] In one North Carolina study, the majority of farmworkers reported wearing protective clothing to reduce sun exposure.[25] However, in another North Carolina study, there was an association between the number of years of experience in farmwork and decreased use of protective clothing, suggesting the need for training refresher courses according to the study authors.[26]

Based on these results, the research identified some potential gaps in heat safety education. While some farmworkers reported receiving limited training on pesticide safety, incoming groups of farmworkers could also receive video and in-person training on HRI prevention.[27] These educational programs for farmworkers are most effective when they are based on health behavior theories, use adult learning principles, and employ train-the-trainer type approaches.[27–29] While the WPS is a nationwide mandatory training, the OSHA Heat Illness Prevention Training is not, and only two states (California and Washington) have regulations for HRI prevention education. Research to evaluate the benefits to workers from receiving OSHA HRI training might inform future legislative efforts in other states.[30,31] Technological advances in breathable fabrics specifically designed for outdoor workers and sold at an affordable price could also benefit farmworkers and reduce HRI risk. Advances in clothing technology is an understudied area in farmworker safety research which could help to decrease negative occupational health outcomes.

Farmworkers employed several different cooling practices. Some farmworkers used wet cool cloths, rest in the shade, and drinking water, *suero* and Gatorade to cool down. There were varying beliefs about the risks associated with drinking very cold water, such as a resulting cardiac event. In the OSHA Heat Illness Prevention Training, there is reference to drinking small amounts of water frequently, which were reviewed in the educational handouts at the end of the training in this study, but there is no specific advisory on water temperature. Further research is needed to update the OSHA training materials on recommended water temperature and cooling methods regarding water ingestion (e.g., tepid versus cold water versus ice chips). The threshold for being able to work outside listed by several workers was 105 degrees Fahrenheit. Farmworkers ascribed responsibility for one's well-being for working in the heat more as an individual factor than as an employer's responsibility. Farmworkers working under contractual arrangements were less likely to take sufficient breaks and assumed greater risks by working long hours. When a worker succumbed to the heat, farmworkers placed the blame on the individual, saying that they ignored their symptoms and should have rested more. Victim blaming would also occur if the farmworker had been drinking alcohol excessively the day before their HRI episode. Experienced workers listed HRI mitigation strategies such as getting enough rest, eating healthy foods, taking pain relievers, and ingesting hydration mix solutions to stay hydrated. Farmworkers did not explicitly associate the work contractual agreement or responsibility of supervisors to maintain a safe work environment with increased risk for work-related HRI injury; however, past research has demonstrated an association.[32]

Other qualitative research with Hispanic farmworkers has identified barriers to HRI prevention such as a belief that cooling treatments should be avoided after HRI symptoms, excess sweating

could help a person to lose weight, some water sources at worksites could potentially be contaminated, caffeinated energy drinks could increase productivity, and drinking excess water would decrease work productivity and create problems with supervisors due to increased restroom breaks.[33] Some of these similar barriers to HRI prevention were also identified in this study and should be addressed in HRI education interventions. Strategies to avoid HRIs recommended by OSHA include instituting frequent breaks for new workers or those who have been away from the job, modifying work schedules, training workers to recognize HRI symptoms and respond to emergencies, watching out for co-workers, wearing hats and light-colored clothing, and going to air-conditioned places during or after work.[31] While these strategies appear reasonable and actionable, in practice, some of these strategies might not be feasible. For example, in this study, workers discussed seeking shade under trucks, which is not an ideal place because of safety reasons and the fact that the vehicles might be radiating heat.

Risk models for heat stress response help to explain the multiple factors that may contribute to a person succumbing to HRI. Survey research and qualitative studies have also reported findings to explain how farmworkers themselves perceive their risk and coping mechanisms employed to adapt to excessive temperatures.[24,34,35] For example, surveys with farmworkers in Washington and Oregon reported that workers were insufficiently hydrated, did not have enough access to shade structures, and had received limited training on HRI prevention.[25] A Georgia study with farmworkers identified prevention practices which included drinking more liquids and resting in the shade, but other prevention practices, such as sunscreen or hats, were rarely used.[36] A literature review of mobile farm clinics reported that farmworkers placed a higher priority on their ability to work above any health-related concern.[37]

Mac and McCauley[3] combine multiple HRI risk factors in their conceptual model of heat stress response. They define vulnerability to environmental heat stress, which may result in a bodily heat stress response, as a combination of workplace exposures (e.g., length of workday), sensitivity (e.g., acclimatization), and adaptive capacity (e.g., hydration levels). Their model highlights the importance of modifiable components of the framework where interventions to reduce risk could occur in these three areas of vulnerability. For example, workplaces could alter farmworkers' work schedules to work more in the mornings and less in the hot afternoon hours. Other strategies could include assigning a supervisor or fellow worker to monitor farmworkers for HRI symptoms and implement appropriate hydration and rest protocols. While there is currently no federal policy for protection from heat, in a few states, such as California, there is a state statute that employers must implement high-heat procedures when the temperature is above 95 degrees Fahrenheit, and agricultural workers must take 10-minute breaks every two hours.[38]

Conclusion

The study results confirm the need for increased health education efforts focusing on HRI prevention for agricultural workers. OSHA's development of the English/Spanish bilingual campaign, "Water, Rest, Shade" is a positive step: it emphasizes HRI prevention as critical to outdoor worker health and safety. The OSHA Heat Safety Tool is a free mobile phone app that provides current heat index alerts, lists symptoms, and provides First Aid instructions. Originally designed with construction workers in mind, there is an opportunity to disseminate, evaluate and adapt these materials with Hispanic farmworkers.[22] The use of this app, or other similar apps currently under development and testing at the University of California – Davis, has the potential to be a powerful educational tool for educating farmworkers in HRI prevention.[39] By addressing the beliefs and attitudes of farmworkers toward this important occupational health and safety topic, health education efforts can better accommodate the education needs of this vulnerable group of agricultural workers.

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