Symptoms of Heat Illness Among Latino Farm Workers in North Carolina

Maria C. Mirabelli, PhD, MPH, Sara A. Quandt, PhD,
Rebecca Crain, BA, Joseph G. Grzywacz, PhD, Erin N. Robinson, BA,
Quirina M. Vallejos, MPH, Thomas A. Arcury, PhD

Background: Symptoms of occupational heat illness provide an early warning that workers are in potentially life-threatening environmental conditions.

Purpose: This analysis was designed to assess the extent to which strategies to reduce the health impact of extreme heat were associated with the prevalence of heat illness among Latino farm workers.

Methods: Between June and September 2009, a total of 300 Latino men and women participated in a cross-sectional survey about farm worker health. Participants reported whether they were employed through the H-2A temporary agricultural worker program and whether they had ever worked in conditions of extreme heat during their work in the U.S. agricultural industry. Workers who had worked in extreme heat also responded to questions about selected activities and behaviors and whether they experienced symptoms of heat illness. Data analysis was conducted in 2009 to assess associations of altering work hours and activities, drinking more water, resting in shaded areas, and going to air-conditioned places during or after work, with the prevalence of symptoms of heat illness among H-2A and non–H-2A workers.

Results: Working in extreme heat was reported by 281 respondents (94%), among whom 112 (40%) reported symptoms of heat illness. Changes in work hours and activities during hot conditions were associated with a lower prevalence of heat illness among H-2A workers but not among non–H-2A workers.

Conclusions: These findings suggest the need to improve the understanding of working conditions for farm workers and to assess strategies to reduce agricultural workers' environmental heat exposure.
(Am J Prev Med 2010;39(5):468–471) © 2010 American Journal of Preventive Medicine

Introduction

Muscle cramps, heat syncope, heat exhaustion, heat stroke, and other heat-related conditions have been reported among people working outdoors (e.g., in agriculture[1] and construction[2]); in hot indoor or enclosed environments (e.g., drivers[2] and miners[3,4]); and who wear heavy equipment and whose jobs require considerable physical exertion (e.g., athletes,[5] firefighters,[2] and military personnel[6,7]). As of 2009, California and Washington each have occupational safety standards for agriculture that address outdoor heat exposure.[8,9] A review[10] of medical examiner records in North Carolina identified a large number of heat-related fatalities among farm workers, suggesting that strategies to prevent occupational heat illness among farm workers could have an important impact on heat stroke fatality overall.

Non-immigrant foreign workers brought to the U.S. to work in temporary and seasonal agricultural labor jobs are contracted through the H-2A (type of visa) temporary agricultural worker program.[11] Better working conditions and more safety behaviors have been reported[12] among H-2A workers than among other workers, although differences in occupational activities and workplace safety practices have not been thoroughly investi-

From the Department of Epidemiology and Prevention, Division of Public Health Sciences (Mirabelli, Quandt), the Department of Family and Community Medicine (Crain, Grzywacz, Robinson, Vallejos, Arcury), and the Center for Worker Health (Mirabelli, Quandt, Grzywacz, Vallejos, Arcury), Wake Forest University School of Medicine, Winston-Salem, North Carolina

Address correspondence to: Maria C. Mirabelli, PhD, MPH, Department of Epidemiology and Prevention, Division of Public Health Sciences, Wake Forest University School of Medicine, Medical Center Boulevard, Winston-Salem NC 27157-1063. E-mail: mmirabel@wfubmc.edu.
0749-3797/$17.00
doi: 10.1016/j.amepre.2010.07.008

gated. Using data collected during the 2009 agricultural season, this analysis was conducted to describe the characteristics of H-2A and non–H-2A farm workers who reported working in conditions of extreme heat. This paper presents self-reported data about strategies to prevent heat illness and associations between these strategies and heat illness among farm workers.

Methods

Between June and September 2009, a total of 300 Latino farm workers participated in a cross-sectional study designed to assess several dimensions of farm worker health. Participants were recruited from the sites maintained as living quarters for migrant farm workers (i.e., farm worker camps) in three contiguous counties in North Carolina. Spanish-speaking study personnel approached 62 camps during the recruitment stage of the study; workers in eight declined to participate and the owners, who are also the farm workers' employers, of two refused to allow study personnel to recruit in the camps. After 157 refusals, 300 farm workers (66%) were successfully recruited from 52 camps. The Wake Forest University School of Medicine IRB approved the study protocol and instruments, and each participant provided written informed consent.

Participants completed interviewer-administered questionnaires in Spanish and reported working in conditions of extreme heat by responding to the following question: *During your work in agriculture in the U.S. (including this year), have you worked in conditions of extreme heat?* Participants with positive responses were asked follow-up questions to assess adaptive strategies and heat-related symptoms. The five adaptive strategies included changing work hours, changing work activities, drinking more water, resting in shaded areas, and going to air-conditioned places during or after work. To assess heat-related symptoms, participants reported whether they ever experienced any of the following symptoms while working in extreme heat: confusion; dizziness; fainting; hot, dry skin; muscle cramps; and nausea or vomiting. Individuals who reported any of the symptoms were identified as having experienced heat illness. Participants also reported their ages, educational attainment, housing type, H-2A status, gender, whether they spoke English, and years of experience working in the U.S. agricultural industry. Workers who reported having an H-2A visa were categorized as H-2A workers; all others were categorized as non–H-2A workers.

Data analysis was conducted in 2009 to assess characteristics of the study population by H-2A status, by experience working in extreme heat, and of the workers who reported heat illness. Associations between the strategies to reduce the health impact of heat and heat-related illness were estimated using log-binomial regression. Associations are presented as prevalence ratios (PR) with 95% CIs, adjusted for educational attainment (0–6, 7–9, 10–16 years); housing type (barracks, house, trailer); and years of experience working in the U.S. agricultural industry (<1, 1–6, ≥7 years). All analyses were performed using SAS, version 9.1.

Results

Table 1 shows characteristics of the 300 participants. The remaining analyses were restricted to 281 participants (94%) who reported working in extreme heat, among whom 112 (40%) reported heat-related symptoms. Heat illness was less common among H-2A workers (31% vs 56%), and the percentage of participants with specific symptoms ranged from 1% (fainting) to 22% (sudden muscle cramps) among H-2A workers and 6% to 44% among non–H-2A workers, respectively.

The majority of participants reported drinking more water (98%) and taking rest breaks in shaded areas (81%; Table 2). Smaller percentages reported changes in their work hours (37%) or work activities (34%), and only 6 (2%) reported going to an air-conditioned place to rest during or after work. Each adaptive strategy was more common among non–H-2A workers. Among H-2A workers, heat illness was associated inversely with each of the adaptive strategies and particularly with reported changes in work hours and activities (PR=0.44, 95% CI=0.22, 0.89). This inverse association was not observed in the population of non–H-2A workers (PR=1.11, 95% CI=0.79, 1.55). Adjusting the final models for the timing of the interview throughout the summer generated PRs closer to unity for all models, including, most notably, those for H-2A workers who reported changes in their work activities (PR=0.55, 95% CI=0.28, 1.09) and all workers who reported changes in work hours and activities (H-2A: PR=0.48, 95% CI=0.23, 0.99; non–H-2A: PR=0.95, 95% CI=0.62, 1.45).

Discussion

Nearly 94% of the surveyed population reported working in extreme heat. Despite not having information about in which other geographic regions the participants may have worked in the past, this high percentage is unsurprising given that the participants were farm workers interviewed in a region where hot and humid conditions are common throughout the summertime. Of these respondents, nearly all reported drinking more water or taking breaks in shaded areas while working. North Carolina currently does not have regulations addressing heat exposure in the agricultural industry, and the two primary prevention measures included in the current survey (namely, changing work hours and changing work activities) were uncommon. This is a concern, given the potential for heat-related illnesses to turn fatal. These findings suggest that use of strategies to reduce exposure or prevent heat illness while working in extreme heat varies by H-2A worker status. In the present survey, adaptive strategies were reported less frequently among H-2A workers, as were the symptoms of heat illness.

Table 1. Characteristics of the H-2A and non–H-2A farm worker study populations, *n* (%)

	H-2A workers			Non–H-2A workers		
Characteristic	**Subgroup total**	**Worked in extreme heat[a]**	**Heat illness[a,b]**	**Subgroup total**	**Worked in extreme heat[a]**	**Heat illness[a,b]**
Study population	194 (100)	177 (91)	54 (31)	106 (100)	104 (98)	58 (56)
Age (years)						
18–27	36 (19)	32 (89)	10 (31)	38 (36)	37 (97)	16 (43)
28–33	59 (30)	54 (92)	14 (26)	14 (13)	13 (93)	8 (62)
34–41	53 (27)	47 (89)	16 (34)	22 (21)	22 (100)	12 (55)
42–65	46 (24)	44 (96)	14 (32)	32 (30)	32 (100)	22 (69)
Educational attainment (years)						
0–6	88 (45)	80 (91)	20 (25)	73 (69)	72 (99)	46 (64)
7–9	88 (45)	82 (93)	27 (33)	27 (26)	26 (96)	11 (42)
10–16	18 (9)	15 (83)	7 (47)	6 (6)	6 (100)	1 (17)
English spoken						
No	178 (92)	163 (92)	51 (31)	87 (82)	85 (98)	49 (58)
Yes	16 (8)	14 (88)	3 (21)	19 (18)	19 (100)	9 (47)
Housing						
Barracks	72 (37)	66 (92)	24 (36)	30 (28)	29 (97)	14 (48)
House	63 (33)	56 (89)	11 (20)	30 (28)	29 (97)	14 (48)
Trailer	59 (30)	55 (93)	19 (35)	46 (43)	46 (100)	30 (65)
Gender						
Female	2 (1)	2 (100)	0 (0.0)	13 (12)	13 (100)	10 (77)
Male	192 (99)	175 (91)	54 (31)	93 (88)	91 (98)	48 (53)
Survey period						
June 24–July 4	63 (33)	56 (89)	17 (30)	15 (14)	14 (93)	7 (50)
July 5–July 18	43 (22)	34 (79)	12 (35)	33 (31)	32 (97)	16 (50)
July 19–August 5	42 (22)	42 (100)	16 (38)	30 (28)	30 (100)	23 (77)
August 5–September 6	46 (24)	45 (98)	9 (20)	28 (26)	28 (100)	12 (43)
Years in U.S. agriculture						
<1	15 (8)	12 (80)	4 (33)	25 (24)	23 (92)	11 (48)
1–6	74 (38)	69 (93)	18 (26)	51 (48)	51 (100)	26 (51)
≥7	105 (54)	96 (91)	32 (33)	30 (28)	30 (100)	21 (70)

[a]Row percentages
[b]Denominators are the numbers of participants who reported working in hot weather

The present study has limitations that should be considered when interpreting the findings and developing future research. The survey did not include information about the frequency, severity, timing, or geographic location of the exposure or the heat-related symptoms. These data and information about workplace safety practices and access to medical attention would yield useful information with which to assess causal associations among working conditions, prevention strategies, and heat illness. Information about specific work-related changes and validation of this information would provide insight into the extent to which workers and their supervisors view hot weather as a danger-

Table 2. Associations of heat illness prevention strategies with heat illness among H-2A and non–H-2A farm workers

	H-2A workers			Non-H-2A workers		
Prevention strategies	**Subgroup total**	**Heat illness**[a]	**PR (95% CI)**[b]	**Subgroup total**	**Heat illness**[a]	**PR (95% CI)**[b]
Total population	177 (100)	54 (31)		104 (100)	58 (56)	
Change work hours	61 (35)	12 (20)	0.58 (0.33, 1.03)	42 (40)	24 (57)	1.18 (0.84, 1.64)
Change work activities	53 (30)	9 (17)	**0.50 (0.26, 0.96)**	43 (41)	25 (58)	1.21 (0.87, 1.69)
Drink more water	172 (97)	53 (31)	0.86 (0.14, 5.29)	103 (99)	58 (56)	—
Take rest breaks in shaded areas	130 (73)	37 (29)	0.68 (0.43, 1.10)	97 (93)	54 (56)	1.20 (0.64, 2.26)
Go to air-conditioned places during breaks or after work	1 (<1)	1 (100)	—	5 (5)	4 (80)	1.27 (0.61, 2.64)
Change hours or activities	62 (35)	13 (21)	0.63 (0.36, 1.10)	45 (43)	27 (60)	1.28 (0.91, 1.80)
Change hours and activities	52 (29)	8 (15)	**0.44 (0.22, 0.89)**	40 (39)	22 (55)	1.11 (0.79, 1.55)

Note: Values are *n* (%) unless otherwise indicated. Boldface indicates significance.
[a]Row percentages
[b]Adjusted for educational attainment, housing type, years in U.S. agriculture
PR, prevalence ratio

ous condition. Improvements in the ascertainment or verification of individual heat-related symptoms would improve the sensitivity and specificity of the definition of heat illness.

Men and women working in the agricultural industry work long hours, and those who work outdoors are likely to work in intensely hot and humid weather conditions that place them at risk of exertional and classic heat illness. The current data suggest a need for more information about the working conditions of populations working in environments or conditions that place them at risk of heat illness and improvements in our understanding of the functional consequences of these working conditions. These findings also indicate an urgent need for rigorous research of hypotheses about strategies to reduce workers' exposure to extreme heat, acclimatization to hot and humid conditions in agricultural work environments, and symptoms of heat-related illness.

This research was funded by the NIH, National Institute of Environmental Health Sciences (Grant Number R01ES008739) and the Northeast Center for Agricultural and Occupational Health, with support from the National Institute for Occupational Safety and Health (Grant Number U50OH007542-09).

No financial disclosures were reported by the authors of this paper.

References

1. CDC. Heat-related deaths among crop workers—U.S., 1992–2006. MMWR Morb Mortal Wkly Rep 2008;57(24):649–53.
2. Bonauto D, Anderson R, Rauser E, Burke B. Occupational heat illness in Washington State, 1995–2005. Am J Ind Med 2007; 50(12):940–50.
3. Donoghue AM, Sinclair MJ, Bates GP. Heat exhaustion in a deep underground metalliferous mine. Occup Environ Med 2000;57(3):165–74.
4. Donoghue AM. Heat illness in the U.S. mining industry. Am J Ind Med 2004;45(4):351–6.
5. Finch CF, Boufous S. The descriptive epidemiology of sports/leisure-related heat illness hospitalisations in New South Wales, Australia. J Sci Med Sport 2008;11(1):48–51.
6. Hakre S, Gardner JW, Kark JA, Wenger CB. Predictors of hospitalization in male Marine Corps recruits with exertional heat illness. Mil Med 2004;169(3):169–75.
7. Gardner JW, Kark JA, Karnei K, et al. Risk factors predicting exertional heat illness in male Marine Corps recruits. Med Sci Sports Exerc 1996;28(8):939–44.
8. Heat Illness Prevention, Title 8 California Code of Regulations, Sec. 3395. www.dir.ca.gov/title8/3395.html.
9. Outdoor Heat Exposure, Washington State Safety Standards for Agriculture. Chapter 296-307-097, 2009. www.Ini.wa.gov/wisha/rules/agriculture/pdfs/307partg-1.pdf.
10. Mirabelli MC, Richardson DB. Heat-related fatalities in North Carolina. Am J Public Health 2005;95(4):635–7.
11. Immigration and Nationality Act, Section 218 [Title 8 U.S. Code Section 1188.] Admission of Temporary H-2A Workers (1952). www.uscis.gov/propub/DocView/slbid/1/2.
12. Whalley LE, Grzywacz JG, Quandt SA, et al. Migrant farmworker field and camp safety and sanitation in eastern North Carolina. J Agromedicine 2009;14(4):421–36.