Heat Index in Migrant Farmworker Housing: Implications for Rest and Recovery From Work-Related Heat Stress

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Although the health risk to farmworkers of working in hot conditions is recognized, potential for excessive heat exposure in housing affecting rest and recovery has been ignored. We assessed heat index in common and sleeping rooms in 170 North Carolina farmworker camps across a summer and examined associations with time of summer and air conditioning use. We recorded dangerous heat indexes in most rooms, regardless of time or air conditioning. Policies to reduce heat indexes in farmworker housing should be developed. (*Am J Public Health.* 2013;103:e24–e26. doi:10.2105/AJPH.2012.301135)

Physical work in hot, humid conditions poses significant health risks for farmworkers.[1] Crop workers report working in extreme heat[2]; they suffer heat-related death at rates higher than other US workers.[3] The dangers of heat illness are recognized in several states by heat standards, which prescribe shaded rest breaks during hot weather and education to encourage drinking adequate water.[4,5]

Daily recovery helps reduce negative effects of heat on health. Among farmworkers, the potential for recovery is determined largely by their ability to spend nonworking time in cooler conditions, including breaks during the day and overnight. Studies of farmworker housing[6–11] have not directly addressed its potential impact on health through the temperature and humidity found in housing and their implications for recovery.

We examined data collected across a summer in North Carolina farmworker camps. The goal was to describe the burden of heat experienced by migrant farmworkers in grower-provided housing in North Carolina and the effect fans or air conditioning (AC) might have on providing relief.

METHODS

In a cross-sectional survey,[6,7] we assessed temperature and relative humidity after 4:00 PM in common rooms and sleeping rooms in 170 migrant farmworker camps selected in 16 counties in eastern North Carolina between June 15 and October 4, 2010. We assessed 1 common room per camp. In camps with multiple sleeping rooms, up to 2 farmworkers per camp from separate sleeping rooms reported use of fans and AC in their sleeping rooms. We measured temperature and relative humidity with Digital Thermo Hygrometers with DataLogger calibrated to National Institute of Standards and Technology standards (Center Technology Corp, Taiwan). We calculated heat index (HI) by using the standard equation. We classified HI as risk levels no danger (<80°F), or danger, divided into lower caution (80°F to 90°F), moderate caution (91°F to 103°F), high danger (103°F to 115°F), and very high or extreme danger (>115°F).[12]

RESULTS

Camps included barracks (n = 53; 31.2%) and nonbarracks (e.g., trailers, houses) arrangements (n = 117; 68.8%). About two thirds of the camps (n = 113; 66.5%) included workers with H-2A guest worker visas. The average age of workers was 35.2 (±10.2) years; median education was 7 years. Most workers (94.8%) were from Mexico; 62.7% had H-2A visas. Twenty-five percent were in their third season or less of work in US agriculture.

More than half of the workers (174; 55.1%) reported no AC in the dwelling; 21 (6.6%) reported central AC, and 121 (38.3%) reported window AC. Window units were most commonly reported in sleeping areas (109; 90.1%). Air conditioning was reportedly used 20 or more of the past 30 days by 121 (85.9%) workers who had AC available. Electric fans in sleeping rooms were reported by 248 (78.5%) workers.

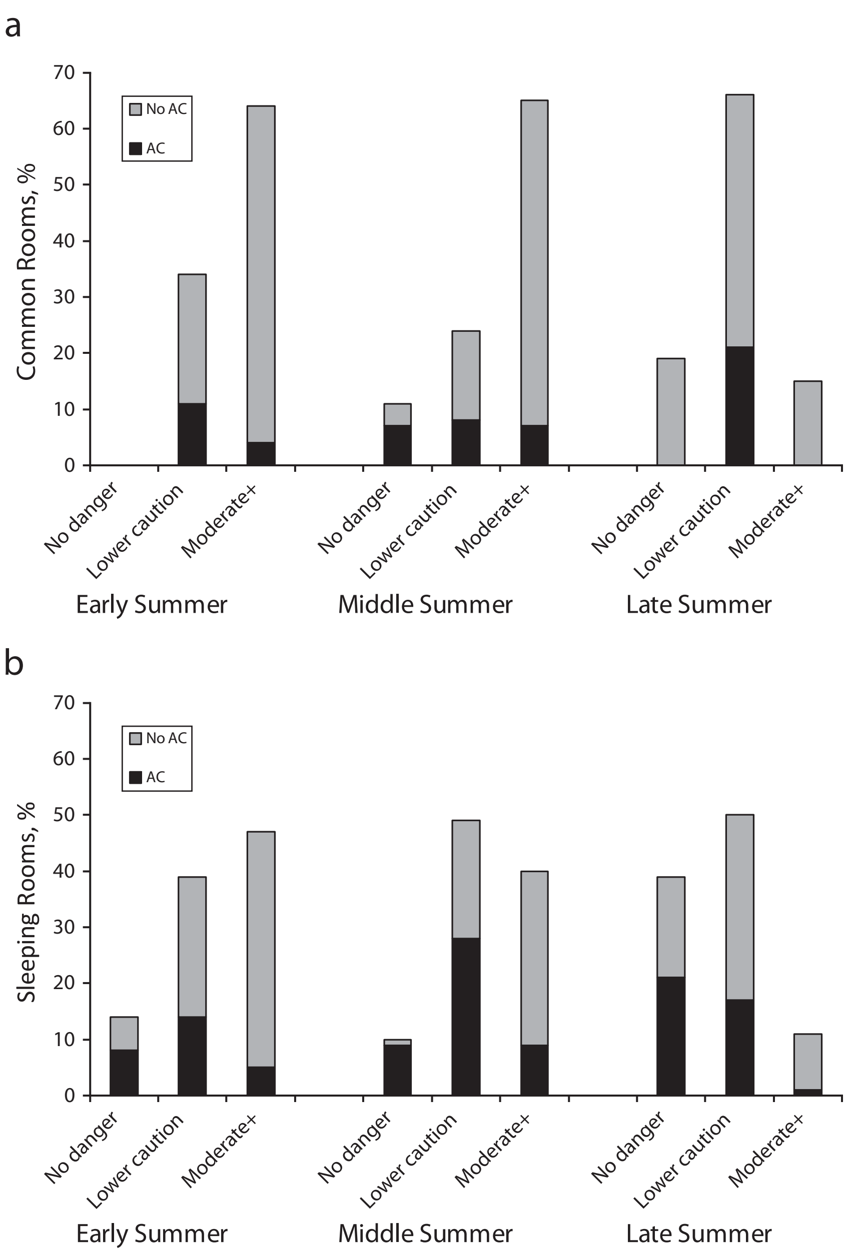
Most HI measures in the common and sleeping rooms exceeded the danger threshold (Figure 1). For both rooms, HI measures were higher in early and middle summer than in late summer. Heat conditions were generally worse in common rooms. Air conditioning was associated with somewhat lower HI measures, particularly in sleeping rooms (Table 1). Associations of HI with time of summer and AC were significant for both common and sleeping rooms. The HI was not associated with housing type.

DISCUSSION

Most of the estimated 1.4 million farmworkers in the United States[13] work in crop harvest, most during the hottest months of the year. The effects of heat are often exacerbated by humidity; evaporative cooling is decreased and thermal load is increased. This study suggests that farmworkers continue to experience excessive heat and humidity even after leaving the fields. Farmworkers, particularly migrants, have little control over their housing. It is frequently grower-provided; in other cases farmworkers must rent from a limited supply of low-quality rural housing stock.[14,15]

Humans show no sleep adaptations to continuous exposure to high heat.[16] High ambient temperatures and elevated humidity impair the quantity and quality of sleep by reducing slow-wave sleep and rapid-eye-movement sleep, both of which indicate deeper and more restorative sleep.[17–19] Combined high heat and humidity increase the thermal load by impairing the body temperature decrease normally evoked by sleep.[18,19]

This study suggests that farmworkers' recovery from the heat stress experienced during daily work will be affected by the HI experienced at night. The HI in sleeping rooms decreases later in the season, but dangerous levels still occur into the late summer.



Note. AC = air conditioning. The sample sizes were n = 168 common rooms and n = 308 sleeping rooms.

FIGURE 1—Heat index across early, middle, and late summer, by the presence and absence of air conditioning in (a) common rooms and (b) sleeping rooms: North Carolina farmworker camps, 2010.

More than three quarters of these workers reported having electric fans in their sleeping rooms. Fans can provide some cooling by increasing convective heat loss, though their efficiency is decreased by high ambient temperatures and humidity, and they can promote dehydration.[20]

Lack of data on the physiological impacts of the HIs measured in farmworker housing is a limitation, as are lack of data on humidity and on the effects of fans on the physiological impacts of indoor HI. Nevertheless, the findings suggest the need for concern. Although the dangers of elevated HIs are recognized for worksites, no current state or federal farmworker housing policies include provisions for cooling. These results suggest that such policies should be considered. Further research should measure the direct physiological impact of HI after work and its possible repercussions for worker health and safety, as well as compare the physiological impact of HI in air-conditioned and non–air-conditioned worker housing. ■

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Contributors

S. A. Quandt, M. F. Wiggins, H. Chen, and T. A. Arcury originated and designed the overall study. T. A. Arcury and W. E. Bischoff supervised the study implementation and data collection. H. Chen conducted the data analysis. S. A. Quandt developed the aims for this specific analysis and led the writing. All authors helped to conceptualize ideas, interpret findings, and review drafts of the article.

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Human Participant Protection

The Wake Forest School of Medicine institutional review board approved this study.

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TABLE 1—Heat Index for Farmworker Camp Common Rooms and Worker Sleeping Rooms: North Carolina, 2010

		Heat Index			
	Total No. (%)	HI = 1: No Danger, No. (%)	HI = 2: Lower Caution, No. (%)	HI = 3: Moderate to Very High Caution, No. (%)	*P*
Common rooms (n = 170)					
Time of summer					< .001
Early: mid-June to mid-July	48 (28.2)	1 (2.1)	16 (34.0)	30 (63.8)	
Middle: mid-July through August	74 (43.5)	8 (10.8)	18 (24.3)	48 (64.9)	
Late: September to early October	47 (27.6)	9 (19.2)	31 (66.0)	7 (14.9)	
AC					<.001
No AC or no AC use	134 (79.8)	12 (9.0)	44 (32.8)	78 (58.2)	
Little to constant AC use	34 (20.2)	6 (17.7)	21 (61.8)	7 (20.6)	
Housing type					.76
Nonbarracks	117 (68.8)	13 (11.1)	47 (40.2)	57 (48.7)	
Barracks plus other	53 (31.2)	5 (9.8)	18 (35.3)	28 (54.9)	
Sleeping rooms (n = 316)[a]					
Time of summer					< .001
Early: mid-June to mid-July	86 (27.8)	12 (14.0)	33 (38.4)	41 (47.7)	
Middle: mid-July through August	141 (45.6)	15 (10.6)	69 (48.9)	57 (40.4)	
Late: September to early October	82 (26.5)	32 (39.0)	41 (50.0)	9 (11.0)	
AC					< .001
No AC	187 (60.7)	22 (11.8)	77 (41.2)	88 (47.1)	
AC present and used	121 (39.3)	37 (30.6)	66 (54.6)	18 (14.9)	
Housing type					.725
Nonbarracks	211 (70.4)	39 (18.5)	95 (45.0)	77 (36.5)	
Barracks plus other	98 (29.6)	20 (20.4)	48 (49.0)	30 (30.6)	

Note. AC = air conditioning; HI = heat index. Numbers may not add to 170 common rooms or 316 sleeping rooms because of missing data.
[a]*P* values were adjusted for clustering of bedrooms within camps.

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