

**Descriptive analysis of occupational heat-related illness treated in Florida
hospitals and emergency departments**

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Introduction

Heat-related illness (HRI) is comprised of a continuum of disorders that occur when the body loses the ability to regulate body temperature due to loss of fluids and electrolyte imbalance. The disorders include: heat edema, heat cramps, heat syncope, heat exhaustion and heat stroke. Death or multiple organ dysfunctions can occur from severe heat stroke which happens when the body's core temperature exceeds 103°F. HRI often, but not always, occurs after exposure to extreme heat. Occupational exposure, both indoors and outdoors is of particular concern as the symptoms of even mild HRI (e.g dizziness or sweaty palms) can lead to other, potentially more severe injuries. Factors that contribute to an individual's increased susceptibility to HRI include increasing age, the presence of underlying medical condition(s), medication use, dehydration, overall general wellness (e.g. obesity or an infection such as a cold) and lack of acclimatization. Environmental factors such as ambient temperature, humidity, wind, and sun exposure may alter the risk of HRI. An individual's physical activity level, hydration level, and amount or type of clothing may also increase the risk of HRI. The literature has suggested that occupational HRI may occur at a lower temperature than non-occupational HRI.¹⁻⁵

The objective of this study was to describe occupational HRI treated in Florida hospitals and emergency departments.

Methods

Data on heat related hospitalizations and ED visits were obtained from the Florida Agency for Health Care Administration (AHCA) for the years 2005-2009. HRI was defined using the following International Classification of Diseases ninth revision Clinical Modification (ICD-9-CM) codes: 992.0-992.9 and E900.0-E900.1. Cases were identified if at least one of the HRI codes was found in the primary diagnosis field or in one of the secondary diagnosis fields. Cases were restricted to individuals age 16 or older to reflect the working population. Work-related cases were identified through principal payer (workers' compensation) and work-related ICD-9-CM Ecodes⁶ (Table 2). Age-adjusted rates with their corresponding 95% confidence intervals (CI) were calculated using population data for Florida workers obtained from the Current Population Survey for the years 2005-2009. The working population (the number of Florida workers) obtained from the Current Population Survey only included the civilian (non-military), non-institutionalized population, those individuals who were at the time either employed and working or employed but absent from work. Population data for non-workers, all Floridians 16 year or older, were also obtained from the Current Population Survey and age-adjusted rates were calculated. All age-adjusted rates were standardized to the 2000 US standard million population for comparability. County-specific crude rates of occupational HRI were calculated using the case's county of

residence. The county specific population data for workers were obtained from the Bureau of Labor Statistics (BLS) Local Area Unemployment Statistics for the years 2005-2009. The county specific working population was also restricted to the civilian, non-institutionalized population 16 years and older. Case fatality rates (CFR) were calculated as the number of heat-related deaths divided by the sum of heat-related deaths and cases of HRI multiplied by 100.

Results

Between 2005 and 2009, 16,523 Florida residents age 16 or older were treated for HRI in the ED or hospital (age-adjusted rate = 18.3/100,000 Floridians; 95% CI = 15.5, 21.2). During the same time period an additional 2,198 cases of occupational HRI were identified for an age-adjusted rate of 3.7/ 100,000 workers (95% CI = 1.9, 5.5). Among the cases of HRI identified, 3 occupational (CFR = 1.4/1,000 occupational HRI cases) deaths occurred. The majority of occupational HRI cases were treated in the ED (N = 1,964; 89.4%). For individuals admitted to the hospital the length of stay was a mean of 2.3 days (median = 2 days). The rate of occupational HRI varied by county with highest rates found in the rural counties of Desoto, Taylor, Madison, Walton, Hamilton and Putnam (Figure 1).

Selected demographic information can be found in Table 2. As expected the majority of occupational HRI, occurred in the summer, July-September. The rate of occupational HRI varies by year with 2005 having the highest rate of occupational HRI (6.1/ 100,000 workers). The greater proportion of occupational HRI is found among males (87%). The greatest proportion of occupational cases presented Tuesday-Thursday (Figure 2). The mean and median age for occupational HRI was 37.2 and 36 years, respectively. The age-specific rates of occupational HRI can be found in figure 3. The rates of occupational HRI decline with age with the highest rate for individuals' age 25-29 years. The majority of occupational HRI cases (59%) were due to hot weather conditions (Table 3).

Conclusion

A descriptive analysis of the Florida hospitalization and ED data were performed examining occupational heat related illness (HRI). The source of the data are hospitals and EDs, HRI is often treated in an outpatient setting such as a physician's office or a clinic. HRI treated in these settings are not included in the analysis and the estimates presented here are an underestimate of the total burden of occupational HRI in the state of Florida.

The majority (83%) of HRI cases included in this analysis were identified as occupational due to a filed workers' compensation claim (primary payer = workers' compensation). However, the use of workers' compensation claims to identify injuries may gravely underestimate the number of cases. Barriers to the use of workers' compensation include but are not limited to: time/convenience – individuals may find it faster and more efficient to file under their own private health insurance; fear – individuals may fear adverse reactions from their employer (e.g. job loss or demotion); lack of knowledge – individuals may not know that workers' compensation coverage is available.⁷ The study used ICD-9-CM ecodes (location/type of injury codes) to help capture occupational HRI cases where a workers' compensation claim was not filed. In general ICD-9-CM codes are required in the medical record for reimbursement or treatment purposes.⁸ The location and type of injury codes (ecodes) are not typically necessary for reimbursement or treatment purposes and therefore are often missing from the record.⁸ In this study only 24% (n=530) of all occupational HRI had an ecode related to work. As a result of potential under-filing of workers' compensation claims and underreporting of work-related ecodes, the rate of occupational HRI treated in the hospital or ED presented here may be greatly underestimated.

The type of occupation is critical in understanding occupational HRI. There are occupations where workers are at a higher risk of HRI due to their working environment (e.g. construction workers, farmers, firefighters or some factory workers).^{1,9} Other occupations such as office workers are not typically at risk for occupational HRI. If only the workers at risk for HRI were included in the study, the age-adjusted rate for occupational HRI would be higher. The hospitalization and ED data set did not allow for analysis by occupation or industry. However, the use of the ICD-9-CM ecodes (location/type of injury codes) allowed for a crude determination of exposure. The source of HRI exposure was present in 83% (n=1820) of occupational HRI cases (Table 3). The majority of occupational HRI cases were due to weather conditions suggesting that they occurred as a result of work activities outdoors while only a small percentage of cases were due to man-made origins (e.g. boiler room, drying room, factory, furnace room, kitchen) indicating an indoor exposure.

Further work will be conducted examining the relationship between occupational HRI and temperature. We will also be examining other datasets that will provide information on industry and occupation.

With awareness and a few simple steps HRI can be prevented. Information on prevention of occupational HRI can be found at <http://www.cdc.gov/niosh/topics/heatstress/>

References

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Table 1. Breakdown of codes used to define an exposed case (work-related) among Florida residents hospitalized or treated in Florida EDs for heat-related illness (HRI), 2005-2009 (N=2,198)

ICD-9-CM	Definition	Count*
---	Principal payer is workers' compensation	1834
E000.0-E000.1	Civilian activity done for income or pay and Military activity	6
E800-E807	Railway accident among railway employee (4th digit = 0)	0
E830-E838	Water transport accident among crew, Dockers and stevedores (4th digit = 2 or 6)	0
E840-E845	Air and space transport accidents among crew and ground crew (4th digit = 2 or 8)	0
E846	Accidents involving powered vehicles used solely within the buildings and premises of industrial or commercial establishment	0
E849.1	Place of occurrence: farm building/land under cultivation	9
E849.2	Place of occurrence: mine or quarry	2
E849.3	Place of occurrence: industrial place and premises	349

*2 individuals had a code of E000.0-E000.1 and E849.3. There were 164 individuals who had both workers compensation and a work-related ecode (3 had E000.0-E000.1, 1 had E849.1, 157 had E849.3, and 3 had both E000.0-E000.1 and E849.3) these individuals are only included in the table under workers' compensation.

Table 2. Selected characteristics of Florida residents diagnosed in a Florida hospital or ED with heat-related illness (HRI) and characteristics of Florida workers, 2005-2009 (N=2,198)

Characteristic	Occupational HRI		Florida Workers*		Rate/100,000 workers	Rate Ratio (p-value)
	Frequency	Percent	Frequency	Percent		
Gender						
Male	1911	86.9	22,686,605	53.0	8.4	Reference
Female	287	13.1	20,162,252	47.1	1.4	0.16 (<0.0001)
Race*						
White	1774	81.2	35,205,969	82.2	5.0	Reference
Black	350	16.0	6,049,942	14.1	5.8	1.15 (0.02)
Other	60	2.8	1,592,946	3.7	3.8	0.75 (0.03)
Ethnicity[†]						
Non-Hispanic	1,892	86.6	33,740,963	78.7	5.6	Reference
Hispanic	292	13.4	9,107,893	21.3	3.8	0.57 (<0.0001)
Quarter						
January-March	77	3.5	42,305,929	24.7	0.2	0.06 (<0.0001)
April-June	597	27.2	43,020,117	25.1	1.4	0.44 (<0.0001)
July-September	1372	62.4	43,331,147	25.3	3.2	Reference
October-December	152	6.9	42,738,225	24.9	0.4	0.11 (<0.0001)
Year						
2005	516	23.5	8,414,253	19.6	6.1	Reference
2006	485	22.1	8,780,346	20.5	5.5	0.90 (0.1)
2007	490	22.3	8,865,198	20.7	5.5	0.90 (0.1)
2008	320	14.6	8,654,891	20.2	3.7	0.60 (<0.0001)
2009	387	17.6	8,134,169	19.0	4.8	0.77 (0.0002)

*Population data from the Current Population Survey for individuals employed at work or employed absent.

†Note 14 individuals did not report their race/ethnicity.

Table 3. Summary of ICD-9-CM ecodes identifying the source of the heat-related illness (HRI) among Florida workers (2005-2009)

ID-9-CM	Definition	Occupational*
E900.0	Excessive heat due to weather conditions	1,302 (59.2%)
E900.1	Excessive heat of man-made origin	79 (3.6%)
E900.9	Excessive heat of unspecified origin	440 (20.0%)
	Unknown (ecode not present)	378 (17.2%)
	Total	2,198 (100%)

*1 individual had a code of E900.0 and E900.1

Figure 1. Quintiled rates of occupational heat-related illness (HRI) treated in Florida hospitals and EDs, 2005-2009

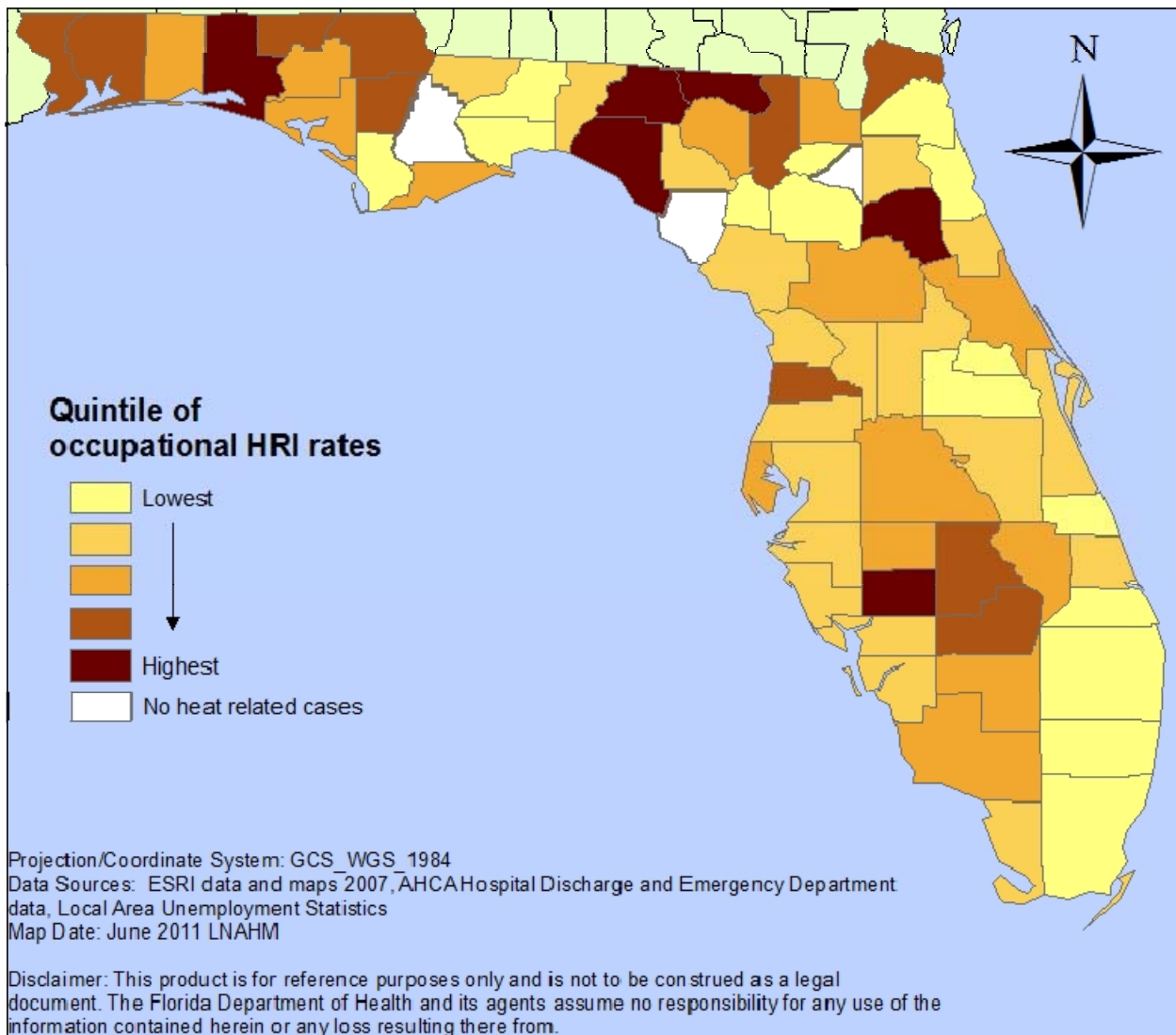


Figure 2. Distribution of admission/visit day of week for occupational heat-related hospitalizations and ED visits among Florida residents, 2005-2009

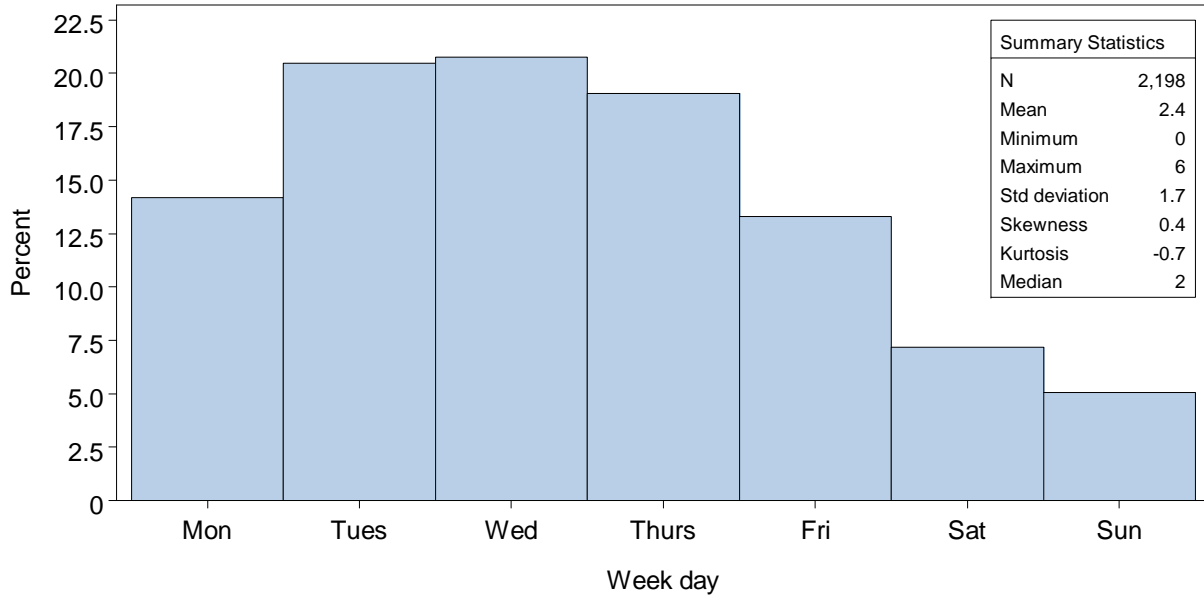


Figure 3. Distribution of age group by rates of occupational heat-related hospitalizations and ED visits among Florida residents, 2005-2009 (N=2,198)

