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Patient-related factors associated with severe heat-related illnesses in Karachi: A hospital perspective

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Abstract

In 2015, Karachi saw its first ever epidemic of severe heat-related illnesses that resulted in an extraordinary number of hospital admissions, especially in the intensive care, for fatal heat stroke within-hospital mortality of 3.7%.We conducted this study to elucidate the patient-related factors that lead to an increase in hospital admissions with heat-related illnesses in a tertiary care hospital. It was a descriptive case series conducted in the department of medicine at the Aga Khan University in June 2015. A total of 134 patients were admitted with heat-related illnesses of which 76(56.7%) were males. The mean age of the patients was 66 ±14.5 years. Heatstroke was present in 86 (64.2%) patients, followed by heat exhaustion in 48 (35.8%) and in-hospital mortality from heat-related illnesses was 5(3.7%). Hypertension (OR 2(95 % CI 1.0, 3.6) and insufficient sleep or food or water intake (OR 1.7(95 % CI 0.8, 3.8) was associated with severe heat-related illnesses. The effects remained even after adjusting for type and area of residence.

Keywords: Heat stroke, Heat syncope, Heat exhaustion, Heat cramps, altered mental state, Karachi heat waves.

Introduction

Climate change seems to be an emerging threat to the mother earth.[1] One of the adverse effects of climate change is an increase in weather temperature as well as an increase in the frequency and/or duration of heat waves[2].According to World Urbanization Prospects 2018(United Nations),Karachi is not only Pakistan's largest city, but the most populous as well with 16.62 million inhabitants.[3] Health inequalities are always a major problem in the city. Karachi faced its first ever heat epidemic in the last week of June 2015, during the holy month of Ramadan when majority of the people were fasting from sunrise to sunset. During this period, the temperature rose above 40°C and the highest recorded temperature was 45°C on 22ndJune 2015.The heat index of 50°C throughout the week was the highest on 20thJune 2015,which left devastating effects on city dwellers as they suffered from various heat-related illnesses that caused more than 1,200 deaths[4].

Heat stroke is defined clinically when the body's core temperature rises above 40°C and is accompanied by hot, dry skin and central nervous system abnormalities such as delirium, convulsions or coma[5].Data on heat-related illnesses with a focus on mortality in the ER has been reported previously from our center. However, the study does not focus on factors associated with the heat-related illness.[6] Risk factors for heat stroke such as environmental issues, compromised health, comorbidity (hypertension, diabetes, stroke, ischemic heart disease), drug use and medications have been reported in literature.[7] Factors associated with a decreased risk were the use of home air conditioning, spending more time in air-conditioned places, and living in a residence well shaded by trees and shrubs.[8]We conducted this study to elucidate patient-related factors during the increase in hospital emergency admissions for severe

heat-related illnesses in a tertiary care hospital. Additionally, we sought to determine the district and type of residence of the patients suffering from heat-related illness.

Patients/Methods and Results

This descriptive case series study was conducted on 134 patients admitted in the department of medicine at the Aga Khan University Hospital with heat-related illnesses from 19th June 2015 to 27th June 2015.All patients aged >18 years were suffering from heat-related illnesses that included heatstroke, exhaustion, syncope and cramps. Those patients with hyperthermia due to infections or other medical illnesses with hyperthermia, such as neuroleptic malignant syndrome were excluded. Data was extracted as per International Classification of Diseases, 9th revision, Clinical Modification (ICD-9-CM) code 992.0 using "Heat stroke", "Heat exhaustion" and "sunstroke." Permission was taken from the Ethical review committee of the Aga Khan University and the Ethical approval number 3291-MED-ERC-15 was given for our study.

Heat stroke is defined as a rising core body temperature against a failing thermoregulatory system (above 40°C) accompanied by hot, dry skin and CNS abnormalities, such as delirium, convulsions or coma. Heat syncope is defined as fainting due to peripheral vasodilation secondary to high (40°C) ambient temperature. Heat exhaustion occurs when a patient becomes dehydrated due to nausea and vomiting in a high ambient temperature but the core body temperature remains less than 40°C. Heat cramps are referred to as muscular cramping that occur during exercise in severe heat related to salt deficiency and are usually benign.[9] For simplification we classified heat stroke and heat syncope as heat-related illness in the analysis where needed.

Data on demographics, comorbid conditions including diabetes, hypertension, ischemic heart disease, type of residence, district of residence were also

recorded. The districts of Karachi were classified according to the classification of the Karachi Metropolitan Cooperation.[10]

All analyses were conducted using the Statistical package for social science (SPSS v. 19.1). Multiple Logistic regression was used to calculate OR for risk factors for heat-related illness. OR of >1.2 was considered as significant. Model 1 was adjusted for systolic blood pressure, diastolic blood pressure and pulse. In addition the final model was adjusted for area and type of residence.

A total of 134 patients were admitted at the Aga Khan University hospital, with heat-related illnesses (heat stroke, heat cramps, heat syncope or heat exhaustion). The mean (SD) age of the patients was 66.3(14.5), and 76(56.7%) of them were males. Seventy nine percent of the patients resided in houses and most were from the central district of Karachi. Hypertension was the most common comorbid condition found in 76 (56.6%) patients (Table 1).

Among the heat-related illnesses, heat stroke was present in 86 (64.2%), followed by heat exhaustion in 48 (35.8%), the remaining were suffering from heat syncope 4(3%) and heat cramps 4(3%).Almost 50% of patients required high dependency units for medical care. Mortality from heat-related illnesses was 5(3.7%).Most common complication was an altered mental state found in 78(58.2%) patients, followed by acute kidney injury in 73 (54.5%), electrolyte imbalance (hyponatraemia and hyperkalemia) and acute liver failure in 4.5%.The mean length of hospital stay was 4(3.8) days.

Hypertension (OR 2.0(95 % CI 1.0, 3.6), lack of sleep, food and water intake (OR 1.7(95 % CI 0.8, 3.8) was associated with severe heat-related illness in Model 1. The association remained even after adjusting for blood pressure and pulse in Model 2. In the final model after additional adjustment for area of residence, OR for hypertension was 2.1(95 % CI 1.0, 5.2) and2.5 (1.0, 6.0) for lack of sleep or food or water intake. (Table 2)

We found from this case series that elderly patients, who were hypertensive (taking antihypertensive drugs), and either had lack of sleep or food or water

intake, were more likely to suffer from severe heat-related illnesses (including heat stroke and heat syncope). This was because they did not stop their medications despite low intake and their condition was further aggravated by the heat wave.

Such high mortality due to heat-related illnesses in a densely populated urban setting where health care costs are high for people who hail from relatively low socio-economic background is a cause for deep concern. Also, the lack of urban planning and trees, non-availability of appropriate outlets at regular distances for water intake and a lack of awareness among the general public regarding precautionary measures against heat-related illnesses, can be the contributing factors for such levels of morbidity and mortality. This requires further research.

There have been a few studies that have reported on the factors associated with heat-related illnesses. A study conducted in Indus Hospital during the same heat wave observed mortality in 24 (16%) patients out of the 150 admitted. Majority of the patients, 64.7% were male and older, with a median age of 51.5 years.[9] It was concluded that patients with low diastolic blood pressure, low oxygen saturation and increased shock index, pulse rate, respiratory rate, temperature and low level of consciousness needed intensive management in the Intensive Care Unit (ICU).[(11)] However, the study does not discuss the factors associated with heat-related illnesses in their study. Becker etal discuss the risk factors associated with heat-related illness[(12)] and report them as age more than 65 years, cognitive impairment, comorbidity of heart and lung, lack of air conditioning, urban residency and strenuous physical activity. We hypothesize from this study that those who were on antihypertensive might have had lower blood pressure due to the drug in addition to dehydration, thus contributing to worsening of the heat-related illness.[(13)] We believe that dehydration was a common factor in those whose food or water intake was insufficient while taking antihypertensive drugs. Hence, keeping oneself well hydrated and

reducing the dosage of antihypertensives can be a useful measure for protection of patients suffering from heat-related illnesses.

Conclusion

Severe heat-related illnesses, including heat stroke and syncope during the intense heat waves in Karachi were associated with old age, hypertension and a lack of either sleep or food or water intake.

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Table 1: Demographic characteristics of participants presenting with Heat related Illness

Characteristic	N=134 N (%)
Mean Age (Years)	66.3±14.5
Male gender	76(56.7)
Type of residence	
Apartment	28(20.9)
House	106(79.1)
Location in Karachi (districts)	
Central	46(34.3)
East	29(21.6)
West	4(3.0)

South	21(15.7)
Malir	11(8.2)
Korangi	4(3)
Outside Karachi	19(14.2)
Lack of sleep, food and water intake in past week	51(38.1)
Comorbid conditions	
Hypertension	76(56.7)
Diabetes Mellitus	50(37.3)
Ischemic heart Disease	27(20.1)

Table 2: Predictors of Severe Heat related Illness* in participants

Covariate	**Model 1**	**Model 2****	**Model 3*****
	OR (95 % CI)	OR (95 % CI)	OR (95 % CI)
Age (18-40) yrs.	1(Ref)	1(Ref)	1(Ref)
Age (41-65) yrs.	0.8(0.2,3.2)	1.0(0.2,3.4)	1.0(0.1,3.1)
Age (>65) yrs.	0.6(0.2,1.3)	1.0(0.3,1.3)	1.0(0.2,1.3)
Male gender	1.0(0.5,2.1)	1.0(0.5,2.3)	1.0(0.4,2.3)
Hypertension	2.0(1.0,3.6)	2.1(1.0,5.2)	2.1(1.0,5.2)
Diabetes	1.0(0.2,2.0)	1.0(0.3,1.5)	0.60(0.2,1.5)
Ischemic heart disease	0.7(0.2,2)	1.0(0.3,2.3)	1.0(0.3,2.4)
Lack of sleep, food and water intake in past week	1.7(0.8,3.8)	2.1(1.0,5.0)	2.5(1.0,6.0)

*Severe Heat-related illnesses comprised of heat stroke and heat syncope, non-severe heat-related illness comprised of heat exhaustion and heat cramps)

**Adjusted for Systolic blood pressure, diastolic blood pressure and pulse

***Adjusted for area of residence and type of residence