

The Effect of Season and Temperature Variation on Hospital Admissions for Incident Stroke Events in Maputo, Mozambique

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Background: Identifying locale-specific patterns regarding the variation in stroke incidence throughout the year and with atmospheric temperature may be useful to the organization of stroke care, especially in low-resource settings. *Goal:* We aimed to describe the variation in the incidence of stroke hospitalizations across seasons and with short-term temperature variation, in Maputo, Mozambique. *Methods:* Between August 1, 2005, and July 31, 2006, we identified 651 stroke events in Maputo dwellers, according to the World Health Organization's STEPwise approach. The day of symptom onset was defined as the index date. We computed crude and adjusted (humidity, precipitation and temperature) incidence rate ratios (IRRs) and 95% confidence intervals (CIs) with Poisson regression. *Results:* Stroke incidence did not vary significantly with season (dry versus wet: crude IRR = .98, 95% CI: .84-1.15), atmospheric temperature at the index date, or average atmospheric temperature in the preceding 2 weeks. The incidence rates of stroke were approximately 30% higher when in the previous 10 days there was a decline in the minimum temperature greater than or equal to 3°C between any 2 consecutive days (variation in minimum temperature -5.1 to -3.0 versus -2.3 to -.4, adjusted IRR = 1.31, 95% CI: 1.09-1.57). No significant associations were observed according to the variation in maximum temperatures. *Conclusions:* Sudden declines in the minimum temperatures were associated with a higher incidence of stroke hospitalizations in Maputo. This provides important information for prediction of periods of higher hospital affluence because of stroke and to understand the mechanisms underlying the triggering of a stroke event. **Key Words:** Stroke—Mozambique—temperature—seasons.

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Introduction

There is a large consensus regarding the main stroke determinants but little information on its triggering factors.^{1,2} The understanding of the transient exposures that contribute to the occurrence of a stroke event in a specific moment might lead to the timely implementation of preventive measures and a better allocation of resources for its management.²

Atmospheric temperature has been associated with stroke incidence.³⁻⁶ Despite the evidence is conflicting, some studies showed a higher frequency of stroke in the colder months,^{5,7-12} and sudden temperature changes in the days before the event, both downward and upward, were shown to influence the risk of stroke.^{3,4,13} However, most of the previous investigations were conducted in temperate climate settings of the northern hemisphere and describing these patterns of variation in tropical and subtropical climates may contribute to understand if high temperatures, together with high humidity, result in different biological consequences.^{14,15}

Mozambique is a sub-Saharan country with a subtropical, high humidity (70%-80%) climate, with a dry season between June and September and a rainy season between October and April. The daily minimum temperature varies mostly between 14°C and 22°C and the daily maximum temperature lies in the interval between 25°C and 30°C throughout the year.¹⁶ Although temperatures are fairly high all year round, in Maputo, the clinicians have the perception that the number of patients with an incident stroke admitted to the hospitals is higher in the days after the occurrence of "cold fronts" (a meteorological phenomenon described as being associated with sudden drops in temperature after a record of high temperatures in the previous days¹⁷). Although Mozambique is in its early steps in the epidemiological transition, stroke is already a frequent condition, responsible for high morbidity and mortality.^{18,19} The recognition of an association between atmospheric temperature and the incidence of stroke in Maputo may allow a more efficient allocation of the limited resources available in this setting for an appropriate management of the cases that seek medical attention.^{1,20,21} Therefore, we aimed to describe the variation in the incidence of stroke hospitalizations across seasons and with short-term temperature variation, in Maputo, Mozambique.

Methods

This study was based on the data collected following the STEPS stroke protocol, Step 1 (registration of hospitalized patients) as previously described in detail.^{18,19} During a 12-month period, from August 1, 2005, to July 31, 2006, all patients admitted to any governmental or private hospital in Maputo (the Maputo Central Hospital, 3 general public hospitals, the military hospital, and 6 private clinics), living in town for more than 12 months, and suspected of

having an incident stroke event were registered. Stroke was defined according to the World Health Organization clinical definition: "a focal (or at times global) neurological impairment of sudden onset, and lasting more than 24 hours (or leading to death), and of presumed vascular origin."²² During this period, 651 stroke events were registered in a population of 1.2 million inhabitants.²³ A computed tomography scan or autopsy was performed in 92.3% of the clinically confirmed stroke events, which allowed categorization according to stroke subtype. Date of symptom onset, as stated by the patient or a next of kin, was used as the date of the event (index date) regardless of date of admission.

Data on the temperature in Maputo (maximum, minimum, and mean temperatures for each day) were obtained from the Meteorological Institute of Mozambique, for the period between July 1, 2005, and July 31, 2006, along with mean relative daily humidity (%) and total daily precipitation (mm³) data.

The factors associated with stroke hospitalizations in Maputo were assessed through incidence rate ratios (IRRs), computed using Poisson regression. We computed crude IRR for the associations with the month of the year and the season (dry versus wet) in the index dates of the stroke events and temperature-, humidity- and precipitation-adjusted IRR for the association with different measures of the temperature in Maputo or its short-term variation; the latter are described in detail in the tables and respective footnotes.

All analyses were conducted using STATA, version 11.0 (Stata Corporation, College Station, TX).

The registry of the stroke events was approved by the National Mozambican Ethics Committee, and written informed consent was obtained from all participants or their relatives.

Results

The monthly mean temperatures were highest in February (maximum, 31.7°C; minimum, 22.7°C) and lowest

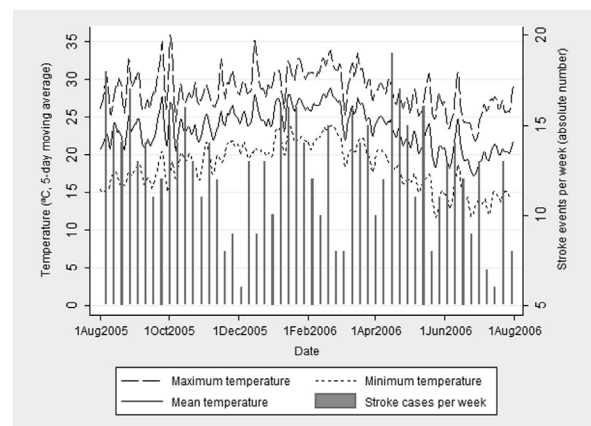


Figure 1. Maximum, minimum, and mean temperature (5-day moving average) and stroke distribution (each bar represents a 1-week period), from August 1, 2005, to July 31, 2006, in Maputo, Mozambique.

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