Heat-Related Mortality in Chicago, Illinois, July 1995

Each year, 148 to 1,700 persons die in the United States either from causes directly attributable to heat, such as heatstroke, or from other illnesses aggravated by excessive exposure to high temperature, such as cardiovascular disease, diabetes, and respiratory diseases.

Although hot weather is beyond human control, heat-related deaths are preventable. Many factors can alter the impact of climate change on mortality, including opening windows, using fans or air conditioners, and going to cooler places. Yet the variation in mortality across populations exposed to similar high temperatures suggests that people may respond to hot weather differently, depending on other parameters, such as knowledge, economic background, lifestyle, and social environment, most of which can affect whole communities.

The purpose of this study was to explain the variation in heat-related mortality in July 1995 among the 77 community areas of Chicago, Illinois, using available data on socioeconomic, demographic and environmental factors. The community was chosen as the unit of analysis because aggregate data were readily available and potential interventions would be most effective if target communities could be identified based on high-risk characteristics.

BACKGROUND

During July 1995, Chicago repeatedly experienced unusually high maximum daily temperatures, ranging from 90° to 104°F (32.2°C to 40.0°C). The heat index, which combines measures of both temperature and humidity, registered a record high on July 13. The Cook County Medical Examiner's Office (CCMEO) began reporting heat-related deaths on July 13. A death was classified as heat-related by the CCMEO if one of the following three criteria was met: 1) core body temperature of the decedent was 105°F or above at the time or immediately after death, 2) substantial environmental or circumstantial evidence of heat as a contributor to death (e.g., decedent found in a room without air-conditioning, all windows closed, and high ambient temperature existed), or 3) decedent was in a decomposed condition without evidence of other cause of death and with evidence that the decedent was last seen alive during the heat period.

METHODS

Data source

Heat-related death records were abstracted from death certificates issued by the CCMEO for those who died in July 1995 with heat as either a primary or a contributing cause of death. Records of all other deaths also were obtained from the CCMEO for July 1995. Counts of all deaths for July 1994 were obtained from the Illinois Department of Public Health.

Independent variables were obtained from death certificates and the 1990 U.S. Census summary tapes of Chicago community areas. From the census data, the following numbers were extracted for each community area: total population, persons 65 years of age and older (aged persons), aged persons living alone, people with a high school education, households owning a car, housing units with more than one person per room, and non-Hispanic blacks and non-Hispanic whites. Also obtained from the census were the median household income, rent, and housing values for each community area.

A search of death certificates at the Illinois Department of Public Health identified the residence of all homicide victims from 1991 to 1994 (International Classification of Diseases, 9th Revision codes E960 to E969) in Chicago. Homicide data were used to measure the extent of hard crime within a community area.

Mortality Measurement

Two mortality measurements were used: the heat-related mortality, as defined by the CCMEO, and excess mortality, as determined by subtracting total deaths in July 1994 when there were no heat waves from total deaths in July 1995 when there were heat waves. Mortality rates were expressed as deaths per 100,000 population.

Geographic Coding and Variable Aggregation

All data were assigned to community areas using a geographic information system (GIS). All deaths were successfully address-matched and aggregated by community area.

ANALYSIS

Both mortality rate measures were evaluated: heat-related mortality rates and excess mortality rates. The variables used to explain the difference in mortality across community areas were selected according to the strength of their association with the outcome variables when each was examined alone. All potential risk factor variables that were significantly associated with an outcome variable at the 0.10 level were included in the multivariate analysis, where the effects of all variables were examined simultaneously. The total population count for each community area was forced into the models to control for the variation in population size among the community areas. Results were considered to be statistically significant when the p value was less than 0.05.

Table 1

PERCENT CHANGE IN MORTALITY[a]

as related to 10 percent decrease in potential risk factors, Chicago, Illinois, July 1995

10% DECREASE IN:	PERCENT CHANGE IN HEAT-RELATED DEATHS	PERCENT CHANGE IN EXCESS DEATH
Aged people living alone	-8.0†	-20.8†
High School Education	3.6	8.1
Median income	1.1	7.1
Homicide	-5.4†	-10.4†
R-square	-0.34	-0.55

[a]All estimates controlled for community area population size.
† p<0.01

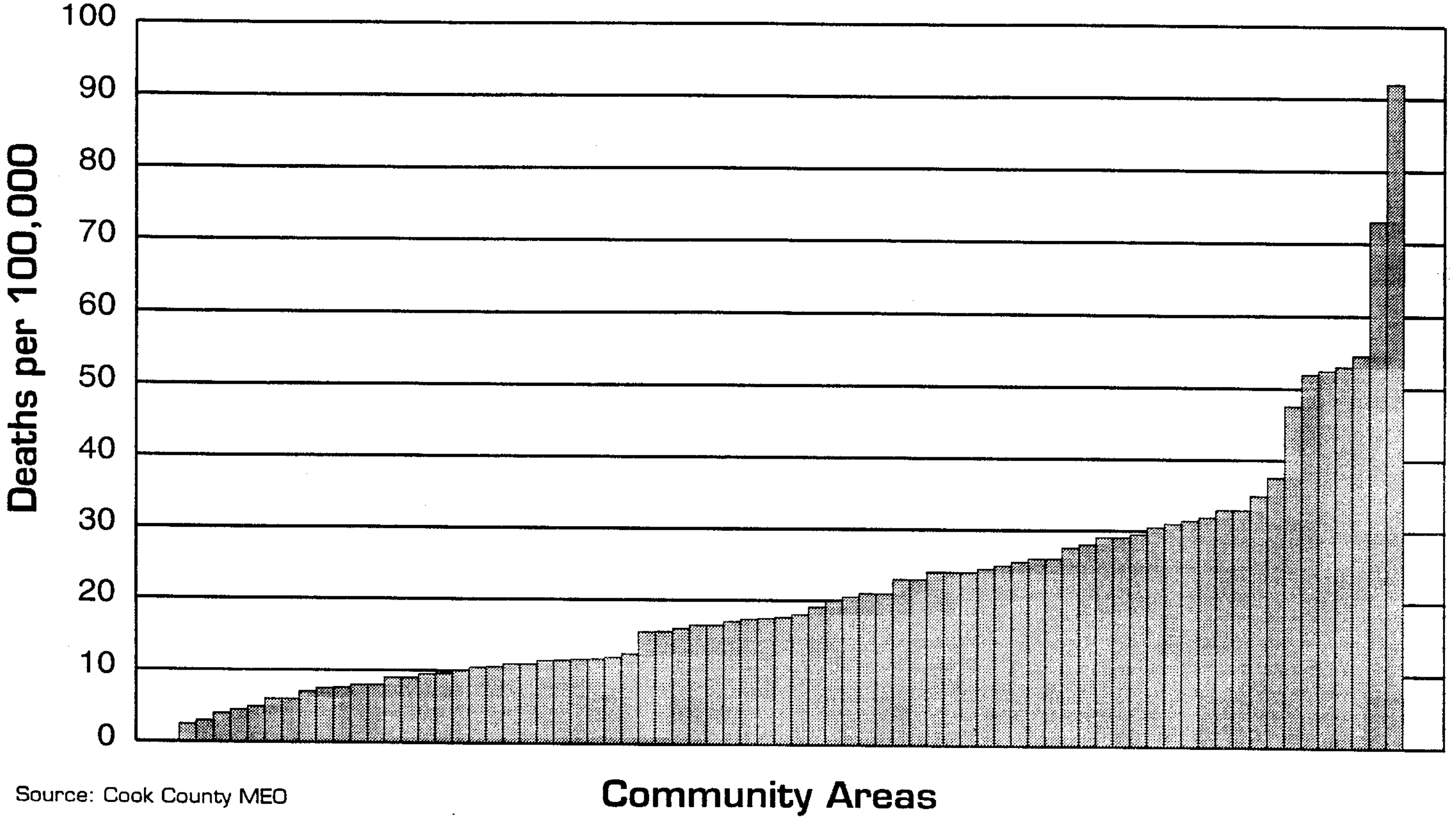
RESULTS

At the time of this study, 536 cases of heat-related deaths were reported by the CCMEO for the city of Chicago for July 1995.

Substantial variation in heat-related mortality existed across community areas even though all were exposed to the same heat waves, as depicted in Figure 1. The heat-related mortality ranged from no deaths per 100,000 population to 90 deaths per 100,000 population.

The best model predicting both excess mortality and heat-related deaths contained five variables: aged people living alone, homicide, median income, high school education, and total population (as a control variable) as shown in Table 1. Aged persons living alone and homicide, as an indicator of hard crime, were significantly associated with heat-related and excess mortality rates. Communities with 10 percent fewer homicides also had 5.4 percent lower heat-related mortality and 10.4 percent lower excess mortality. Similarly, a community area with 10 percent fewer aged persons living alone also had 8 percent lower heat-related mortality and 20.8 percent lower excess mortality. The number of homicides and aged persons living alone were consistently significant predictors of heat related mortality, regardless of which outcome variable was

FIGURE 1. HEAT-RELATED MORTALITY ACROSS COMMUNITY AREAS, JULY 1995



Source: Cook County MEO

used in the model. The model explained 34 percent of the total variation in heat-related mortality across the community areas and 55 percent of the community area variation for the excess death rates.

DISCUSSION

Communities with more aged people living alone had higher heat-related and excess mortality during the July 1995 heat waves. The areas with more homicides also had both more heat-related and excess death rates.

Most descriptive studies have shown that old age in general is a risk factor for heat-related deaths. This study showed that the number of aged people living alone was a better predictor of community-level heat mortality. This sub-group of aged persons may represent not only old age as a risk factor, but also a low level of inter-personal relationships or family support.

A review of other studies revealed that this is the first time homicide has been identified as a risk factor at a community level for heat-related deaths. Homicide rates are an indicator of social environment. These crimes can create fears that influence a person's desire to open windows, leave home, or stay away from home for extended periods. Even during a heat wave, these fears may cause additional reluctance to go to cooling centers or to open windows.

In summary, the number of aged people living alone and the number of homicides were significantly correlated with heat-related and excess mortality rates across Chicago community areas. These two risk factors should be considered in the prevention of heat-related mortality and can be used to identify and target high-risk communities.

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