Mapping social vulnerability to heat wave in Chicago

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In the face global climate change, we increasingly face the likelihood of witnessing more extreme weather events, and in turn, greater risk to disasters. On the other hand, hazards—such as extreme weather events—form only one part of the disaster risk equation. The risk of a disaster is governed by the interaction of *both* a hazard *and* a vulnerable population (Blaikie et al., 1994); without vulnerability, hazards pose no threat, or conversely, without hazards, vulnerable populations are not at risk. While it is crucial to consider both factors in anticipating disasters, most mitigation strategies have mainly focused on the hazard and have overlooked vulnerability, largely assuming that when a hazard strikes, everyone is equally at risk.

Emphasizing that disasters result from the impact of hazards on vulnerable people (Blaikie et al. 1994), and that vulnerability varies differentially across a population (Smoyer-Tomic et al., Cutter et al.), the present study seeks to identify conditions within a population that render specific groups vulnerable to extreme heat events. In particular, we focus on examining vulnerability to heat morbidity in the City of Chicago across a five-year period (i.e., from 2003 to 2007). While we utilize the pressure and release model (PAR) (Blaikie et al., 1994) to frame the larger contention that vulnerability forms half of the disaster risk equation, the present study serves as an initial attempt at examining the spatiality of vulnerability to heat morbidity with the larger goal of shedding light on the broader social processes that produce the "unsafe conditions" (Blaikie et al., 1994) that result in a differential impact on different groups. In that respect, the analyses of our results draw from the "access" model (Blaikie et al., 1994) of disaster vulnerability. The present work parallels the in depth work done by Klinenberg (2002) in his social autopsy of the 1995 Chicago heat wave. The scale of analysis, however, is different. While Klinenberg followed individual accounts as well as compared two neighborhoods within the City during one specific heat event (i.e., 1995 heat wave), the present study, in comparison, examines vulnerability across the entire City over a five-year period, with the hope of uncovering trends across a larger spatial extent, and over recent time. Ultimately, results of the present study, along with climate data, will help anticipate impacts of extreme heat events to groups most vulnerable, and as such, inform mitigation and adaptation strategies for these.

For the present study, we used Census tracts (CT) as the unit of analysis. CT variables from Census 2000 were selected as surrogates for social environmental risk factors based on Smoyer's (1998) and Klinenberg's (2001) work. These selected CT variables served as indices to neighborhood stability (e.g., vacancy rates, renter vs. owner-occupied), economic vitality (e.g., poverty levels, income, reliance on public assistance, property value), quality of dwelling units (e.g,, presence of plumbing units, median room number, proportion of housing units with only one room), as well as the proportion of highly vulnerable individuals (relative to race, age, sex, and isolation) present in a location. Heat and crime incident data were provided by the city of Chicago's Office of Emergency Management and Communications (OEMC) and geocoded using ESRI's (Environmental Systems Research Institute) geocoding function in ArcToolbox. In order

to visually examine how well the different variables correspond spatially, the demographic characteristics and crime incident data were then mapped out along with the locations of the heat-related dispatch (HRD) calls using ESRI's ArcMap. In order to test whether these variables were correlated with the heat incidents, Pearson's product moment correlation was run. Regression analysis was used to quantify how well the variables predict the heat-related emergency dispatches.

Results of our analyses show that in the City of Chicago, the highest number of heat incidents from 2003 to 2007 occurred in areas characterized as recreational, commercial, and tourist destinations (these included areas in and around the Downtown Loop, with the highest numbers recorded in the Grant Park area). This area typically has a greater proportion of transients—such as the homeless as well as tourists—who may not have access to information or the means for coping strategies during extreme heat. Our results also point that in the City, areas with higher incidence of heat morbidity tended to be places with relatively higher crime rate. In times of extreme heat, people in high crime areas who do not own A/C units or who do not have the means to run them, may refuse to venture out and go to cooling stations for fear of personal safety. While heat emergency calls were correlated with crime incidents, the rest of the variables examined were correlated only to a lesser degree with heat incidents; in other words, the variables were not good predictors of heat morbidity across the City. On the other hand, when we pulled out specific sub-areas (e.g., areas with high crime incidents, areas with a large population of elderly, areas with high poverty levels, and areas with a greater proportion of African American), the ability of different combinations of variables to predict heat morbidity improved. This suggests that across the City of Chicago, there is no *one* set of variables that can predict morbidity to heat. We surmise that the spatiality of the distinct neighborhoods in Chicago, along with the variability of the characteristics of the vulnerable populations in these neighborhoods preclude a single model to explain heat morbidity in the City. Given the particularity of places within Chicago, developing mitigation and adaptation strategies for extreme heat events for the City is especially rife with challenges. The implications of the results in relation to the broader social process in the City are discussed.

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