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A Geospatial Analysis of Contributors to Flood Health Behaviors Among Midwest Residents

Kevin J. Boes
https://orcid.org/0000-0002-0881-9788
School of Medicine, Creighton University, USA

Danielle A. Hotalling
School of Medicine, Creighton University, USA

Jack H. Taylor
Creighton University, USA

Timothy C. Guetterman
https://orcid.org/0000-0002-0093-858X
Medical School, University of Michigan, USA

Dhitinut (DT) Ratnapradipa (
School of Medicine, Creighton University, USA

ABSTRACT

Inland flooding poses significant acute and longer-term health risks, but many individuals living in or near floodplains may be unaware of their danger. Major flooding occurred in the Midwest USA during 2019. Our objective was to assess inland flood-related risk reduction behaviors and preparedness in flood-prone communities to inform risk communication and flood education interventions. We mailed a survey to residential addresses in the floodplains of Iowa and Nebraska in 2022 to assess flood knowledge, awareness, and risk reduction behaviors (such as having a flood plan). The 258 survey responses were linked to area-level Social Vulnerability Index (2020) and flood hazard maps to assess whether flood awareness and reduction behaviors were associated with risk. None of the examined factors explained flood-related behaviors well, although area-level race variables and distance from a major city were statistically significant (p<.05) for overall flood-related behavior. More targeted approaches may be warranted.

KEYWORDS

Inland Flooding, Health Lifestyle Theory, Environmental Health, Emergency Management, Risk Perception, Geospatial Analysis

INTRODUCTION

Among other natural disasters, flood events can negatively impact individuals' and communities' quality of life by increasing their risk of negative health outcomes, including injury and loss of life, and compromising individual and community resources. Risk communication professionals can reduce the effects of flood events by promoting flood health behaviors and the development of personal or household flood plans. To do so efficiently, an understanding of factors promoting and inhibiting these flood health behaviors is necessary. This paper examines data from a mailed survey fielded

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to households in Nebraska and Iowa in 2022 using geospatial analysis to identify factors showing significant correlations with respondents' exhibited flood health behaviors. Factors were identified and organized within a framework drawn from Cockerham's Health Lifestyle Theory (Cockerham, 2005). Using insights gained from this analysis, public health and risk communication professionals may be better prepared to develop flood risk communication strategies, which reduce the negative impacts of flood events on their communities.

LITERATURE REVIEW

Flooding Health Risks in the Heartland

Flood events can cause significant property damage and negative health outcomes in coastal and riverine areas. As of 2017, around 280,000 individuals resided in flood hazard areas in Nebraska and Iowa, comprising 8.6% and 3.83% of the population, respectively (*FloodzoneData.Us*, 2017). From 2017 to 2024, there have been 370 and 431 flash flood warnings in Iowa and Nebraska, respectively (Iowa State University, 2024). In that same timespan, there have been 1752 and 1123 total flood warnings in Iowa and Nebraska (Iowa State University, 2024). In the time preceding a flood event, the incidence of traffic accidents and falls can increase as residents evacuate from flood zones (Lane et al., 2013). During flood events, residents experience increased risk of injury and loss of life; furthermore, the post-flood period is characterized by increased incidence of negative health outcomes as residents are exposed to environmental health risks such as decreased air quality or increased contact with displaced wild animals while navigating compromised social and physical infrastructures (Chakraborty et al., 2019; Frumkin, 2010). As a result, flood events represent a significant health risk to residents of riverine areas such as those present in Nebraska and Iowa.

Household Flood Plans: Improving Flood-Related Health Outcomes

To reduce the risk of adverse health outcomes resulting from exposure to flood events, emergency flood plans can provide a potential framework for action. Such plans catalogue needed resources and coordinate prospective actions to reduce individuals' or communities' exposure to a flood or mitigate the effects of flood exposure if it occurs. Development of an emergency flood plan at a community level may reduce individuals' likelihood of injury during a flood event, as pre-planned and coordinated evacuation can reduce the likelihood of traffic accidents and falls occurring during evacuation. (Lane et al., 2013)

While state governments are required by the Federal Emergency Management Agency (FEMA) to produce hazard mitigation plans and distribute them to local communities every five years, individual-level guidelines in these plans may not be adapted to a local level or made available to the public (Agarwal, 2022; Boes et al., 2023). In this context, household flood plans may be the largest-scale emergency flood plan available to individuals or communities, which is designed to guide health behaviors. Because of their potential to reduce potential negative flood-related health outcomes, risk communication professionals should seek to increase the prevalence of household flood plan development in the communities they serve.

The Health Lifestyle Theory: Balancing Structure and Agency

Health education interventions aim to reduce flooding impacts by encouraging health-promoting behavior in a population (O'Sullivan et al., 2003). These interventions are often framed within health communication theories such as the health belief model (HBM) or the stages of change model (SoC). The HBM is derived from cognitive theory, which views logical decision-making as the foundation of health behaviors, as well as social process theory, which suggests that health behaviors originate from the attitudes and behaviors of others in one's community (O'Sullivan et al., 2003). These theoretical orientations emphasize individuals' ability to choose which health behaviors they pursue and may only

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