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Keeping Each Other Safe: Who Checks on Their Neighbors During Weather Extremes in Summer and Winter?

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Original Research

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Abstract

Objective: Weather extremes are increasing with climate change and associated with higher morbidity and mortality. Promotion of social connections is an emerging area of research and practice for risk reduction during weather extremes. This study examines the practice of checking on neighbors during extreme summer heat and extreme winter weather. Objectives are to (1) describe the extent of neighbor checking during these extremes, and (2) examine factors associated with neighbor checking.

Methods: We analyze survey data (n = 442) from a primarily low- and moderate- income study sample in a Southeastern U.S. city, using descriptive statistics and logistic regression.

Results: About 17.6% of participants checked on neighbors during extreme summer heat, and 25.2% did so during extreme winter weather. Being middle or older aged and having more adverse physical health impacts were positively associated with neighbor checking, for both extremes. For winter only, having less education was positively associated with neighbor checking.

Conclusions: Community-based partnerships for reducing risk during weather extremes may consider people who are older or have experienced their own adverse health impacts as initial target groups for promoting neighbor checking. Future research should also examine the motivations for, details about, and impacts of neighbor checking in greater depth.

Introduction

In the United States (U.S.), weather extremes are increasing with climate change and harming human health and well-being.[1,2] This paper focuses on 2 kinds of weather extremes: extreme summer heat and extreme winter weather, which have been associated with higher morbidity and mortality, especially among socially vulnerable groups.[2–4] Previous studies have documented several physical health impacts of these extremes, including increased cardiovascular events, exacerbated respiratory conditions, hospitalization, and death.[5–10] Though fewer in number, previous studies have also documented mental health impacts of these extremes including greater anxiety, depression, and psychiatric admission.[11–15]

A pressing question for public health is how to keep people safe during these particular weather extremes. An important strategy is public provision of forecasts and alerts for weather extreme events by the National Weather Service (NWS), which aims to inform and influence individual, household, and organizational safety decisions.[16] Challenges to the effectiveness of NWS messaging include reaching people through new channels such as social media[16,17]; making messages concise, targeted, and tailored to the event and audience[17,18]; integrating social science understanding of human behavior into hazard communications[19]; and recognizing that public health impacts may occur at lower thresholds than those set for NWS alerts.[20]

Another public health strategy is city or county operation of cooling centers in summer, and warming centers in winter, in response to specific weather extreme events as they occur. Drop-in use of these centers can keep people safe, yet critical barriers to their utilization can include lack of public awareness that they are available, inadequate promotion of their availability, lack of transportation for people to get to the center, and underestimation of personal health risk during an extreme weather event.[21,22]

Household emergency preparedness is a third and proactive public health strategy to keep people safe during weather extremes. A 2012 literature review emphasizes how household preparedness is dynamic,[23] (e.g., shaped by shifting hazard contexts and social vulnerabilities) and complex (e.g., shaped by often intersecting individual, household, community, and institutional factors). Having an emergency plan and emergency supplies on hand is recommended. Also, the links between household and community preparedness are seen as key, as information and resource sharing among members of the same community (for example, about the NWS advisories or cooling or warming centers described above) can be an important mitigation strategy.

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In a more recent review, Ramsbottom and colleagues emphasize that community preparedness and capabilities are often overlooked,[24] with more attention given to institutional capabilities instead. The potential of community engagement, understanding networks within communities, and tapping into the strength of connections or ties among neighbors, who may, for example, check in on, and provide support to each other via phone or in person, are seen as promising strategies for enhancing individual, household, and community resilience to hazards, including the 2 kinds of weather extremes that are the focus of this paper.[23–25]

Social connections among community members are 1 form of social capital that is an emerging area of research and practice for keeping people safe during weather extremes.[26,27] Such connections are a bonding form of social capital which, in the context of a weather extreme event, may help people access resources and strengthen both personal (individual or household) and community resilience.[26,28] For example, such connections could help lower social isolation and adverse mental health impacts among older adults, facilitate access to cooling or warming centers for people who do not have or who are hesitant to use their own air conditioning or heating out of financial concerns, serve as a form of outreach that helps people access health care for adverse physical health symptoms before an emergency situation occurs, or help bring organizational or government attention to a community that may be overlooked but where many people are experiencing adverse effects of extreme weather.[27,29,30]

The particular practice of checking on neighbors during weather extremes has been sparsely studied, despite the potential public health safety impacts that this practice may have.[29] In order to address this important knowledge gap, the present study aims to (1) describe the extent of neighbor checking during extreme summer heat and extreme winter weather, among a primarily low- and moderate- income population, and (2) examine what factors are associated with the self-reported behavior of neighbor checking. Informed by better understanding of the extent and pattern of who checks on their neighbors during weather extremes, this study can inform practices for engaging more people in neighbor checking; hence further developing this as a public health strategy for keeping people safe during extreme summer heat and extreme winter weather.

Methods

Data source

The data used in this study are from a larger survey of weather extremes and health conducted by the first author from August to November 2016 in Knoxville, Tennessee.[31] Knoxville is a medium-sized city, has a humid subtropical climate, and is projected to experience increasing hot days due to climate change as well as greater severity of winter storms when they occur.[31]

Randomly-selected residents of 25 census tracts in Knoxville were recruited through a 4-contact approach: postcard, letter and survey, follow-up postcard, follow-up letter and survey. Census tracts were included if their median household income was at or below the city median (based on 2010–2014 Census estimates) of $33494. A census tract that met the income threshold was excluded because it houses primarily undergraduate students at the University of Tennessee. In another census tract, we oversampled to try and reach Spanish-speaking participants; all study materials were mailed to residents of this tract in both Spanish and English. The survey response rate was 24.3%, with 442 completed surveys returned. The University of Tennessee Institutional Review Board approved the study procedures for ethical conduct with human subjects (UTK IRB-16-03029-XP).

Measures

The larger survey asked 56 questions related to health impacts, financial impacts, and other experiences related to: 3 kinds of weather extremes (summer heat, extreme winter weather, and heavy rainfall and flooding); concerns and perceptions about climate change; neighborhood relationships; and individual and household demographics. Measures used for the present study are summarized below.

Dependent Variables

We measured the behavior of checking on neighbors with a similarly worded item for each seasonal event. For summer, we asked, "When the temperature in the summer is very hot, which of the following do you do, if any? (check all that apply)," with 1 of several possible response options being, "Check on neighbors to see if they are safe." For winter we replaced the beginning of the item with, "When extreme winter weather occurs, which . . . " and provided the same response options, including checking on neighbors. Earlier in the survey, we described "extreme winter weather" as "unusually cold, snowy, or icy conditions in the winter."

Independent Variables

1) Individual Characteristics: For this study, we included the participant's gender, race or ethnicity, marital status, education level, and age. Gender was captioned as either male or female. For race and ethnicity, participants selected 1 or more responses from the following list: White or Caucasian, Black or African American, Hispanic or Latino, Asian, American Indian or Alaska Native, Other (specify). Responses were then coded into White, Black, or neither White nor Black. Marital status was coded as married or living with a long-term partner (yes/no). Education level was coded as having a high school diploma or less, some college education (including vocational or technical training), or a college degree or more. Age was collected in years and coded into 3 categories based on data distribution and preliminary bivariate associations with the dependent variables: 18 to 39, 40 to 69, and 70 and older.
2) Household Characteristics: We included household income, emergency savings, home ownership, central air in the home, and central heat in the home, as household characteristics. For income, participants selected 1 of 8 levels representing their annual gross household income. Levels ranged from "less than $10000" to "$95000 or more." We treated income category as a continuous variable in regression analyses. Emergency savings, home ownership, central air in the home, and central heat in the home, were each coded as binary (yes/no) variables.
3) Health: We asked participants about their general health with the question, "How would you rate your general health status?", with 5 response options: very poor, poor, neither good nor poor, good, very good. For regression analysis, we collapsed very poor/ poor into 1 group, and good/ very good into another group, based on preliminary bivariate associations with the dependent variables. We also asked 4, similarly-worded items about impacts to physical health and mental health, each by

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season, by asking, "To what extent is your {physical/ mental} health negatively affected by {very hot temperatures in the summer/ extreme winter weather}?" Response options for each of the 4 items were not at all, slightly, somewhat, or very much. For regression analysis, we treated these items as continuous variables.

4) Concern about Climate Change: We asked participants 3 questions about their climate change concerns. Each item began with, "To what extent do you feel concerned about . . . " followed by: (1) " . . . climate change in general?" (2) "climate change in Knoxville?" and (3) "how climate change may impact you and your household?" For each item, participants chose from the following response options: not at all, slightly, somewhat, or very much. We present descriptive results for all 3 items below. For regression analysis, we included only the third item based on preliminary bivariate associations with the dependent variables, and we treated it as continuous.

Analyses

We analyzed the data with SPSS 25.0 (IBM Corp, Armonk, NY). For descriptive results, we applied sampling weights due to oversampling in 1 census tract, bringing our sample size for these results from 442 to 424. In order to address missing data, we created 10 imputed datasets using multiple imputation with fully conditional specification.[32] Descriptive results with imputed versus non-imputed data did not differ meaningfully, thus, we present only imputed results below.

We conducted 2 series of binary logistic regressions to identify factors associated with neighbor checking during weather extremes, 1 series for checking on neighbors in summer heat, and the other series for checking on neighbors in extreme winter weather. For each series, we regressed the dependent variable on the same set of individual characteristics, household characteristics, health, and concern about climate change variables, which were entered into each model sequentially in blocks so that potential changes in associations could be observed with each new block of variables. Model diagnostics included assessing for goodness-of-fit, multicollinearity, and influential outliers; no problematic issues were found.

Results

Characteristics of the Study Sample

Table 1 summarizes the characteristics of the study sample. Compared to the 2015 Census estimates of the adult population in the sampled census tracts, the study sample was more likely to be female (64.0% vs. 52.3%), white (72.6% vs. 66.0%), and have a college degree or higher (35.1% vs. 20.1%) (Table 1).

Half of participants in the study sample reported having household savings, and 51% reported home ownership. Approximately 65% of participants reported good or very good general health status. With respect to health impacts during weather extremes, a greater proportion of participants reported adverse physical health impacts (77% in summer and 66% in winter) than adverse mental health impacts (57% in summer and 53% in winter). More than 80% of participants expressed concern about climate change, with general climate change concerns reported by 84% of participants, area-specific (i.e., Knoxville) concerns reported by 83%, and household concerns reported by 81% (Table 1).

Seasonal neighbor checking

Overall, about 1 in 6 participants (n = 74, 17.6%) reported that they check on their neighbors when summer temperatures are very hot, and about 1 in 4 (n = 107, 25.2%) reported doing so during extreme winter weather. Table 2 presents the percentage of participants who reported neighbor checking by each sample characteristic and by season. The prevalence of neighbor checking during summer heat was higher for participants who are male, are neither White nor Black, are married or living with a long-term partner, have less education, are in the middle age bands, have lower household income, do not have emergency savings, do not own their home, and do not have central air conditioning. For winter, this descriptive pattern was generally similar, substituting central heat for central air conditioning.

In terms of self-reported health, participants who reported that they check on neighbors tended to report that their own general health is in 1 of the middle response categories and also that they experience more mental health and physical health impacts; a pattern which holds across both seasons (Table 2). For concerns about climate change, there is no clear pattern with neighbor checking for participant concern about climate change generally or in Knoxville. However, participants who reported that they check on neighbors tended to also report a higher level of concern about how climate change will impact their own household, and more notably for extreme winter weather than summer heat (Table 2).

Associations with Neighbor Checking During Summer Heat

Older age was consistently associated with a greater likelihood of checking on neighbors during summer heat, as was reporting a higher degree of physical health impacts from summer heat (Table 3). In the final summer model, participants in the middle age band of 40 to 69 years were 5.19 times as likely (95% confidence interval [CI]: 1.90 - 14.23) to check on neighbors as participants 18 to 39 years old, and those aged 70 years or older were 3.79 times as likely to (95% CI: 1.08 - 13.35). For every level increase in self-reported physical health impacts, participants were 1.61 times as likely (95% CI: 1.10 - 2.35) to check on neighbors during summer heat.

Compared to participants with a college degree, those with less education seemed more likely to check on neighbors during summer heat in the first model, which only included individual characteristics. As other variables were added to the model, however, confidence intervals for calculated odds ratios widened, and statistical significance for an education effect was no longer observed (Table 3).

Associations with Neighbor Checking During Extreme Winter Weather

For checking on neighbors during extreme winter weather, associations were consistently found for having less than a college education, being in the middle age band, and reporting a higher degree of physical health impacts from extreme winter weather (Table 4). In the final winter model, participants with a high school diploma or less education were 2.20 times as likely (CI: 1.05 - 4.64) to check on neighbors during extreme winter weather as participants with at least a college degree, and those with some college education were 2.26 times as likely to (CI: 1.16 - 4.41). Participants from age 40 to 69 years were 3.28 times as likely (CI: 1.59 - 6.79) to check on neighbors during extreme winter weather as those from age 18

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Table 1. Characteristics of the study sample (weighted)

Sample Characteristic (n = 424)	%
Individual	
Gender	
Male	36.0
Female	64.0
Race or ethnicity	
White	72.6
Black	20.4
Neither White nor Black	7.0
Married/long-term partner	
Yes	37.7
No	62.3
Education	
High school or less	31.8
Some college/technical/vocational	33.0
College degree or more	35.1
Age, years	
18 to 29	15.1
30 to 39	14.7
40 to 49	15.5
50 to 59	22.0
60 to 69	18.8
70 to 79	9.1
80 and up	4.9
Household	
Income, annual	
Less than $10K	19.8
$10K to < $20K	18.8
$20K to < $35K	22.7
$35K to < $50K	15.8
$50K to < $65K	7.7
$65K to < $80K	5.9
$80K to < $95K	3.5
$95K+	5.8
Has savings	
Yes	49.8
No	50.3
Owns home	
Yes	50.8
No	49.2
Has air conditioning	
Yes	79.6
No	20.4
Has central heating	
Yes	74.6
No	25.5
Health	
General health	
Very poor	2.4
Poor	9.4
Neither good nor poor	23.1
Good	41.2
Very good	24.0
Own mental health affected, summer	
Not at all	42.9
Slightly	29.4
Somewhat	20.9
Very much	6.7
Own mental health affected, winter	
Not at all	47.1
Slightly	27.6
Somewhat	19.5
Very much	5.8
Own physical health affected, summer	
Not at all	22.6
Slightly	30.1
Somewhat	30.2
Very much	17.0
Own physical health affected, winter	
Not at all	33.8
Slightly	29.3
Somewhat	25.3
Very much	11.6
Climate Change Concern	
In general	
Not at all	15.8
Slightly	17.9
Somewhat	33.8
Very much	32.5
Knoxville	
Not at all	16.7
Slightly	21.2
Somewhat	38.7
Very much	23.5
Own household	
Not at all	18.9
Slightly	21.6
Somewhat	35.3
Very much	24.3

to 39 years. For every level increase in self-reported physical health impacts, participants were 1.36 times as likely (CI: 1.01 - 1.83) to check on neighbors during extreme winter weather.

Being married or living with a long-term partner may also be associated with checking on neighbors during extreme winter weather (Table 4). A statistically significant association was observed in the first 3 models, though not the final one. In the final winter model, the odds of checking on neighbors if married or with a long-term partner was 1.74 times (1.00 - 3.03) compared to those not married nor living with a long-term partner.

Discussion

This study provides new knowledge about the practice of checking on neighbors during extreme summer heat and extreme winter weather; a practice which has been little studied but is of growing interest to public health because it builds on social connections to keep people safe during weather extremes. Among our sample of a primarily low- and moderate- income population, we found self-reported rates of checking on neighbors to be 17.6% for extreme

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Table 2. Rates of seasonal neighbor checking by sample characteristic (weighted)

	Summer Heat (n = 74)	Extreme Winter Weather (n = 107)
Characteristic	**%**	**%**
Individual		
Gender		
Male	21.6	26.7
Female	15.4	24.1
Race or ethnicity		
White	17.3	24.3
Black	16.3	26.9
Neither White nor Black	27.8	27.8
Married/long-term partner		
Yes	18.1	29.3
No	17.3	22.6
Education		
High school or less	24.8	33.4
Some college/technical/ vocational	20.2	30.0
College degree or more	8.7	13.4
Age, years		
18 to 29	3.3	11.2
30 to 39	6.1	13.3
40 to 49	29.1	37.0
50 to 59	23.2	29.7
60 to 69	23.4	33.0
70 to 79	16.6	19.0
80 and up	17.8	31.1
Household		
Income, annual		
Less than $10K	25.8	28.5
$10K to < $20K	23.6	32.2
$20K to < $35K	11.8	27.4
$35K to < $50K	16.9	22.9
$50K to < $65K	13.5	19.9
$65K to < $80K	16.8	20.8
$80K to < $95K	8.1	14.9
$95K+	8.3	8.3
Has savings		
Yes	13.7	21.6
No	21.5	28.5
Owns home		
Yes	15.7	24.7
No	19.6	25.5
Has air conditioning		
Yes	15.1	NA
No	27.6	NA
Has central heating		
Yes	NA	24.3
No	NA	28.3
Health		
General health		
Very poor	20.0	10.0
Poor	35.5	37.7
Neither good nor poor	21.8	32.3
Good	17.2	25.3
Very good	7.0	14.9
Own mental health affected, summer		
Not at all	12.6	NA
Slightly	19.4	NA
Somewhat	23.7	NA
Very much	25.0	NA
Own mental health affected, winter		
Not at all	NA	23.0
Slightly	NA	19.4
Somewhat	NA	37.5
Very much	NA	28.3
Own physical health affected, summer		
Not at all	6.3	NA
Slightly	11.8	NA
Somewhat	21.4	NA
Very much	35.8	NA
Own physical health affected, winter		
Not at all	NA	17.2
Slightly	NA	21.6
Somewhat	NA	32.2
Very much	NA	42.7
Climate Change Concern		
In general		
Not at all	16.4	24.4
Slightly	16.0	24.2
Somewhat	19.8	28.1
Very much	16.8	23.2
Knoxville		
Not at all	17.0	24.5
Slightly	15.9	23.1
Somewhat	19.2	27.4
Very much	17.1	23.4
Own household		
Not at all	11.3	16.6
Slightly	18.6	23.2
Somewhat	17.7	29.7
Very much	21.4	27.2

Abbreviations: NA, not applicable.

summer heat and 25.2% for extreme winter weather. This result for summer heat is lower than the 1 other study of neighbor checking for a similar event that we found in the literature: in a national sample of U.S. adults aged 18 and older, Esplin, *et al.*,[29] found that about half of their study participants reported "occasionally" or "often" checking on "family, friends, or neighbors," during a heat wave. Meanwhile, to our knowledge, our present study is the first to report neighbor checking rates for extreme winter weather.

Across both types of weather extremes studied, we found that middle-aged (40 to 69 years) participants were most likely to check

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Table 3. Associations with checking on neighbors, summer heat (n = 442)

Characteristic	Model 1 OR (95% CI)	Model 2 OR (95% CI)	Model 3 OR (95% CI)	Model 4 OR (95% CI)
Individual				
Gender, male	1.36 (0.77 – 2.40)	1.47 (0.83 – 2.63)	1.50 (0.83 – 2.73)	1.57 (0.86 – 2.86)
Race or ethnicity (reference = White)				
Black	0.70 (0.35 – 1.40)	0.65 (0.32 – 1.34)	0.67 (0.31 – 1.42)	0.65 (0.31 – 1.39)
Neither White/Black	1.90 (0.69 – 5.20)	1.91 (0.69 – 5.29)	2.21 (0.76 – 6.47)	2.20 (0.75 – 6.49)
Married/long-term partner	1.12 (0.64 – 1.95)	1.37 (0.74 – 2.54)	1.22 (0.65 – 2.28)	1.16 (0.61 – 2.19)
Education (reference = college+)				
High school or less	**2.68 (1.29 – 5.57)**	1.77 (0.76 – 4.11)	1.63 (0.69 – 3.84)	1.79 (0.75 – 4.30)
Some college	**2.14 (1.01 – 4.52)**	1.75 (0.80 – 3.82)	1.70 (0.77 – 3.75)	1.79 (0.81 – 3.99)
Age (reference = 18 to 39)				
40 to 69	**5.79 (2.27 – 14.75)**	**6.81 (2.59 – 17.93)**	**5.14 (1.88 – 14.06)**	**5.19 (1.90 – 14.23)**
70+	**3.92 (1.26 – 12.21)**	**5.13 (1.56 – 16.91)**	**3.79 (1.09 – 13.25)**	**3.79 (1.08 – 13.35)**
Household				
Income level	–	0.91 (0.74 – 1.14)	0.96 (0.77 – 1.21)	0.97 (0.78 – 1.22)
Savings	–	0.90 (0.46 – 1.78)	0.93 (0.46 – 1.88)	0.93 (0.46 – 1.88)
Homeownership	–	0.65 (0.36 – 1.19)	0.67 (0.36 – 1.24)	0.70 (0.38 – 1.30)
Central air conditioning	–	0.62 (0.32 – 1.17)	0.67 (0.35 – 1.31)	0.67 (0.34 – 1.30)
Health				
General health (reference = neither good/poor)				
Very poor/poor	–	–	1.00 (0.42 – 2.37)	0.97 (0.41 – 2.32)
Good/very good	–	–	1.23 (0.60 – 2.52)	1.21 (0.59 – 2.48)
Mental health impacts, summer	–	–	1.04 (0.76 – 1.44)	1.02 (0.74 – 1.42)
Physical health impacts, summer	–	–	**1.65 (1.14 – 2.40)**	**1.61 (1.10 – 2.35)**
Climate Change Concern				
Own household	–	–	–	1.21 (0.91 – 1.60)

Model 1 was adjusted for gender, race/ ethnicity, marital status, education and age.
Model 2 was adjusted for household income, household savings, homeownership, and central air conditioning, in addition to variables in model 1.
Model 3 was adjusted for general health, summer mental health impacts, and summer physical health impacts, in addition to variables in model 2.
Model 4 was adjusted for climate change concern, in addition to variables in model 3.
Abbreviations: OR, odds ratio; CI, confidence interval.
– = not included in the model.
Bold type indicates statistical significance at $P < 0.05$.

on neighbors. For extreme summer heat, participants aged 70 years and older were also likely to check on neighbors, more so than those aged 18 to 39 years. This general pattern of older age being associated with neighbor checking is similar to results found by Esplin, *et al.*,[29] specific to summer heat. Though the present study cannot shed light on why neighbor checking increased with age, possible explanations may include that with age comes more personal experience with extreme events and their impacts, more longevity and interconnections in a community, and more personal preparation and willingness to share resources during crisis.[33]

Also across both types of weather extremes studied, participants who reported a higher level of negative physical health impacts due to an extreme were more likely to check on neighbors, a finding also similar to Esplin, *et al.'s*,[29] summer-specific study. Again, though the present study cannot interpret why this relationship was observed, it may be that personally experiencing an adverse effect leads to an increased awareness of the risks associated with weather extremes. Experiencing adverse health effects may also motivate impacted individuals to check on others, out of concern that they, too, are being affected. Future research on neighbor checking could include deeper understanding of why people do this (i.e., what their motivations are) which may help inform recruitment of others to do the same.

This study's results for education were mixed. For extreme summer heat, we found an initial association in regression analyses between less education and neighbor checking. However, as more variables were added to the model, no associations were observed between education and neighbor checking. This finding is similar to Esplin, *et al.* for summer heat.[29] For extreme winter weather, less education was more consistently associated with neighbor checking. As this study is one of the first to examine neighbor checking during winter extremes, our education findings should be explored in greater detail in future investigations. A better understanding of the association between education and neighbor checking, particularly among low- and moderate-income communities, can inform public health strategies and interventions during winter extremes. Of note, our study found no other statistically significant associations between other demographic variables such as gender, race or ethnicity, and income; and the practice of neighbor checking during weather extremes.

This new knowledge about the extent of and patterns associated with neighbor checking can inform efforts by public health agencies, emergency planners, and social service or other nonprofit organizations to partner proactively with communities to keep people safe during weather extremes. Coverage of extreme events by local media and NWS offices, for example, might include a message encouraging people to, "Take a moment to check on your

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Table 4. Associations with checking on neighbors, extreme winter weather (n = 442)

Characteristic	Model 1 OR (95% CI)	Model 2 OR (95% CI)	Model 3 OR (95% CI)	Model 4 OR (95% CI)
Individual				
Gender, male	1.01 (0.61 – 1.66)	1.09 (0.66 – 1.81)	1.13 (0.67 – 1.89)	1.17 (0.69 – 1.96)
Race or ethnicity (reference = White)				
Black	0.90 (0.50 – 1.61)	0.87 (0.48 – 1.57)	0.85 (0.45 – 1.59)	0.81 (0.43 – 1.52)
Neither White/Black	1.10 (0.43 – 2.81)	1.08 (0.42 – 2.77)	1.16 (0.44 – 3.04)	1.15 (0.44 – 3.04)
Married/long-term partner	**1.67 (1.03 – 2.71)**	**2.05 (1.20 – 3.52)**	**1.84 (1.06 – 3.19)**	1.74 (1.00 – 3.03)
Education (reference = college+)				
High school or less	**2.81 (1.50 – 5.26)**	2.01 (0.97 – 4.16)	2.03 (0.98 – 4.22)	**2.20 (1.05 – 4.64)**
Some college	**2.66 (1.41 – 5.01)**	**2.21 (1.14 – 4.30)**	**2.17 (1.12 – 4.21)**	**2.26 (1.16 – 4.41)**
Age (reference = 18 to 39)				
40 to 69	**3.02 (1.56 – 5.84)**	**3.37 (1.69 – 6.73)**	**3.16 (1.54 – 6.50)**	**3.28 (1.59 – 6.79)**
70+	2.02 (0.84 – 4.84)	2.21 (0.88 – 5.58)	1.94 (0.73 – 5.12)	1.99 (0.75 – 5.29)
Household				
Income level	–	0.85 (0.70 – 1.02)	0.88 (0.72 – 1.07)	0.89 (0.73 – 1.09)
Savings	–	1.20 (0.68 – 2.12)	1.17 (0.65 – 2.11)	1.16 (0.64 – 2.09)
Homeownership	–	0.85 (0.50 – 1.44)	0.90 (0.52 – 1.54)	0.93 (0.54 – 1.60)
Central heating	–	1.10 (0.62 – 1.94)	1.08 (0.61 – 1.92)	1.07 (0.60 – 1.91)
Health				
General health (reference = neither good/poor)				
Very poor/poor	–	–	0.72 (0.32 – 1.60)	0.69 (0.31 – 1.55)
Good/very good	–	–	1.06 (0.58 – 1.92)	1.05 (0.58 – 1.91)
Mental health impacts, winter	–	–	0.99 (0.73 – 1.34)	0.94 (0.69 – 1.29)
Physical health impacts, winter	–	–	**1.38 (1.03 – 1.85)**	**1.36 (1.01 – 1.83)**
Climate Change Concern				
Own household	–	–	–	1.24 (0.97 – 1.59)

Model 1 was adjusted for gender, race/ethnicity, marital status, education and age.
Model 2 was adjusted for household income, household savings, homeownership, and central heating, in addition to variables in model 1.
Model 3 was adjusted for general health, winter mental health impacts, and winter physical health impacts, in addition to variables in model 2.
Model 4 was adjusted for climate change concern, in addition to variables in model 3.
Abbreviations: OR, odds ratio; CI, confidence interval.
– = not included in the model.
Bold type indicates statistical significance at $P < 0.05$.

neighbors." Programs looking for volunteers to call people who are known to be homebound, socially isolated, or financially insecure might be designed, for example, around targeting more middle-age and older adults as prospective volunteers. When people who experience their own negative health impacts of weather extremes seek care, health care providers can take care to ensure people know what resources are available (e.g., cooling or warming centers, financial assistance for utility bills) and see patients as partners in helping share information about resources more widely.

This latter point about knowledge of resources and referrals may be key. While this study sheds new light, quantitatively, on the practice of neighbor checking, even less is yet known about what happens when someone checks on a neighbor. Informally checking on a neighbor, with no other follow-up or resource provision, may be sufficient and important on its own. It may, for example, provide human connection during a winter storm that helps improve someone's everyday mental health and decrease their sense of social isolation. If the neighbor, however, is in more urgent need of help, is the person who is making effort to check in familiar with resources that are available and how to access them? Further research on these details about how neighbor checking occurs, and what might bolster its effectiveness in protecting public health, is fruitful ground for community-partnered research in this area.

Limitations

Though this study makes important contributions to a sparsely studied area of research and practice, study limitations should be carefully considered when interpreting results. First, the study was administered in a single, medium-sized city in the Southeastern U.S., and sampled a primarily low- to moderate-income population in targeted census tracts. Participants who responded to the survey are not necessarily representative of the general population in those tracts. Second, the survey asked participants about extreme summer heat and extreme winter weather in general, not in a reference to a specific or recent event, thus potential recall bias is important to consider. Third, we used a binary measure of whether participants checked on neighbors (yes/no), when a Likert-like item may have provided more nuance, and we did not include open-ended or qualitative measures which may have helped better ascertain more details about neighbor checking, such as motivation or whether help when a neighbor is found to be in need is provided, for those who responded yes.

Conclusion

In this study of neighbor checking during extreme summer heat and extreme winter weather, we found that people who are older,

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have more of their own adverse health impacts of weather extremes, and have less education (for winter checking only) tend to be more likely to check on neighbors during weather extremes. Although very few studies have examined the practice of checking on neighbors during weather extremes, this practice holds promise as a potential strategy for keeping people safe during extreme summer heat and extreme winter weather. New and mixed methods research, in particular, that examines the motivations for, details about the nature of, and impacts of this practice, will further inform public health strategies that build on social connections, and the valuable role they can play in promoting public health and safety.

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