Resilience and Vulnerability to the Psychological Harm From Flooding: The Role of Social Cohesion

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Objectives. We examined the role of social cohesion as a component of vulnerability and resilience to the psychological distress of flooding.

Methods. A survey collected data from 2238 individuals living in flood-affected areas of England (South Yorkshire and Worcestershire) in 2007. We used Bayesian structural equation modeling to assess factors relating to the latent variables of resilience (years in area, family nearby, and social cohesion) and vulnerability (disruption of essential services, flood risk, and previous flood experience).

Results. Flooding was strongly associated with poor mental health; however, resilience factors (associated with the ability to cope with natural disasters), but not vulnerability, were strongly associated with a reduction in psychological distress.

Conclusions. Resilience and social cohesion were important influences on the risk of developing poor mental health following flooding. Increasing resilience of communities by strengthening social cohesion through measures that increase civic participation and changing land use should be considered as potentially inexpensive and effective defenses against avoidable mental harm that will result from increased climate instability. (*Am J Public Health.* 2015;105: 1792–1795. doi:10.2105/AJPH.2015.302709)

The past decade has seen an unprecedented increase in extreme weather events in the northern latitudes,[1] prominent among which are flooding disasters.[2] The impact of flooding on public safety is obvious, but the burden also extends to psychological harm and other mental disorders.[3–7] For example, following the summer floods in England in 2007, we found that the prevalence of mental health symptoms (psychological distress, anxiety, depression, and posttraumatic stress disorder) was up to fivefold higher among individuals affected by floodwater in the home.[8] Evacuation from the home, disruption of essential services such as water, gas, and electricity, and concern about the effect on personal health and finances as a result of the flood were independently associated with increased risk of mental health symptoms. Although enhancing the resilience of individuals and communities to cope with the increasing threat of natural and manmade disasters is now a recognized public health priority, public health strategies have to look beyond the capabilities of institutions, organizations, and business to maintain or restore essential infrastructure and services and consider also the sociopsychological resources of individuals, families, and neighborhoods to sustain mental health and well-being.[9,10]

Aldrich has cogently argued that research in the social sciences on social capital and social networks is directly relevant to the concept of community resilience in the face of disasters and may help explain the observed variation between neighborhoods in postdisaster recovery.[9] Social capital is still a debated concept, but it may be considered to have 2 main dimensions: structural (engagement in civic activities) and cognitive (perceptions of social relations, trust, and reciprocity). In the latter category, measures of individuals' perceptions of trust in neighbors, reciprocity, and social bonds have been aggregated at the neighborhood level to measure the social cohesion of communities. Using this measure, studies have shown that high levels of social cohesion protect against the impact of neighborhood poverty on mental health.[11,12]

We tested the hypothesis that strong neighborhood social cohesion protects residents from the psychological harm caused by flooding. In doing so, we have addressed a major methodological issue in social cohesion research, which is the possibility of reverse causality in cross-sectional studies.[13,14] Social cohesion survey measures are based on individuals' perceptions, and it is possible that false-positive associations are found because those experiencing poorer mental health may be more likely to view themselves as more isolated and may be more pessimistic about the level of social cohesion in their communities.

METHODS

In June and July 2007, South Yorkshire and Hull, Worcestershire, Gloucestershire, and the Thames Valley areas in England were particularly badly affected by flooding. The national public health protection agency at the time, the Health Protection Agency (now Public Health England), conducted a survey in South Yorkshire (September–October 2007) and Worcestershire (January–February 2008). Local public health staff identified areas with homes that experienced flooding to varying degrees and areas with homes that were not affected; unaffected households were included as controls. Details of sampling and data collection methods have been published.[8] Local directors of Public Health sent out letters of invitation to participate in the survey to "the occupier" of households, outlining a choice of 3 methods to complete the survey: (1) by telephone, (2) online, or (3) by return of a paper questionnaire using a postage-free envelope. In 2 villages in Worcestershire, data collection was carried out by face-to-face interviews, as these areas were small enough for this method of data collection to be feasible. Nonresponders received reminder postcards after 3 weeks.

Demographics and Exposure Variables

The survey, which included data on a range of sociodemographic variables (Table 1), has

been described in detail elsewhere.[8] Variables related to severity of flood exposure were also collected, including whether the homes in a flood-affected area were actually flooded. Psychological distress was measured with the General Health Questionnaire (GHQ-12).[15] A "case" of psychological distress was defined as a score on the GHQ-12 questionnaire of 3 or more. A maximum of 2 missing scores for the GHQ-12 were allowed, with the missing value(s) being imputed as the rounded average for the 11 or 10 completed items. Responses with more than 2 missing GHQ-12 items were omitted from the analysis (n = 47 in South Yorkshire, n = 114 in Worcestershire).

Social cohesion was measured with the Neighborhood Cohesion Scale.[16,17] Each of the 8 questions consisted of a 5-point Likert scale ranging from "strongly disagree" to "strongly agree." Across the literature pertaining to social cohesion and mental health, the use of cross-sectional methods has raised issues about reverse causality[13,14] or same-source bias because of the nature of the constructs. Those experiencing poorer mental health may in turn be more likely to view themselves as more isolated and be more pessimistic about the cohesion in their communities, and vice versa. To address this point, we calculated an area social cohesion score using a standardized census geographical unit, the lower super output area (LSOA), with an average population size of approximately 1500 individuals. Each individual had a score aggregated at the LSOA level for all individuals in that area, other than themselves.

Analysis

We used a Bayesian version (BSEM) of a structural equation modeling (SEM) approach for the statistical analysis.[18] SEM was chosen because of its ability to explore both direct and indirect effects as well as allowing the production of latent variables derived through the correlation structure of directly observed variables. Through the use of SEM, it was possible to explore the latent concepts of resilience and vulnerability, which were not directly measured at the time of data collection. Risk factors identified by Paranjothy et al.[8] were the level of flood waters, reported damage to property, disruption to services, health concerns relating to the floods, and perceived negative impact on finances.

The present analysis initially explored the covariance structure through factor analysis, an iterative principle factor design with varimax rotation. Factor analysis identified 2 clusters of variables conceptualized as resilience and vulnerability. We then regressed these factors upon psychological distress using the BSEM method. We addressed missing values using a Bayesian method in Mplus 6 (Muthén & Muthén, Los Angeles, CA)[19] and Markov chain Monte Carlo simulation.

We assessed the goodness of fit of the models by the positive predictive checking method,[20] which generates a positive predicative *P* value for the overlapping distributions of the real and replicated data—that is, it answers the question, Does the replicated data have a distribution similar to that of the real data? The more similar the data, the better the fit; therefore, a well-fitted model is expected to have 95% confidence intervals for the difference between the observed and the replicated χ^2 values that cross zero and a positive predicative *P* value greater than .05.[18]

RESULTS

Survey response rates were 38% in South Yorkshire and 14% in Worcestershire. The age range for the sample was 16 to 96 years. The mean age of responders was 50 years (SD = 17 years) in South Yorkshire and 57 years (SD = 17 years) in Worcestershire. On the basis of 2001 census data, the age profile of responders was similar to that of the sample populations, although people younger than 36 years were underrepresented and people older than 50 years were overrepresented. Most respondents to the survey were female (72% in South Yorkshire and 57% in Worcestershire). According to data from the Office for National Statistics,[21] 52% of the population in the sample areas were female.

Residents who were flooded were similar to those who were not flooded in terms of the length of time they had lived in the area (20 vs 22 years), the presence of family and friends nearby, and the mean area-level social cohesion (Table 1). The distribution of social cohesion values ranged from 8 to 40 (mean = 29.32; SD = 5.61; median = 30.0; interquartile range = 26.0–33.0). The 8-item Neighborhood Cohesion Scale demonstrated good internal consistency: the Cronbach α was 0.820, with all items loading on to 1 factor, and the Eigenvalue was 3.61, with item loads ranging from 0.64 to 0.78. The Cronbach α for the GHQ-12 was

TABLE 1—Characteristics of Residents of Flooded Property and of Nonflooded Property (n = 2029): England, 2007

Variable	Resident of Flooded Property, No. (%) or Mean ±SD	Resident of Nonflooded Property, No. (%) or Mean ±SD	*P* for Trend
Experienced disrupted services[a]	201 (52.76)	232 (15.33)	< .001
Perceived home to be at risk of flooding[a]	110 (28.50)	204 (12.55)	< .001
Had previous flood experience[a]	90 (24.39)	267 (17.01)	< .001
Years in area[b]	19.90 ±17.38	22.28 ±19.31	.03
Family or friends nearby[b]	337 (88.68)	1388 (85.89)	.18
Social cohesion[b]	29.85 ±1.47	29.83 ±1.75	.85

Note. For illustrative purposes, we dichotomized the level of flooding and categorized "flooding" as any water entering the house.
[a]Factors loading on the vulnerability latent construct.
[b]Factors loading on the resilience latent construct.

0.72. The level of reported psychological distress in the flooded group was 68.9%, compared with 19% in the unaffected group.

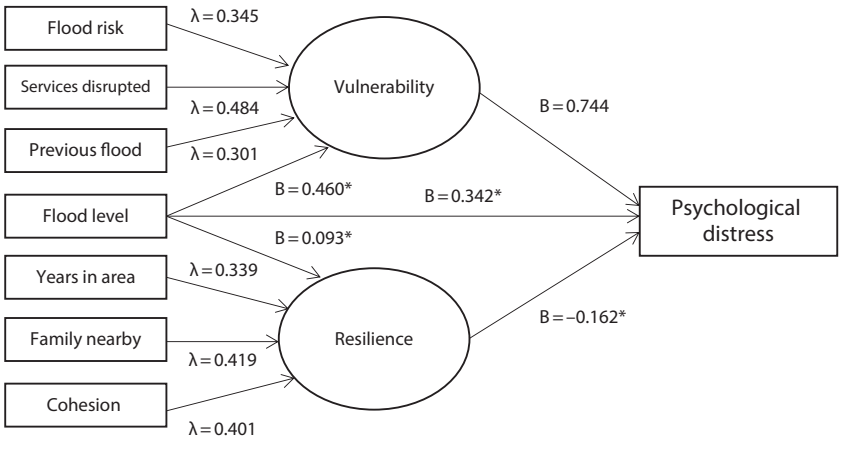
We used SEM to explore the relationship between community-level factors (vulnerability and resilience) and poor mental health (psychological distress). The results from the factor and path analysis are shown in Figure 1. The figure shows both the loadings of the items onto the latent variable, represented by λ, and the parameter estimates, represented by B. Factor loadings represent the degree to which each of the variables correlates with each of the factors, revealing the extent to which each of the variables contributes to the meaning of each of the factors. The boxes refer to directly observed variables, whereas the ovals are latent constructs. The factor loadings for the latent variable of vulnerability were flood risk (λ = 0.345), disruption of services (λ = 0.484), and previous flood experience (λ = 0.301); for resilience, they were years in area (λ = 0.339), family nearby (λ = 0.419), and perceived social cohesion (λ = 0.401). All factor loadings were significant ($P > .005$).

Flood level was positively associated with both vulnerability (b = 0.460; 95% confidence interval [CI] = 0.336, 0.616) and resilience (b = 0.093; 95% CI = 0.008, 0.174), as well as with psychological distress (b = 0. 342; 95% CI = 0.205, 0.444). The standardized BSEM model estimates for the latent constructs regressed on the outcome of psychological distress showed a significant decrease for resilience (b = –0.162; 95% CI = –0.244, –0.079) and a positive but nonsignificant effect on vulnerability (b = 0.744; 95% CI = –0.194, 1.641).

The 95% confidence interval for the difference between the observed and the replicated χ^2 values indicated a good fit (95% CI = –1.565, –60.963; positive predicative $P = .07$).

DISCUSSION

In this study, we sought to examine the influence of concepts of vulnerability and resilience, which are often mooted as important in population health but are inherently hard to measure. The use of SEM allows the exploration of potential causal mechanisms. Our findings suggest that variables relating to the construct of resilience and, in particular, social cohesion are more strongly associated with psychological distress than variables related to vulnerability. In developing a method for assessing social cohesion, we have addressed one aspect of reverse causality in cross sectional studies; where social cohesion survey measures are based on individuals' perceptions, it is possible that false-positive associations are found because those experiencing poorer mental health may be more likely to view themselves as more isolated and may be more pessimistic in their answers about the level of cohesiveness in their communities.



*$P < .001$.

FIGURE 1—Path model of the determinants of psychological distress from flooding: England, 2007.

Social cohesion is thought to influence health in a number of ways: by promoting the adoption and reinforcement of health-related behaviors and by increasing access to resources and amenities.[22,23] Social cohesion also influences the psychological processing of the individual by providing meaningful contact and increasing the sense of purpose and connection with other residents, contributing to more favorable mental health outcomes.[24–26] During times of adversity, when disasters affect the community as a whole, an increase in levels of social cohesion allows for greater interaction and communication, which reduce individual self-reliance and perceived inequity.

Interventions to increase social cohesion have been shown to be effective when they encourage the creation of informal social ties while reinforcing commitment to positive social values.[27] Ecologically based investigations focusing on self-efficacy and enhancing a positive self-concept[28,29] may also be effective. These methods seek to enhance the individual within his or her neighborhood, to develop friendships, and to show the availability of others to help. It needs to be borne in mind, however, that communities with greater levels of cohesion will still have marginalized groups on the periphery that may be significantly disadvantaged.[30]

Strengths and Limitations

We have attempted to quantify, through correlation, the higher-level community constructs from real data gathered soon after a disaster. The levels of reported psychological distress in flooded and unaffected groups were comparable to those of other studies, providing evidence of the external validity of these data.[31] Furthermore, the 8 items on the Neighborhood Cohesion Scale demonstrated good internal consistency, in line with other studies.[11,32,33]

However, there are a number of limitations. The response rate to the survey was 38% in South Yorkshire and 14% in Worcestershire. Although these figures are similar to those reported in other studies of this type,[34] it is possible that those experiencing a more profound reaction to the flooding were more likely to respond, producing an overestimate of psychological distress in the flooded group. However, the prevalence of psychological distress in the flooded group in our study is similar to the

reported levels in other studies of flooding victims,[35,36] suggesting that our results are unlikely to be biased in this way.

Conclusions

Our data suggest that societal adaptation to climate change and the increasing frequency of disasters cannot be adequately addressed just by agencies responsible for disaster planning and management. Purely focusing on the physical safety of populations and the resilience of infrastructure and services will lessen the acute physical harm of disasters. However, to protect and strengthen the psychological health and well-being of communities, attention needs to be given to strengthening social cohesion. ■

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Contributors

G. Greene undertook the analysis and wrote the first draft of the article. S. Paranjothy contributed to the conceptualization and design of the study. S. R. Palmer initiated and led the initial investigation. All authors contributed to interpretation of the data and critical revision of the article.

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Human Participant Protection

The analysis, which reported a secondary analysis of a data set collected by the UK Health Procreation Agency, was not deemed a research project but a Health Impact Assessment; therefore, ethical review was not needed.

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