

Who Participates in Building Disaster Resilient Communities: A Cluster-Analytic Approach

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Context: The Los Angeles County Community Disaster Resilience project is a community-based program to improve disaster resilience. We collected baseline measures of resilience-related attitudes and practices among targeted communities prior to the implementation of the intervention. **Objectives:** This study identified community disaster resilience behavior patterns and assessed their associations with sociodemographic and social cognitive characteristics. **Design:** Telephone surveys during summer 2013. **Setting:** Sixteen communities in Los Angeles County (2 per service planning area). **Participants:** The address-based sample of adults (≥ 18) was selected to be representative of 2010 census tracts in each of the communities. **Main Outcome Measures:** We examined relationships between sociodemographic characteristics, social cognitive factors, and participation in community disaster resilience activities. **Results:** Three clusters of community resilience behavior patterns emerged. Cluster distribution significantly differed across several sociodemographic and social cognitive factors. Participants who were African American, Hispanic, had higher education, income, self-efficacy, trust in the public health department, civic engagement, and social capital were significantly associated with being in the cluster most active in resilience-building activities. **Conclusions:** The results confirm that there are distinct community resilience behavior patterns. These patterns vary according to population characteristics, which supports audience segmentation approaches and developing a range of emergency preparedness programs targeted to the strengths and weaknesses of the different audience segments.

KEY WORDS: cluster analysis, community resilience, emergency preparedness

For many decades, personal disaster preparedness has been the critical element of citizen engagement in community disaster readiness.¹ Communication campaigns aiming to improve self-sufficiency have emphasized that each household should have a disaster kit and plan.^{2,3} A vast literature on preparedness has focused on the household prevalence of disaster supplies and emergency plans.^{1,4,5} How household-level self-sufficiency relates to population characteristics and social cognitive factors is thus well researched. Generally, persons who are older, have higher socioeconomic status, non-Latino white, speak English, and are in good health are more likely to have disaster supplies.⁶⁻¹⁰ Self-efficacy, social networks, civic engagement, and locus of responsibility are also influential.¹¹⁻¹⁵

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Community resilience now complements the focus on household preparedness and is a guiding paradigm in several national disaster preparedness directives.¹⁶⁻²⁰ Despite its importance, self-sufficiency in the form of household preparedness is only a single part of the disaster resilience framework. Chandra et al²¹ depict 7 additional levers for action: partnership, access, wellness, education, engagement, quality, and efficiency. These concepts translate into a variety of community-based activities such as talking with neighbors about disaster planning and volunteering with neighborhood organizations to improve the community's overall readiness.²² Emphasizing that people should work together to build capacity enhances a community's ability to mitigate and rebound from disasters.²³

The enthusiasm surrounding community disaster resilience is coupled with numerous "how to" questions, such as how to move beyond the traditional messages of "get a kit and make a plan" and involve the public in building resilience.¹⁶ Audience segmentation has been suggested as an approach to better tailor campaigns to the strengths and weaknesses of the population.²⁴ Previous research has identified so called "lions" of preparedness, actively prepared persons who perceive themselves to be leaders in a disaster.^{24,25} Identifying these resilient individuals and targeting them for community leadership roles could prove more effective than implementing uniform approaches. Furthermore, since social cognitive factors influence household disaster preparedness, it may be valuable to know how these traits are associated with participating in a broader range of community resilience activities. Community programs promoting resilience behaviors should be guided by an understanding of which attitudes and beliefs influence adoption of these behaviors.

Cluster analysis is a statistical technique useful for audience segmentation as it identifies subgroups of individuals who share similar behaviors, beliefs, or outcome variables. For instance, cluster analysis has been used in risk behavior research to identify subgroups who share lifestyle risk factors such as binge drinking, smoking, physical inactivity, and psychological stress.^{26,27} Applying cluster analytic methods to understand community resilience activities might be similarly useful in designing programs to enhance community disaster resilience.

This study uses cluster analysis to (1) identify community disaster resilience behavior patterns in Los Angeles County and (2) study how sociodemographic and social cognitive characteristics are associated with such behavior patterns. Our goal is to discern typologies of attitudes, behaviors, and demographics that may be useful in segmenting audiences and tailoring community resilience programming.

● Methods

Background

The Los Angeles County Community Disaster Resilience project is a community-based program to improve disaster resilience. Sixteen communities were randomly assigned to receive an experimental community resilience program or a comparison program focusing on traditional preparedness (see reference Eisenman et al²⁸ for a complete description of the project). We surveyed adult residents (≥ 18) of the involved communities at baseline to measure their resilience-related attitudes and practices prior to the intervention. The address-based sample was selected to be representative of 2010 census tracts in each of the communities. The Public Health Response to Emergent Threats Survey was administered by landline and mobile telephone in English, Spanish, and Korean between June 3 and August 7, 2013. Survey questions were drawn from published studies and planned national surveys and modified to fit this project's evaluation.^{15,21-31} The study protocol was reviewed and approved by an institutional review board of the Los Angeles County Department of Public Health.

Measures

The Public Health Response to Emergent Threats Survey assessed participation in 10 community disaster resilience activities, as well as the following social cognitive variables: self-efficacy, perceived benefit of disaster preparedness, locus of responsibility, trust in the county public health department, civic engagement, and social capital (see Supplemental Digital Content Appendix for survey questions, available at <http://links.lww.com/JPHMP/A193> and <http://links.lww.com/JPHMP/A194>). We also measured sociodemographic characteristics including gender, age, race/ethnicity, income, education, marital status, language most used in home, perceived general health, and activity limitations.

Statistical analysis

The data were weighted using raking ratio estimation. The population benchmarks for age, sex, and race/ethnicity were based off of the 2010 census blocks for each of the 16 communities. We imputed missing values in the weighting variables using the modal responses for each community prior to raking. Raked weights were trimmed at the 2nd and 98th percentiles to reduce variance.³²

A 2-step approach was used to identify community disaster resilience behavior patterns. First, factor

analysis using principal component extraction identified overarching behavior themes among the 10 survey questions of interest. We determined the number of factors using the Scree Test and a factor loading of at least 0.40 after Varimax rotation. Standardized component scores were then produced for each of the factors and used in the cluster analysis.

Second, Ward's hierarchical cluster method was used to determine how participants cluster by community resilience behaviors. We used the goodness of fit metrics—distance between cluster centroids, maximum distance from seed to observation, pseudo F statistic, overall R^2 , and cubic clustering criterion—to identify the number of distinct clusters.

Next, we examined the frequencies of the sociodemographic and social cognitive characteristics in each of the clusters, with χ^2 tests assessing statistically significant differences in proportions ($\alpha = .05$). We categorized self-efficacy, perceived benefit of preparedness, and trust in the department of public health as “high” or “low” by adding up the scores of their measures and then dichotomizing the values at the median. Each of the variables that demonstrated a significant difference among clusters at the bivariate level were then included as covariates in a multivariable logistic regression model with being in the most active community resilience cluster as the outcome. Odds ratios (ORs) were then generated for the variables in the model. We explored potential interactions between demographic and cognitive variables using 3-way crosstabs and including interaction terms in the regression model. All analyses were conducted using SAS software, version 9.4 (SAS Institute, Inc., Cary, North Carolina).

● Results

Survey data from 4700 respondents were included in this analysis (35% response rate). Factor analysis identified 3 types of community resilience behaviors: (1) household self-sufficiency, (2) information seeking and exchange, and (3) community capacity and skill building. These 3 factors accounted for 50.29% of the variance. Household self-sufficiency included having a 3-day supply of water and nonperishable food, having a household plan to reunite, and buying additional emergency supplies. Information and exchange consisted of attending a community meeting to discuss preparedness, talking with a neighbor about preparedness, and looking for information about preparedness. Community capacity and skill building involved attending first aid/cardiopulmonary resuscitation (CPR) or psychological first aid training and volunteering to help their neighborhood prepare for a disaster (Table 1).

Three stable patterns emerged from the cluster analysis. The majority of participants fell within cluster 1 (59.06%), the Inactive Cluster, which was characterized by low participation in all 3 community disaster resilience behaviors. Less than 5% of participants in this cluster indicated attending first aid, CPR, or psychological first aid training; working or volunteering with the neighborhood to help prepare for a disaster; attending a community meeting discussing preparedness; or talking with a neighbor about preparedness. While the Inactive Cluster possessed higher frequencies of self-sufficiency behaviors, the proportions were still substantially lower than the other clusters.

Conversely, cluster 2, the Very Active Cluster, which contained 16.24% of the participants, demonstrated a

TABLE 1 ● Percentages of Disaster Preparedness Behaviors in Each Cluster, Public Health Response to Emergent Threats Survey 2013 (N = 4700)

Factors	Inactive Cluster	Very Active Cluster	Medium Active Cluster
Household self-sufficiency			
Has 3-d supply of water	48.31	74.27	74.96
Has 3-d supply of food	58.19	83.30	83.79
Has household plan to reunite	29.56	69.45	63.97
Bought additional emergency supplies	31.52	72.93	77.04
Information seeking and exchange			
Attended community meeting discussing preparedness	3.12	34.69	18.20
Talked with a neighbor about preparedness	4.37	32.26	43.75
Looked for information regarding preparedness	7.20	56.47	82.86
Community capacity and skill building			
Attended first aid, CPR, etc, training	3.15	97.83	1.65
Attended psychological first aid training	1.66	26.08	2.76
Worked or volunteer to help neighborhood prepare/respond to a disaster/emergency	3.57	33.40	13.42

Abbreviation: CPR, cardiopulmonary resuscitation.

behavior pattern of high participation across all 3 factors. In particular, this cluster had high levels of community capacity and skill building, with 97.83% attending a first aid or CPR training. Over one-third of the Very Active Cluster participants also worked or volunteered to help their neighborhood prepare for a disaster and attended a community meeting discussing preparedness.

Cluster 3, the Medium Active Cluster, which contained the remaining 24.70% of the participants, possessed a combination of behaviors from the other 2 clusters. It demonstrated high levels of information seeking and exchange as well as household self-sufficiency but lower participation in community capacity and skill building. A summary of the community resilience behaviors in each cluster is located in Table 1.

Chi-square tests found that cluster assignment was statistically significantly dependent on age, race/ethnicity, household income, education, marital status, language most used at home, and perceived health (Table 2). While the majority of participants were in the Inactive Cluster across all sociodemographic characteristics, the Very Active Cluster possessed higher proportions of participants who were 18 to 29 years of age (21.00%), black (20.89%), married or living with a partner (16.99%), English speaking (17.23%), in good health or better (17.77%), and reporting no health limitations (17.08%). The Medium Active Cluster also possessed more people in better self-reported health and without any health limitations, as well as higher frequencies of people who were 30 to 44 years of age (25.84%), white (26.11%), married or living with a partner (26.55%), and Spanish speaking (25.18%). Both income and education possessed an increasing trend for the Very Active Cluster but only income for the Medium Active Cluster.

Cluster categories were statistically significantly dependent on each of the social cognitive factors, except for locus of responsibility (Table 3). A higher frequency of those with low levels of self-efficacy (65.03%), perceived benefit of preparedness (65.59%), and trust in the public health department (62.94%) were in the Inactive Cluster. More than twice the number of people who participated in civic activities in the past year were in the Very Active Cluster (22.74%) than those who did not (8.83%). As the number of neighbors that the participants could turn to for a favor increased, so too did the proportion within the Very Active and Medium Active clusters.

Logistic regression demonstrated that after controlling for other covariates, several sociodemographic variables were statistically significantly associated with being in the Very Active Cluster (Table 4). African Americans (OR = 1.87, 95% confidence interval [CI] = 1.38-2.52) and Hispanics (OR = 1.33, 95%

CI = 1.04-1.70) had significantly higher odds of being in this cluster than those who are white. Higher income and education levels also had significant positive associations with being in the Very Active Cluster. Older participants, on the contrary, were less involved in resilient activities. Participants from predominantly Spanish-speaking households (OR = 0.73, 95% CI = 0.55-0.97) had statistically significantly lower odds of being in the Very Active Cluster than those speaking English.

Those with high self-efficacy (OR = 2.34, 95% CI = 1.94-2.84) and trust in the public health department (OR = 1.39, 95% CI = 1.16-1.66) were significantly positively associated with being in the Very Active Cluster. Having 10 or more neighbors to ask for a favor (OR = 1.70, 95% CI = 1.04-2.78) and engaging in civic activities in the past year (OR = 2.36, 95% CI = 2.15-3.18) also statistically significantly increased the odds.

While there was little evidence of statistically significant interactions in the multivariable model, 3-way crosstabs revealed certain racial cluster trends across social cognitive variables. Most notably, more than 3 times the number of African Americans and Asians who participated in civic meetings or activities within the past year were in the Very Active Cluster in comparison to those who did not. Cluster assignment was also significantly dependent on race at a high level of trust in the public health department, but the effects were mitigated at a lower level of trust (Table 5).

● Discussion

Overall, the results confirm that community disaster resilience activities can be divided into discrete domains, which manifest into different behavior patterns at the local county level. These patterns vary according to sociodemographic and social cognitive characteristics, supporting more targeted emergency preparedness campaigns and programs that address the strengths and weaknesses of the different audience segments.

Reducing the community resilience activities into (1) household self-sufficiency, (2) information seeking and exchange, and (3) community capacity and skill building helps illustrate the overarching structure of the community resilience framework. The second and third factors are especially salient as they expand upon traditional household activities to include a more community-oriented approach. Information seeking and exchange emphasizes community-level preparedness by focusing on sharing information and strategies with neighbors. Community capacity and skill building describes how community members volunteer and

TABLE 2 ● Percentages of Sociodemographic Variables Within Each Cluster, Public Health Response to Emergent Threats Survey 2013 (N = 4700)

Variable	Inactive Cluster	Very Active Cluster	Medium Active Cluster
Gender			
Male	58.26	15.54	26.19
Female	59.53	16.66	23.82
Age, y ^a			
18-29	55.94	21.00	23.06
30-44	58.59	15.57	25.84
45-59	55.91	18.79	25.31
60+	63.07	13.13	23.80
Race/ethnicity ^a			
White	58.54	15.36	26.11
African American	57.49	20.89	21.63
Asian	63.53	15.50	20.97
Hispanic	60.05	15.82	24.13
Other	59.49	16.12	24.39
Household income ^a			
<\$10 000	66.52	12.37	21.11
\$10 000-\$29 999	63.96	13.24	22.80
\$30 000-\$49 999	59.93	16.50	23.57
\$50 000-\$99 999	53.25	19.73	27.02
≥\$100 000	45.96	23.72	30.31
Education ^a			
Some high school or less	66.83	10.18	22.99
High school graduate/GED	64.61	14.71	20.68
Trade school/some college/associate degree	59.14	17.95	22.91
College degree and above	51.64	18.90	29.46
Marital status ^a			
Married/living with a partner	56.46	16.99	26.55
Divorced/separated	65.70	14.26	20.04
Widowed	64.27	14.60	21.13
Never married	60.38	15.98	23.64
Language most used in home ^a			
English	57.86	17.23	24.91
Spanish	61.55	13.27	25.18
Other	65.60	16.06	18.35
Perceived health ^a			
Poor/fair	68.45	11.66	19.89
Good/very good/excellent	56.04	17.77	26.20
Any health limitation ^a			
No	57.53	17.08	25.39
Yes	67.29	11.75	20.96

^aChi-square test demonstrates a statistically significant difference among clusters at .05 α level.

attend community events, which helps them build relationships with their neighbors while learning tangible skills that can be used to help others.

Using these 3 factors, cluster analysis revealed 3 behavior patterns among the study population. The majority of respondents were in the Inactive Cluster, which reflects findings reported in previous US studies exam-

ining household preparedness.^{1,4} Most people do not actively participate in either personal or community-oriented disaster preparedness and thus may possess barriers to engaging in these activities. Alternatively, participants in the Very Active Cluster are already participating in all 3 resilience behaviors, representing potential community leaders for preparedness. The

TABLE 3 • Percentages of Social Cognitive Variables Within Each Cluster, Public Health Response to Emergent Threats Survey 2013 (N = 4700)

Variable	Inactive Cluster	Very Active Cluster	Medium Active Cluster
Self-efficacy ^a			
Low	65.03	11.99	22.98
High	43.48	27.37	29.14
Perceived benefit of emergency preparedness ^a			
Low	65.59	13.69	20.72
High	49.00	20.18	30.82
Locus of responsibility during emergency			
Government mostly	65.10	13.30	21.61
Equal	57.93	17.13	24.94
My own mostly	58.54	16.46	25.00
Trust in public health department ^a			
Low	62.94	14.12	22.94
High	53.82	19.11	27.06
Civic engagement in past 12 mo ^a			
No	71.20	8.83	19.97
Yes	48.44	22.74	28.82
How many people in neighborhood could you ask for a favor? ^a			
0 people	77.86	9.92	12.21
1-5 people	64.89	12.80	22.31
6-10 people	49.06	20.82	30.12
10+ people	42.86	25.74	31.40

^aChi-square test demonstrates a statistically significant difference among clusters at .05 α level.

emergence of the Medium Active Cluster revealed a more nuanced resilience behavior pattern. While these people are actively seeking emergency response resources, they are less involved in working with community members to develop skills.

The Very Active Cluster members are demographically different from the other clusters. Most notably, 20.89% of African Americans were in this cluster, which increased their odds by 82.4% in comparison to white participants. One potential explanation is that the African American population may be involved in faith-based organizations that promote community resilience. Extensive research has documented the high religious involvement among this population, with churches historically playing a central role in community empowerment.³³⁻³⁶ Faith-based organizations are key actors in emergency preparedness and response as they are embedded and trusted in the community.³⁷ This explanation is further supported by the pronounced racial trend among those who participated in meetings or activities with churches or other civic organizations in the past year (Table 5). Interestingly, we also saw this same trend disappear among those with low trust in the public health department. Historical racism, such as the Tuskegee syphilis experiment, may be contributing to this interaction effect.³⁸ Such dras-

tic differences in cluster distribution across trust levels were not seen for other racial groups, demonstrating that government distrust among African Americans may hinder disaster preparedness.³⁹

The increasing income and education trends for both the Very Active and Medium Active clusters suggest that community resilience is linked to socioeconomic status. These results mirror past literature examining predictors of household preparedness, demonstrating that these resources are also tied to more active community participation in disaster resilience activities.⁹⁻¹¹ Similarly, those in worse health were less represented in these active clusters.⁸ Low socioeconomic status and disabled populations likely possess tangible barriers such as resource and physical limitations to attending community-wide meetings and trainings.

The results also demonstrate that language was a significant contributor to cluster group. Those who speak Spanish at home possessed the highest frequency in the Medium Active Cluster and the lowest frequency in the Very Active Cluster. Here, the nuanced distinction between the 2 active clusters becomes clear, with Spanish-speaking persons actively seeking emergency response resources within the community but less involved in neighborhood events. One possible explanation is that community activities may be mostly held in English

TABLE 4 ● Odds Ratio Estimates From Multivariable Logistic Regression With Being in Very Active Cluster as the Outcome, Public Health Response to Emergent Threats Survey 2013 (N = 4700)

Variables	Odds Ratio Estimate (95% CI)
Race	
White (reference)	...
Asian	1.113 (0.765-1.619)
African American ^a	1.865 (1.382-2.516)
Hispanic ^a	1.328 (1.039-1.697)
Other	1.292 (0.880-1.898)
Age, y	
18-29 (reference)	...
30-44 ^a	0.612 (0.469-0.801)
45-59 ^a	0.705 (0.533-0.933)
60+ ^a	0.527 (0.374-0.743)
Income	
<\$10 000	1.071 (0.733-1.565)
\$10 000-\$29 000	1.078 (0.818-1.419)
\$30 000-\$49 000 (reference)	...
\$50 000-\$99 999 ^a	1.317 (1.003-1.731)
>\$100 000	1.347 (0.988-1.837)
Education	
Less than high school (reference)	...
High school graduate/GED ^a	2.166 (1.439-3.262)
Trade school/some college/associate degree ^a	2.338 (1.539-3.554)
College degree and above ^a	2.131 (1.372-3.308)
Language	
English (reference)	...
Spanish ^a	0.729 (0.550-0.966)
Other	0.930 (0.597-1.448)
Marital status	
Married/living with partner (reference)	...
Never been married	0.945 (0.742-1.202)
Separated/divorced	0.945 (0.650-1.375)
Widowed	1.161 (0.735-1.834)
Perceived health	
Fair/poor	...
Excellent/very good/good	0.814 (0.624-1.061)
Any health limitation	
No (reference)	...
Yes	0.774 (0.542-1.105)
Self-efficacy	
Low (reference)	...
High ^a	2.344 (1.935-2.838)
Perceived benefit of emergency preparedness	
Low (reference)	...
High	0.963 (0.794-1.169)
Trust in department of public health	
Low (reference)	...
High ^a	1.392 (1.164-1.664)

(continues)

TABLE 4 ● Odds Ratio Estimates From Multivariable Logistic Regression With Being in Very Active Cluster as the Outcome, Public Health Response to Emergent Threats Survey 2013 (N = 4700) (Continued)

Variables	Odds Ratio Estimate (95% CI)
Civic engagement in past 12 mo	
No (reference)	...
Yes ^a	2.359 (2.145-3.179)
How many people in neighborhood could you ask for a favor?	
None (reference)	...
1-5 people	0.958 (0.602-1.524)
6-10 people	1.574 (0.964-2.569)
10+ people ^a	1.704 (1.044-2.780)

Abbreviation: CI, confidence interval.

^aStatistically significant at .05 α level.

whereas other preparedness information and resources can be sought from Spanish language sources.^{7,40,41} The language of community-wide events may, therefore, be contributing to lower participation among Spanish speakers.

While almost all of the social cognitive variables were significantly associated with cluster assignment at the bivariate level, the multivariable logistic regression model revealed which characteristics possessed enduring relationships with the Very Active Cluster after controlling for all other covariates. One of the strongest associations was seen for those with high self-efficacy, which more than doubled the odds of being in this cluster. Although self-efficacy is known to predict household preparedness, its influence now extends to a community resilience context. This supports models employed by other researchers. For instance, Paton⁴² uses a framework to illustrate how personal cognitive factors, such as self-efficacy, influence community measures of resilience. Barnett et al⁴³ also demonstrate how efficacy can be used to predict public health workers' willingness to respond to an influenza pandemic using the Extended Parallel Process Model. In this model, the efficacy appraisal is characterized as a combination of self-efficacy and response efficacy, both of which are assessed in our measure by asking about *confidence* and the ability to *help* in a disaster.

Civic engagement was strongly associated with being in the Very Active Cluster, which bolsters evidence that access to social, civic, and religious organizations is important in community disaster resilience.¹⁵ Communities with more active civic organizations may provide a portal for community members to get involved in emergency preparedness. Persons with the highest level of social capital also participated in more community resilient activities. Knowing more neighbors to turn to for a favor likely translates into having

TABLE 5 • Racial Cluster Percentages Across Levels of Civic Engagement and Trust in Public Health Department, Public Health Response to Emergent Threats Survey 2013 (N = 4700)

Race/Ethnicity			Inactive Cluster	Very Active Cluster	Medium Active Cluster
White	Civic engagement in past 12 mo	No	69.75	8.64	21.61
African American			75.88	8.04	16.08
Asian			74.56	7.10	18.34
Hispanic			70.87	9.35	19.78
Other			74.73	9.89	15.38
White	Civic engagement in past 12 mo	Yes	48.87	21.14	29.98
African American			46.78	28.36	24.85
Asian			51.88	24.38	23.75
Hispanic			48.87	22.51	28.62
Other			42.15	23.97	33.88
White	Trust in public health department	Low	61.83	13.32	24.85
African American			64.10	15.38	20.51
Asian			65.95	15.14	18.92
Hispanic			63.94	13.94	22.11
Other			60.00	15.71	24.29
White	Trust in public health department	High ^a	54.54	17.84	27.63
African American			45.26	31.05	23.68
Asian			60.42	15.97	23.61
Hispanic			55.05	18.23	26.71
Other			48.61	22.22	29.17

^aChi-square test demonstrates a statistically significant difference among clusters at .05 α level.

a larger network of people that can share information, skills, and strategies that help with disaster preparedness.

The results from this analysis have implications for health officials designing programs to enhance community disaster resilience. By clustering individuals into groups with homogeneous behavior patterns, we learn how to better segment the audience in order to hone in on existing strengths and better reach certain populations. For instance, the Very Active Cluster comprises key leaders in community resilience efforts. Providing these persons with opportunities and resources to organize local community resilience coalitions could help transfer those skills to others in the community. This supports Abramson's "herd preparedness" strategy, which emphasizes providing the highly motivated "lions" with tools to develop formal response structures while encouraging the less active "lambs" to enhance self-efficacy through skill-building activities.^{24,25}

Those in the Medium Active Cluster share similarities with Abramson's "lone wolves" in that they are seeking emergency response information and resources that could benefit themselves and their families but are not developing community-based strategies.^{24,25} These individuals may be less motivated to work with the community and would benefit more from disaster preparedness efforts that focus on providing information about personal preparedness skills.

We have also identified members of hard-to-reach populations in the Inactive Cluster. Community resilience campaigns could target these groups by promoting self-efficacy, civic engagement, and other positively associated social cognitive factors. One strategy could be to host resilience activities at Spanish and Korean churches in Los Angeles in order to get Spanish-speaking and Korean-American populations more involved in community capacity and skill building. Another approach could be to address government distrust among African Americans through the strengthening of partnerships between the public health department and leaders in the black community. By identifying the characteristics of the populations exhibiting different behavior patterns, preparedness efforts can better address the needs of these distinct groups.

Limitations

This analysis is bounded by limitations. Nonresponse bias may be present due to the low-response rate, but we attempted to improve validity by weighting the sample to the population.⁴⁴⁻⁴⁶ Because of the cross-sectional nature of the data, all of the findings must also be interpreted as association rather than causation. Furthermore, the generalizability of the findings is limited to residents of the 16 Los Angeles County

communities participating in the Los Angeles County Community Disaster Resilience Project. However, the varying demographic and geographic characteristics of the study communities provides reasonable insight into community resilience behaviors among diverse populations.

Implications for practice

Our understanding of disaster preparedness is moving beyond the 1-dimensional focus on disaster supplies and family emergency plans. Individuals can do more to increase their preparedness by participating in community disaster resilience activities. Talking with neighbors about disasters provides a social cue for them to get prepared, which increases everyone's resilience. Still, the enthusiasm surrounding community disaster resilience is coupled with uncertainty. Audience segmentation may improve the aim of messages and programs. Our results confirm that cluster analysis at the local level will detect distinct audience segments by resilience behavior patterns. This lends support to recent recommendations against single, national campaigns without local variation.

REFERENCES

1. Levac J, Toal-Sullivan D, O'Sullivan TL. Household emergency preparedness: a literature review. *J Community Health*. 2011;37(3):725-733.
2. Glik DC. Risk communication for public health emergencies. *Annu Rev Public Health*. 2007;28(1):33-54.
3. U.S. Department of Homeland Security. Preparing makes sense, get ready now. Ready.gov. 2011. <http://www.ready.gov/document/preparing-makes-sense-get-ready-now-printer-friendly>. Accessed August 26, 2015.
4. Kohn S, Eaton JL, Feroz S, Bainbridge AA, Hoolachan J, Barnett DJ. Personal disaster preparedness: an integrative review of the literature. *Disaster Med Public Health Prep*. 2012;6(3):217-231.
5. Kapucu N. Culture of preparedness: household disaster preparedness. *Disaster Prevent Manage*. 2008;17(4):526-535.
6. Ablah E, Konda K, Kelley CL. Factors predicting individual emergency preparedness: a multi-state analysis of 2006 BRFSS data. *Biosecur Bioterror*. 2009;7:317-330.
7. Andrulis DP, Siddiqui NJ, Gantner JL. Preparing racially and ethnically diverse communities for public health emergencies. *Health Aff (Millwood)*. 2007;26(5):1269-1279.
8. Eisenman DZ, Zhou Q, Ong M, Asch S, Glik D, Long A. Variations in disaster preparedness by mental health, perceived general health, and disability status. *Disaster Med Public Health Prep*. 2009;3(1):33-41.
9. Canadian Red Cross. *Integrating Emergency Management and High-Risk Populations: Survey Report and Action Recommendations*. Ottawa, Ontario: Canadian Red Cross; 2007. http://www.redcross.ca/cmslib/general/dm_high_risk_populations.pdf. Accessed August 20, 2015.
10. Brouwer R, Akter S, Brander L, Haque E. Socioeconomic vulnerability and adaptation to environmental risk: a case study of climate change and flooding in Bangladesh. *Risk Anal*. 2007;27(2):313-326.
11. Murphy ST, Cody M, Frank LB, Glik D, Ang A. Predictors of emergency preparedness and compliance. *Disaster Med Public Health Prep*. 2009;7:S1-S8.
12. Paek H-J, Hilyard K, Freimuth V, Barge JK, Mindlin M. Theory-based approaches to understanding public emergency preparedness: implications for effective health and risk communication. *J Health Commun*. 2010;15(4):428-444.
13. Eisenman DP, Cordasco KM, Asch S, Golden JF, Glik D. Disaster planning and risk communication with vulnerable communities: lessons from hurricane Katrina. *Am J Public Health*. 2007;97(suppl 1):S109-S115.
14. Paton D. Disaster preparedness: a social-cognitive perspective. *Disaster Prev Manage*. 2003;12(3):210-216.
15. Federal Emergency Management Agency. In: *2009 National Conference on Community Prep. Personal Preparedness in America: Findings From the 2009 Citizen Corps National Survey*. Washington, DC: Federal Emergency Management Agency; 2009.
16. Plough A, Fielding JE, Chandra A, et al. Building community disaster resilience: perspectives from a large urban county department of public health. *Am J Public Health*. 2013;103(7):1190-1197.
17. The White House. *National Security Strategy*. Washington, DC: The White House; 2010.
18. U.S. Department of Health & Human Services. *National Health Security Strategy of the United States of America*. Washington, DC: U.S. Department of Health & Human Services; 2009.
19. U.S. Centers for Disease Control and Prevention. *Public Health Preparedness Capabilities: National Standards for State and Local Planning*. Atlanta, GA: U.S. Centers for Disease Control and Prevention; 2011.
20. Federal Emergency Management Agency. *A Whole Community Approach to Emergency Management: Principles, Themes and Pathways for Action*. Washington, DC: Federal Emergency Management Agency; 2011.
21. Chandra A, Acosta J, Stern S, et al. *Building Community Resilience to Disasters: A Way Forward to Enhance National Health Security*. Santa Monica, CA: RAND Corporation; 2010.
22. Chandra A, Williams M, Plough A, et al. Getting actionable about community resilience: the Los Angeles County Community Disaster Resilience Project. *Am J Public Health*. 2013;103(7):1181-1189.
23. Cutter SL, Ahearn JA, Amadei B, et al. Disaster resilience: a national imperative. *Environ Sci Policy Sustainable Dev*. 2013;55(2):25-29.
24. Abramson D. *Summary Report on Awareness to Action: A Workshop on Motivating the Public to Prepare*. Washington, DC: Federal Emergency Management Agency, American Red Cross; 2013. http://www.fema.gov/media-library-data/20130726-1908-25045-9125/20130311_awareness_to_action_workshop_report_final_508.pdf. Accessed August 20, 2015.
25. Abramson D. Who responds to emergency preparedness messages: the story of lions, lambs, and lone wolves. *Prehosp Disaster Med*. 2010;25(21):S13-S14.

26. Dodd LJ, Al Nakeeb Y, Nevill A, Forshaw MJ. Lifestyle risk factors of students: a cluster analytical approach. *Prev Med.* 2010;51(1):73-77.
27. Busch V, Van Stel HF, Schrijvers AJ, de Leeuw JR. Clustering of health-related behaviors, health outcomes and demographics in Dutch adolescents: a cross-sectional study. *BMC Public Health.* 2013;13(1):1118.
28. Eisenman D, Chandra A, Fogleman S, et al. The Los Angeles County Community Disaster Resilience Project—a community-level, public health initiative to build community disaster resilience. *Int J Public Health Res.* 2014;11(8):8475-8490.
29. Eisenman DP, Williams MV, Glik D, Long A, Plough AL, Ong M. The public health disaster trust scale. *J Public Health Manag Pract.* 2012;18(4):E11-E18.
30. Centers for Disease Control and Prevention. *Behavioral Risk Factor Surveillance System Questionnaire.* Atlanta, GA: U.S. Department of Health & Human Services, Centers for Disease Control and Prevention; 2011. <http://www.cdc.gov/brfss/questionnaires/pdf-ques/2011brfss.pdf>. Accessed August 20, 2015.
31. Statistics Canada. *General Social Survey.* Ottawa, Ontario: Government of Canada; 2011.
32. Little R, Lewitsky S, Heeringa S, Lepkowski J, Kessler R. Assessment of weighting methodology for the National Comorbidity Survey. *Am J Epidemiol.* 1997;146:439-4349.
33. Levin JS, Taylor RJ, Chatters LM. Race and gender differences in religiosity among older adults: findings from four national surveys. *J Gerontol.* 1994;49(3):S137-S145.
34. Taylor RJ, Chatters LM, Jayakody R, Levin JS. Black and white differences in religious participation: a multisample comparison. *J Sci Study Relig.* 1996;35(4):403.
35. Mamiya LH, Lincoln EC. *The Black Church in the African American Experience.* Durham, NC: Duke University Press; 1990.
36. Billingsley A, Caldwell CH. The church, the family, and the school in the African American community. *Journal Negro Educ.* 1991;60(3):427.
37. Joshi P. *Faith-Based and Community Organizations' Participation in Emergency Preparedness and Response.* Durham, NC: Institute for Homeland Security Solutions; 2010. http://sites.duke.edu/ihss/files/2011/12/Faith-Based_DeskStudy_FinalReport_3-16-10.pdf. Accessed August 20, 2015.
38. Gamble VN. Under the shadow of Tuskegee: African Americans and health care. *Am J Public Health.* 1997;87(11):1773-1778.
39. Eisenman DP, Wold C, Setodji C, et al. Will public health's response to terrorism be fair? Racial/ethnic variations in perceived fairness during a bioterrorist event. *Biosecur Bioterror.* 2004;2(3):146-156.
40. Mathew AB, Kelly K. *Disaster Preparedness in Urban Immigrant Communities: Lessons Learned From Recent Catastrophic Events and Their Relevance to Latino and Asian Communities in Southern California.* Los Angeles, CA: The Tomas Rivera Policy Institute and Asian Pacific American Legal Center; 2008. http://trpi.org/wp-content/uploads/archives/DISASTER_REPORT_Final.pdf. Accessed August 26, 2015.
41. Glik D, Harrison K, Davoudi M, Riopelle D. Public perceptions and risk communications for botulism. *Biosecur Bioterror.* 2004;2(3):216-223.
42. Paton DF. *Community Resilience: Integrating Hazard management and Community Engagement.* Launceston, Tasmania, Australia: University of Tasmania School of Psychology; 2005.
43. Barnett DJ, Balicer RD, Thompson CB, et al. Assessment of local public health workers' willingness to respond to pandemic influenza through application of the extended parallel process model. *PloS One.* 2009;4(7):e6365.
44. Kohut A, Keeter S, Doherty C, Dimock M, Christian L. *Assessing the Representativeness of Public Opinion Surveys.* Washington, DC: Pew Research Center; 2012.
45. Carkin DM, Tracy PE. Adjusting for unit non-response in surveys through weighting. *Crime Delinq.* 2015;61(1):143-158.
46. Lynn P. Weighting for non-response. *Sur Stat Comput.* 1996:1205-1214.