



# Gender and Public Health Emergency Preparedness Among United States Adults

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## Abstract

Public health emergency preparedness can improve a community's ability to cope health outcomes associated with environmental disasters and complex emergencies. Previous studies of gender and preparedness have yielded mixed results. The objective of this study was to examine the association between gender and public health emergency preparedness among U.S. adults using data from the behavioral risk factors surveillance system (BRFSS). Data was analyzed from the 2006–2012 BRFSS for 96,137 adults from 10 states. Three self-reported preparedness behaviors were evaluated: household preparedness (3-day supply of water, 3-day supply of food, battery-operated radio, and flashlight), emergency evacuation plan, and 3-day supply of medication. Multivariable log-binomial regression was used to estimate associations between gender and each preparedness behavior. Gender-specific regression analyses were also conducted to identify determinants of public health emergency preparedness. After adjusting for sociodemographic characteristics, women were less likely to report household preparedness (PR 0.71, 95% CI 0.67–0.75) and a 3-day supply of medication (PR 0.89, 95% CI 0.79–0.99) than men. Among women, being divorced, widowed or separated (PR 0.84, 95% CI 0.71, 1.00) and living in a household with children (PR 0.84, 95% CI 0.77, 0.92) was inversely associated with reported household preparedness. This study adds to the epidemiology literature regarding gender and preparedness behaviors in the United States. Future investigations are warranted to confirm these findings and inform practices aimed at improving public health emergency preparedness.

**Keywords** Public health · Gender · Environmental health · Disasters · Emergency preparedness

## Introduction

Natural and human-made environmental disasters present significant public health challenges to affected communities. Recent events in the United States (U.S.), such as Hurricanes Katrina, Sandy, and Harvey have revealed the variety and complexity of community health needs during and after a disaster. In addition to property damage and death, disasters are often accompanied with loss of essential services, interruption of health care, and shortages of food, water, and medical supplies. As a result, the direct and indirect health effects of disasters have ranged from death and acute

illnesses and injuries to the incidence and worsening of physical and mental health conditions [1, 2].

Although disasters and complex emergencies disproportionately impact at-risk populations, women are particularly vulnerable to the adverse effects of disasters [3, 4]. Gender roles may result in limited access to decision-making power and economic resources for women [4]. Furthermore, after disasters, women and girls' vulnerability to domestic violence, sexual violence, and trafficking is exploited and exacerbated [5, 6]. Studies have also shown that disaster-affected women experience adverse reproductive health outcomes [7].

Emergency preparedness has the potential to mitigate the adverse health outcomes associated with disasters and complex emergencies. In the U.S., for example, national public health emergency preparedness campaigns have encouraged residents to prepare for natural and human-made disasters, disease outbreaks, and acts of terrorism [8]. The purpose of these campaigns have been to increase public awareness about preparedness and promote resiliency in the immediate

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period following these events. Thus, examining disparities in public health emergency preparedness can inform work towards improving resiliency and identify potential target populations for preparedness planners [9]. Although studies have shown that men and women experience differential health outcomes following a disaster, previous studies of gender differences in disaster preparedness have yielded mixed results [10]. The objective of the current study was to examine the relationship between gender and public health emergency preparedness in the United States using population-based data from the U.S. Behavioral Risk Factor Surveillance System.

## Methods

### Data Source

The behavioral risk factor surveillance system (BRFSS) is an annual, state-based telephone survey of non-institutionalized adults administered by the U.S. Centers for Disease Control and Prevention (CDC) [11]. The BRFSS is designed to assess health behavioral risk factors among U.S. adults. The BRFSS survey consists of three parts: (1) a core component which includes standard questions asked by all states about the health related behaviors, conditions and perceptions, (2) optional supplemental modules is consisted of questions focused on specific topics, questions varied by different states, and (3) state-added questions, which are added by the states themselves and not evaluated by the CDC [11]. From 2006 to 2010 and 2012, a total of ten states (Alabama, Delaware, Georgia, Louisiana, Mississippi, Montana, Nevada, New Hampshire, North Carolina, Tennessee) administered an optional General Preparedness supplemental module.

### Public Health Emergency Preparedness Behaviors

BRFSS respondents who completed the General Preparedness module were asked the following questions: (1) Does your household have a 3-day supply of water for everyone who lives there?, (2) Does your household have a 3-day supply of nonperishable food for everyone who lives there? (3) Does your household have a working battery operated radio and working batteries for your use if the electricity is out? (4) Does your household have a 3-day supply of prescription medication for each person who takes prescribed medicines? (5) Does your household have a working flashlight and working batteries for your use if the electricity is out?, and (6) Does your household have a written disaster evacuation plan for how you will leave your home, in case of a large-scale disaster or emergency that requires evacuation? Responses to these questions were used to create three dependent preparedness behavior variables. The

first variable, *Household Preparedness*, was created using responses to the first four questions: a 3-day supply of water, 3-day supply of non-perished food, a battery-operated radio with working batteries, and a flashlight with working batteries. A dichotomous (yes/no) variable was created for having all four items compared with having three or fewer items. The second dependent variable, *3-day Supply of Medication*, was based on responses to the 3-day prescription medication question (yes/no, among medication users only). The third dependent variable, *Evacuation Plan*, was also dichotomous (yes/no), and was based on whether the respondents reported an emergency evacuation plan or not. BRFSS respondents who provided non-missing responses to all six general preparedness questions were included in the current analysis.

### Statistical Analysis

Multivariable log-binomial models were generated to estimate the prevalence ratio (PR) and the 95% confidence interval (CI) for the association between gender and each preparedness behavior variable. All models controlled for sociodemographic factors such as age, race/ethnicity, education, income, marital status, the presence of children (age < 18 years) in the household, employment status, urban/rural residence, US region (North, South, Midwest, West), self-rated health, and the presence of a chronic disease or disability. We also stratified our analyses by gender to explore associations between sociodemographic variables and public health emergency preparedness by gender. To account for the complex sampling design of the BRFSS, all statistical analyses were performed with SAS (version 9.4; SAS Institute, Cary, NC, USA) and SUDAANN (Release 11.0; Research Triangle Institute, Research Triangle Park, NC, USA). Ethics approval was not required as the BRFSS is publicly available, de-identified data.

## Results

The final analytical sample consisted of 96,137 respondents (mean age 52.4 years; 48% men, 70% non-Hispanic Whites, 19% non-Hispanic Blacks, 5% Hispanics, and 6% other racial/ethnic groups; 58% some college/technical school education; 23% with annual household income below \$25,000; 63% married; and 43% with children in household). Overall, the prevalence of BRFSS respondents reporting all four Household Preparedness items was 42%. Approximately 24% of respondents had an Emergency Evacuation Plan and 89% of respondents reported a 3-day Supply of Medication (Table 1).

Table 1 presents adjusted prevalence ratios and 95% confidence intervals for associations between gender and public health emergency preparedness behaviors. After

**Table 1** Prevalence, adjusted prevalence ratios (PR), and 95% confidence intervals (95% CI) for public health emergency preparedness behaviors by gender, behavioral risk factor surveillance system, 2006–2012 (unweighted n = 96,137)

Preparedness behavior	Prevalence			Prevalence ratio (women vs. men)	
	Overall Weighted %	Men Weighted % 48.2%	Women Weighted % 51.8%	PR <sup>c</sup>	95% CI
<b>Household preparedness<sup>a</sup></b>					
Yes	42.4	46.8	38.3	<b>0.71</b>	<b>0.67, 0.75</b>
No	57.6	53.2	61.7	1.0	–
<b>Emergency evacuation plan</b>					
Yes	24.2	24.4	24.2	0.94	0.88, 1.00
No	75.8	75.6	75.8	1.0	–
<b>3-day supply of medication<sup>b</sup></b>					
Yes	88.8	89.3	88.4	<b>0.89</b>	<b>0.79, 0.99</b>
No	11.2	10.7	11.6	1.0	–

Bold type indicates statistical significance

<sup>a</sup>Household preparedness items include 3-day supply of water; 3-day supply of food; battery-operated radio; and flashlight with batteries

<sup>b</sup>Among respondents with prescribed medications

<sup>c</sup>Adjusted for age, race/ethnicity, education, income, marital status, the presence of children under age 18 in the household, employment status, urban/rural residence, US region, self-rated health, and chronic disease/disability status

adjusting for sociodemographic variables, self-rated health, and the presence of a chronic health condition or disability, women were 29% less likely than men to report Household Preparedness (PR 0.71, 95% CI 0.67–0.75) and 11% less likely than men to report a 3-day supply of medication, (PR 0.89, 95% CI 0.79–0.99). We found no difference in the prevalence of an emergency evacuation plan between women and men.

Table 2 displays associations between sociodemographic variables and Household Preparedness, stratified by gender. Among both genders, older respondents were more likely to report all four preparedness items than younger respondents (Table 2). Other race (Asians/American-Indians/Alaska Natives) women were more likely report all four Household Preparedness items than White, non-Hispanic women (PR 1.34, 95% CI 1.13–01.60), and men with some college/technical school education were more likely report all four household preparedness items than men with a high school education or less (PR 1.17, 95% CI 1.05–1.30).

Among women, being divorced, widowed or separated (PR 0.84, 95% CI 0.71, 1.00) and living in a household with children (PR 0.84, 95% CI 0.77, 0.92) was inversely associated with Household Preparedness. Among men, reporting an annual income of less than \$25,000 was inversely associated with household preparedness (PR 0.79, 95% CI 0.68–0.91). We did not observe gender differences in associations with having an emergency evacuation plan or having a 3-day supply of medication (data not shown).

## Discussion

In this large population-based sample, we observed that women were 29% less likely than men to report household preparedness, and 11% less likely than men to report a 3-day supply of medication. Women were also less likely to report an emergency evacuation plan than men; however, this association was not significant.

This study contributes to the epidemiologic literature regarding gender and preparedness behaviors in the United States. Our findings that women are less likely to report participating in preparedness behaviors are consistent with some, but not all previous studies [12–20]. We also identified vulnerable groups of women (divorced, widowed or separated women and women with children in the household) that may inform tailored interventions to promote preparedness. Replication studies are warranted to confirm these findings. It should also be noted that there is a paucity of studies on the relationship between preparedness behaviors and adverse outcomes after disaster. Future research would be enhanced by evaluating the effectiveness of these preparedness behaviors, particularly among vulnerable populations such as women.

## Limitations

This study is not without limitations. First, preparedness behaviors were self-reported by participants and subject to misclassification or reporting bias. As a result, we were unable to distinguish between gender differences in reporting

**Table 2** Adjusted prevalence ratios (PR) and 95% confidence intervals (95% CI) for household preparedness items include 3-day supply of water; 3-day supply of food; battery-operated radio; and flashlight with batteries) by gender, behavioral risk factor surveillance system, 2006–2012 (unweighted n = 96,137)

	Women		Men	
	PR <sup>a</sup>	95% CI	PR <sup>a</sup>	95%CI
Age (years)				
18–34	1.00	1.00	1.00	1.00
35–54	<b>1.25</b>	<b>1.21, 1.39</b>	<b>1.21</b>	<b>1.05, 1.40</b>
55–64	<b>1.55</b>	<b>1.36, 1.76</b>	<b>1.54</b>	<b>1.30, 1.82</b>
65 or older	<b>1.46</b>	<b>1.26, 1.69</b>	1.14	0.94, 1.38
Race/ethnicity				
White, non-Hispanic	1.00	1.00	1.00	1.00
Black, non-Hispanic	1.10	0.99, 1.21	1.08	0.93, 1.25
Hispanic	0.99	0.82, 1.21	0.95	0.73, 1.24
Other race	<b>1.34</b>	<b>1.13, 1.60</b>	1.01	0.81, 1.27
Education				
≤ High school	1.00	1.00	1.00	1.00
≥ Some college or technical school	1.05	0.98, 1.13	<b>1.17</b>	<b>1.05, 1.30</b>
Income				
> \$50,000	1.00	1.00	1.00	1.00
\$25,000–\$50,000	1.04	0.95, 1.14	0.96	0.85, 1.08
< \$25,000	1.07	0.96, 1.19	<b>0.79</b>	<b>0.68, 0.91</b>
Marital status				
Married, member of unmarried couple	1.00	1.00	1.00	1.00
Never married	1.31	0.96, 1.80	1.10	0.93, 1.30
Divorced, widowed, separated	0.84	0.71, 1.00	1.01	0.90, 1.13
Children in household				
No	1.00	1.00	1.00	1.00
Yes	<b>0.84</b>	<b>0.77, 0.92</b>	0.97	0.71, 1.30

Bold type indicates statistical significance

<sup>a</sup>Adjusted for age, race/ethnicity, education, income, marital status, the presence of children under age 18 in the household, employment status, urban/rural residence, US region, self-rated health, and chronic disease/ disability status

behaviors and gender differences in *actual* behaviors in this study. Second, this was a cross-sectional analysis and causal inferences from this data cannot be made. Finally, the general preparedness module was administered to BRFSS respondents in only ten states and may not be representative of the U.S. population as a whole.

## Conclusions

Our findings support future investigations of gender differences in public health emergency preparedness in the United States. As men and women may experience differential preparedness before a disaster, it will be important for the public health community to address these gaps and focus efforts on strategies, such as gender-specific messages and interventions, that can potentially mitigate the public health impact of complex emergencies and disasters.

## Compliance with Ethical Standards

**Conflict of interest** The authors declare that they have no conflict of interest.

## References

1. Satcher, D., Friel, S., & Bell, R. (2007). Natural and manmade disasters and mental health. *JAMA*, 298(21), 2540–2542. <https://doi.org/10.1001/jama.298.21.2540>.
2. Noji, E. K. (1996). *The public health consequences of disasters*. Oxford: Oxford University Press.
3. Callaghan, W. M., Rasmussen, S. A., Jamieson, D. J., Ventura, S. J., Farr, S. L., Sutton, P. D., et al. (2007). Health concerns of women and infants in times of natural disasters: lessons learned from Hurricane Katrina. *Maternal and Child Health Journal*, 11(4), 307–311.
4. World Health Organization. (2002). *Gender and health in disasters*. Geneva: World Health Organization (WHO).
5. Anastario, M., Shehab, N., & Lawry, L. (2013). Increased gender-based violence among women internally displaced in Mississippi 2 years post-Hurricane Katrina. *Disaster Medicine and*

- Public Health Preparedness*, 3(1), 18–26. <https://doi.org/10.1097/DMP.0b013e3181979c32>.
6. Thornton, W. E., & Voigt, L. (2007). Disaster rape: Vulnerability of women to sexual assaults during Hurricane Katrina. *Journal of Public Management and Social Policy*, 13(2), 23–49.
  7. Swatzyna, R. J., & Pillai, V. K. (2013). The effects of disaster on women's reproductive health in developing countries. *Global Journal of Health Science*, 5(4), 106.
  8. Centers for Disease Control and Prevention (CDC). (2017). Are you prepared? Atlanta: CDC. Retrieved September 16, 2018, from <https://www.cdc.gov/phpr/areyouprepared/>.
  9. Castleden, M., McKee, M., Murray, V., & Leonardi, G. (2011). Resilience thinking in health protection. *Journal of Public Health*, 33(3), 369–377. <https://doi.org/10.1093/pubmed/ldr027>.
  10. Khan, Y., Fazli, G., Henry, B., de Villa, E., Tsamis, C., Grant, M., et al. (2015). The evidence base of primary research in public health emergency preparedness: a scoping review and stakeholder consultation. *BMC Public Health*, 15(1), 432.
  11. Centers for Disease Control and Prevention. (2013). *Behavioral risk factor surveillance system overview*. Atlanta: Centers for Disease Control and Prevention.
  12. Ablah, E., Konda, K., & Kelley, C. L. (2009). Factors predicting individual emergency preparedness: a multi-state analysis of 2006 BRFSS data. *Biosecurity and Bioterrorism*, 7(3), 317–330.
  13. Centers for Disease Control and Prevention. (2012). Household preparedness for public health emergencies—14 states, 2006–2010. *MMWR Morbidity and Mortality Weekly Report*, 61(36):713.
  14. Bethel, J. W., Burke, S. C., & Britt, A. F. (2013). Disparity in disaster preparedness between racial/ethnic groups. *Disaster Health*, 1(2), 110–116.
  15. Clay, L. A., Goetschius, J. B., Papas, M. A., & Kendra, J. (2014). Influence of mental health on disaster preparedness: findings from the behavioral risk factor surveillance system, 2007–2009. *Journal of Homeland Security and Emergency Management*, 11(3), 375–392.
  16. DeBastiani, S. D., Strine, T. W., Vagi, S. J., Barnett, D. J., & Kahn, E. B. (2015). Preparedness perceptions, sociodemographic characteristics, and level of household preparedness for public health emergencies: Behavioral risk factor surveillance system, 2006–2010. *Health Security*, 13(5), 317–326.
  17. Smith, D. L., & Notaro, S. J. (2015). Is emergency preparedness a 'disaster' for people with disabilities in the US? Results from the 2006–2012 behavioral risk factor surveillance system (BRFSS). *Disability & Society*, 30(3), 401–418.
  18. Gazibara, T., Jia, H., & Lubetkin, E. I. (2014). Disaster preparedness: A comparative study of North Carolina and Montana. *Disaster Medicine and Public Health Preparedness*, 8(3), 239–242. <https://doi.org/10.1017/dmp.2014.38>.
  19. Eisenman, D. P., Wold, C., Fielding, J., Long, A., Setodji, C., Hickey, S., et al. (2006). Differences in individual-level terrorism preparedness in Los Angeles County. *American Journal of Preventive Medicine*, 30(1), 1–6.
  20. Lindell, M. K., & Hwang, S. N. (2008). Households' perceived personal risk and responses in a multihazard environment. *Risk Analysis*, 28(2), 539–556.

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