



HHS Public Access

Author manuscript

Disaster Med Public Health Prep. Author manuscript; available in PMC 2015 September 15.

Published in final edited form as:

Disaster Med Public Health Prep. 2014 February ; 8(1): 12–19. doi:10.1017/dmp.2013.111.

Household Emergency Preparedness by Housing Type from a Community Assessment for Public Health Emergency Response (CASPER), Michigan

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Abstract

Objectives—We examined the association between housing type and household emergency preparedness among households in Oakland County, Michigan.

Methods—We used interview data on household emergency preparedness from a cluster design survey in Oakland County, Michigan, in 2012. We compared survey-weighted frequencies of household demographics, medical conditions, and preparedness measures in single-detached homes versus multi-unit dwellings, and determined the unadjusted odds ratios (OR) and the income-level adjusted OR for each preparedness measure.

Results—Households had similar demographics and medical conditions between housing types. Unadjusted ORs were statistically significant for single-detached homes having a generator (11.1), back-up heat source (10.9), way to cook without utilities (5.8), carbon monoxide (CO) detector (3.8), copies of important documents (3.4), evacuation routes (3.1), and three-day supply of water (2.5). Income level adjusted ORs remained statistically significant except for owning a CO detector.

Conclusions—Households in multi-unit dwellings were less likely to have certain recommended emergency plans and supplies compared to those in single-detached homes. Further research is required to explore the feasibility, barriers, and alternatives for households in multi-unit dwellings in terms of complying with these measures.

Keywords

emergency preparedness; housing; survey; logistic regression; Michigan

Background

Household emergency preparedness

“Regretfully, we were not prepared for Sandy. ... In the future, I will be proactive in being prepared for all hurricanes and storms by following the advice and recommendations to avoid another horrific experience.”

Hurricane Sandy survivor¹

Hurricane Sandy made landfall along the northeastern United States (U.S.) coastline on October 29, 2012, and caused billions of dollars in damage and numerous fatalities.² The widespread and prolonged power outages and interruption of services caused by Sandy exemplify the need for households and individuals to be prepared for such emergencies.³ Hurricane Sandy was the largest disaster event in the U.S. in 2012, accounting for 23 of the 112 federally declared disasters that year, but the other 89 disaster declarations demonstrate the need for ongoing preparedness at all levels.⁴ Disasters may vary in size and severity, but they invariably impact the individuals and communities where they occur. The U.S. Federal Emergency Management Agency (FEMA), whose mission is to support citizens and first responders in emergency preparedness, response and recovery, recommends a 'Whole Community' approach to disaster preparedness. This entails a shared responsibility for preparedness amongst individuals, businesses, community organizations, non-governmental organizations, schools and academia, media, and all levels of government.⁵

In 2003, FEMA began its *Ready* campaign to increase the level of basic preparedness of citizens in the U.S.⁶ Along with *Ready*, the American Red Cross and the Centers for Disease Control and Prevention (CDC), encourage individuals to 'be informed', 'make a plan', 'build a kit' and 'get involved'.^{7,8} In the event of a disaster, individuals are encouraged to have pre-established plans and enough provisions to be able to last on their own for at least 72 hours.^{7,8}

The U.S. National Preparedness Guidelines and Target Capabilities List were established in 2003 as part of the all-hazards national preparedness system. The Guidelines' *Community Preparedness and Participation* capability outlines performance measure targets for community-level citizen preparedness, such as increasing the percentage of citizens with basic first aid training to 80% of the population.⁹ Despite promotion of household preparedness, regional and national surveys of individuals and households since these campaigns have found variable, but overall below target, rates of preparedness.^{10,11,12,13} FEMA's 2009 national household survey on personal preparedness in the U.S. found that 57% of respondents reported having supplies set aside in their home in case of a disaster and 44% reported having a household emergency plan.¹⁴

Studies on household and individual preparedness have identified several socio-demographic factors that influence preparedness levels, including sex, race/ethnicity, age, education, and income.^{11,14,15,16,17} Housing characteristics such as renting versus owning or living in urban versus rural areas have also been shown to impact household preparedness.^{11,18,19,20,21} While housing type has been identified as a component of social vulnerability during a disaster, its influence on household emergency preparedness has not been assessed.^{22,23} Households in multi-unit dwellings, such as apartments or condominiums, may have limitations for owning recommended emergency supplies compared to those living in single-detached homes.^{24,25}

Oakland County, Michigan

In September, 2012, the Oakland County Health Division (OCHD), the Michigan Department of Community Health (MDCH), and the Centers for Disease Control and Prevention (CDC) conducted a Community Assessment for Public Health Emergency Response (CASPER) survey of residents in Oakland County.²⁶ CASPER is a rapid household survey sampling methodology that can be used to assess a population's needs after a disaster, or preparedness for a disaster. It uses a two-stage cluster sampling method originally developed by the World Health Organization to assess vaccine coverage.²⁷ As part of Michigan's capability-based planning for public health emergency preparedness, and in conjunction with National Emergency Awareness Month, the purpose of the survey was to assess levels of household preparedness in Oakland County and to develop public health capacity for emergency preparedness and response.²⁸ Michigan is subject to extreme weather events, and Oakland County is 50 miles from the Fermi Nuclear Power Plant. The objective of this analysis was to determine if housing type was associated with household emergency preparations in Oakland County.

Methods

Sample selection

We used the "30x7" two-stage cluster design methodology described in CDC's CASPER Toolkit to obtain a sample size of 210 households.²⁶ The sampling frame included the 527,255 housing units in Oakland County according to the 2010 U.S. Census.²⁹ Clusters were defined as single Census Blocks, with size being based on the number of housing units in each Census Block. The first stage of sampling selected 30 clusters (Blocks [Figure 1]) using probability-proportionate-to-size. In the second stage of sampling, interview teams systematically selected seven households within each selected census block by choosing a starting point within the cluster and then every 'nth' household, where 'n' equals the total number of households in cluster divided by seven. Teams made up to three attempts at each selected household before replacing the household from within the cluster. Interviewers recorded housing type by identifying households as single-detached homes, or multi-unit dwellings which included duplexes, townhomes, condominiums and apartment buildings.

Survey Instrument

We developed a two-page questionnaire on self-reported household level emergency preparedness. We asked respondents about their total number of household members, and their age ranges, pet ownership, whether any member of the household had medical conditions including diabetes, hypertension/heart disease, respiratory condition, physical disability, developmental disability, or are immunocompromised, or if any member had a medical need associated with their medical conditions including daily medication, use of a wheelchair/cane/walker, dialysis, home oxygen, home health care, or other medical needs. Questions on emergency preparedness measures were grouped into three categories: emergency plans, training in emergency response, and ownership of emergency supplies. Households were asked if they had the following plans: i) copies of important documents in a safe location, ii) multiple routes away from your home in case evacuation is necessary, and iii) an emergency communication plan, such as a list of numbers and a designated out-of-

town contact. Households were asked if anyone in the household had taken training in either i) first aid or ii) cardiopulmonary resuscitation (CPR) in the last five years. Households were asked if they owned the following emergency supplies: i) 72 hours of food for each person, ii) 72 hours of water (1 gallon/person/day), iii) method to cook without utilities (e.g., gas or charcoal grill), iv) back-up heat source, v) generator, vi) fire extinguisher, vii) working smoke detector, viii) working carbon monoxide (CO) detector, ix) emergency supply kit (with supplies such as flashlights, radio, and extra batteries that is kept in a designated place in the home), and x) first aid kit.

Data Collection and Analysis

Interview teams composed of staff and volunteers from OCHD, MDCH, and CDC were trained prior to conducting interviews. Teams conducted interviews from September 10–12, 2012. In each household, one adult representative, aged at least 18 years or older, was interviewed for household level responses. The survey purposely did not collect any identifiable or sensitive information (e.g., household income) that may have hindered participation. Therefore, household income was assigned to each household based on the inflation-adjusted median household income and benefits of their Census Tract from the 2010 U.S. Census.²⁹ Households were divided into three income level categories (low, middle, and high), based on their tertile.

We used SAS 9.3 (© 2002–2010 SAS Institute Inc., Cary, NC) to compare households in single-detached homes and multi-unit dwellings. We determined their cluster, Census Tract, and income level distribution, and the mean, median, and range of median household incomes across their Census Tracts. We used chi-square tests to compare the survey-weighted frequencies of household demographics, medical needs and conditions, and emergency preparedness measures by household type. We used survey-weighted logistic regression models to determine the unadjusted and adjusted odds ratios (OR) and their 95% CI for emergency preparedness measures. Based on studies of socio-demographic factors, we included income level in the adjusted model as the most likely source of confounding in the association with housing type.^{15,16} Only 2% of households had children two years of age and younger. Having adults aged 65 years and older and having pets in the home were statistically significant for some preparedness measures in bivariate models, but did not contribute to the overall goodness of fit in the multivariable models; therefore, final models were adjusted for income level only. *P* values of <0.05 were considered statistically significant. This study was part of a CDC EpiAid investigation which was determined to be exempt for human subjects review.

Results

Household Characteristics

There were a total of 192 completed surveys (91% completion rate), with 150 single-detached homes and 42 multi-unit dwellings (Table 1). Households in multi-unit dwellings belonged to 10 clusters (representing 9 Census Tracts) and those in single-detached homes belonged to 26 clusters (representing 25 Census Tracts). Almost two-thirds of the multi-unit dwelling households belonged to the low income level category, and no multi-unit dwelling

households belonged to a Census Tract with a median household income of \$100,000 or more. There were no statistically significant differences between the two groups for households having children aged two years or younger or adults aged 65 years or older. Households in single-detached homes were more likely to own a pet ($p<0.05$). Household size in multi-unit dwellings tended to be smaller, with 68% having only one or two members, but this was not a statistically significant difference. There was no statistically significant difference in medical conditions and medical needs by housing type (Table 2).

Emergency Preparedness Measures

Weighted percentages for households in single-detached homes were the same or higher for all emergency preparedness measures compared to those in multi-unit dwellings (Table 3). Over 70% of households in single-detached homes had all three types of emergency plans in place; whereas, less than half of households in multi-unit dwellings had copies of important documents or an evacuation plan ($p<0.05$). Less than half of all households had someone in the home trained in CPR or first aid in the last five years, and there were no differences by housing type. For all households, a working smoke detector and a 72 hour supply of food were the two most common supplies, and a generator and a back-up heat source were the two least common supplies owned. There were statistically significant differences by housing type for having: copies of important documents, evacuation routes, a way to cook without utilities, a three-day supply of water, a back-up heat source, and a generator.

Association by Housing Type

Table 4 shows the unadjusted and adjusted ORs and their 95% CI for emergency preparedness measures in households in single-detached homes compared to households in multi-unit dwellings. Of emergency plans, households in single-detached homes had approximately three times the odds of having copies of important documents and evacuation routes ($p<0.05$). There were no differences by housing type for having emergency training in CPR or first aid. There were four supply types that had statistically significant unadjusted and adjusted odds ratios: owning a generator, owning a back-up heat source, having a way to cook without utilities, and having a 3-day supply of water. The unadjusted odds ratio for having a working carbon monoxide detector was statistically significant, but its adjusted odds ratio was 2.84 with a p-value of 0.06. Households in single-detached homes had lower odds of owning a working fire extinguisher, but this was not statistically significant.

Discussion

According to the U.S. Census Bureau, 25.9% of housing units are within multi-unit structures.³⁰ With approximately one-quarter of households living in a multi-unit dwelling, understanding the influence from housing type has important implications for emergency planners. Previous studies have postulated an association between apartment buildings and emergency preparedness; however, this is the first study to demonstrate an association between housing type (multi-unit dwelling versus single-detached home) and specific emergency preparedness measures. Households in multi-unit dwellings were less likely to own a generator, a back-up heat source, a way to cook without utilities, a three-day supply of water, and were less likely to have copies of important documents and evacuation routes.

Studies on earthquake preparedness suggested that apartment dwellers may be constrained by building code requirements or other tenant policies set by their building owners.^{24, 25} Individuals living in multi-unit dwellings may be constrained by smaller spaces and lack of storage capacity, restricting their ability to stockpile bulky emergency supplies for a family. Additionally, the use of cooking or heating devices that do not require electricity of gas may not be allowed due to risks from fire or carbon monoxide exposure.

In this study, overall reported ownership of a working smoke detector was high; however, households in multi-unit dwellings were less likely to report owning a working carbon monoxide detector. Without validating self-reports of ownership, it is unclear whether this represents an actual or perceived difference. Households in multi-unit dwellings may have their CO detector provided by their building operator, compared to those in single-detached homes who have to purchase and install a detector themselves. Since 2009, newly constructed or renovated single-family homes and units in multi-unit dwellings in Michigan are required to have a CO detector.³¹ Given the recent history of this requirement, older multi-unit dwellings may not have retroactively installed CO detectors in all units. Further research is needed to validate differences observed in this study.

We also found that households in multiple-unit dwellings were also less likely to have emergency plans of having copies of important documents and having multiple routes away from the home. One previous study found that families living in apartments five stories or greater were more likely to have a family emergency response plan compared to those in apartments less than five stories tall, town homes, row homes and single-family homes, although that study did not assess specific components of an emergency plan by housing type.³² Without ascertaining reasons for responses, the mechanism of influence by housing type on these preparedness measures is uncertain. Households that store their documents in a safe at home may face the same space limitations as for other bulky emergency supplies, but there are alternate ways to store documents, such as on an electronic server or in a bank safety deposit box that would be independent of housing type. In terms of evacuation routes, building codes for multi-unit dwellings require alternate exits in case of fire. Households may be unaware of these routes, or may be unable to access them. In answer to the question, “does your household have multiple routes away from your home in case evacuation is necessary?” several respondents in single-detached homes said, “yes, I have a front door and a back door.” Considering this interpretation of the question, those in multi-unit dwellings would be less likely to report multiple evacuation routes. Understanding the differences in household preparedness by housing type requires further investigation. The possibility of storage limitations as outlined above is one consideration. Another possibility is that those in multi-unit dwellings were, on average, less affluent as they lived in Census Tracts with lower median household incomes, and therefore may be less likely to purchase recommended emergency supplies. This possibility seems less likely because the association between housing type and preparedness measures persisted after controlling for Census Tract income level. Identification of this association has implications for addressing the issue because emergency planners could target interventions at all households in multi-unit dwellings, regardless of income level.

Our study has several limitations. First, CASPER surveys are self-report data, so responses may not reflect actual levels of emergency preparedness measures. Second, there may be residual confounding from socio-demographic factors, such as race, education, and house ownership. There may also be residual confounding from using assigned income versus ascertained income. Lastly, this was a post-hoc analysis of data collected from Oakland County's CASPER survey on emergency preparedness. The study design was not powered for detecting differences by housing type, which may have limited our ability to fully assess its association with preparedness measures. For the magnitude of effects seen in this analysis, and our ability to account for income level, the associations found are likely valid differences by housing type. Future research is required to further explore the precision of these estimates, the scope of the association between housing type and emergency preparedness, and the generalizability to other populations.

During a disaster, households in multi-unit dwellings may be vulnerable to overcrowding when funneled into limited exits and unsafe and disorderly evacuation onto the street.²²²³ Because of these risks, census information on housing is one component of disaster planning tools for identifying socially vulnerable populations, such as the Social Vulnerability Index (SVI).³³ The results of this study suggest households in multi-unit dwellings may also be vulnerable during a disaster from a lack of emergency preparedness measures. This finding is important to public health and emergency planners because, unlike other measures of social vulnerability such as socioeconomic status or language, multi-unit dwellings are readily identified within a local jurisdiction and provide opportunities for outreach to households within them, such as targeted preparedness campaigns.

Conclusions

Identifying and understanding the barriers that households may face in trying to improve their level of emergency preparedness are significant findings that might influence emergency planning and public health. This study provides evidence that housing type is associated with having emergency plans and owning certain emergency supplies. This creates another avenue to improve household emergency preparedness by targeting interventions to those living in multi-unit dwellings and their building owners. Preparedness messaging on "getting a kit" may consider adjusting for limitations of living in a multi-unit dwelling. With fewer preparedness measures to enable sheltering-in-place during a disaster, as shown in this study, emergency planners might address accommodations for those living in multi-unit dwellings. Further research should explore strategies for improving household preparedness within different housing types.

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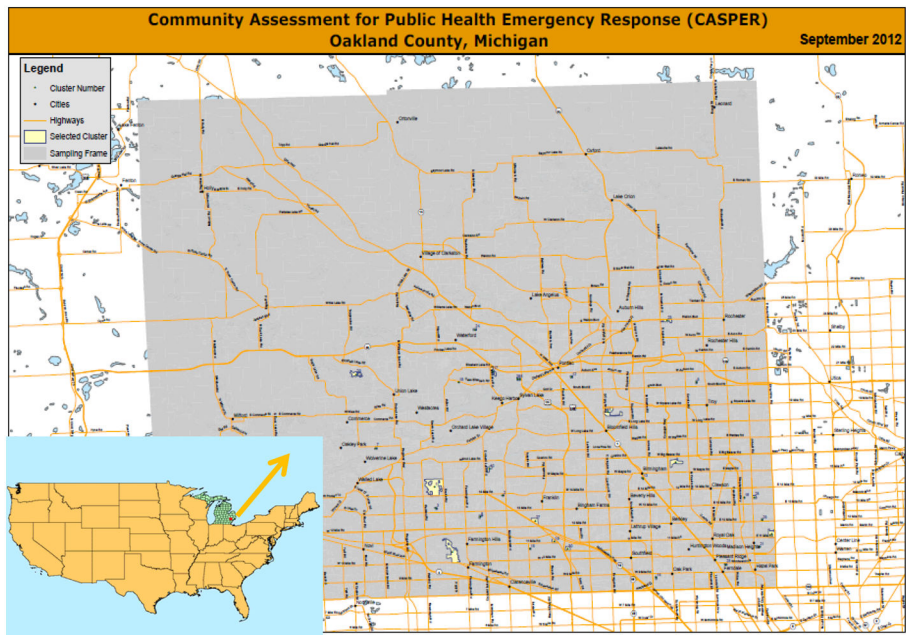


Figure 1.
Oakland County, Michigan.

Table 1

Characteristics of study households in multi-unit dwellings and single-detached homes, Oakland County, Michigan, 2012.

	Multi-Unit Dwelling	Single-Detached Home
# Households, n (weighted %)	42 (21.4)	150 (78.5)
# Census Blocks (clusters)	10	26
# Census Tracts	9	25
Household Income*		
Mean	\$50,602	\$70,498
Median	\$45,938	\$65,909
Range	\$27,109–\$91,750	\$28,169–\$137,961
Income Level, n (weighted %)		
Low	27 (64.4)	40 (29.1)
Middle	7 (17.8)	55 (37.6)
High	8 (17.8)	55 (33.3)
# Household Members	Weighted % (95% CI)	Weighted % (95% CI)
1	31.5 (11.1–51.9)	18.1 (7.20–29.0)
2	36.3 (23.1–49.5)	35.5 (25.9–45.1)
3	12.2 (1.30–23.1)	18.2 (11.1–25.3)
4	12.6 (0.46–24.7)	20.5 (13.8–27.2)
5	7.4 (0–14.9)	7.7 (3.60–11.8)
Households with children 2 years old		
Yes	0	2.4 (0.14–4.71)
No	100 (n/a)	97.6 (95.3–99.9)
Households with adults 65 years old		
Yes	27.8 (4.00–51.6)	25.4 (16.1–34.7)
No	72.2 (48.4–96.0)	74.6 (65.3–83.9)
Households with a pet†		
Yes	30.4 (15.7–45.0)	53.8 (42.2–65.4)
No	69.6 (55.0–84.3)	46.2 (34.6–57.8)

* Based on Census Tract level median household income and benefits, inflation-adjusted (U.S. Census 2010)

† $p < 0.05$

Table 2

Weighted percentages and their 95% CI for self-reported medical conditions and medical needs by households in multi-unit dwellings and single-detached homes.

	Multi-Unit Dwelling Weighted % (95% CI)	Single-Detached Home Weighted % (95% CI)
Medical Conditions[†]		
Hypertension/heart disease	28.5 (15.9–41.1)	33.0 (22.5–43.4)
Respiratory condition*	5.4 (7.9–29.9)	25.6 (15.4–35.8)
Diabetes	11.9 (3.4–20.3)	21.1 (9.6–32.6)
Physical disability	18.1 (2.1–34.2)	13.2 (6.7–19.8)
Developmental disability	0	3.6 (0.4–6.7)
Immunodeficiency	0	3.1 (0.5–5.7)
Medical Needs[‡]		
Daily medication	49.3 (33.5–65.0)	68.8 (60.1–77.6)
Mobility device**	16.3 (0.3–32.3)	9.8 (2.8–16.8)
Home health needs	9.6 (2.3–17.0)	5.6 (2.0–9.1)
Other Medical needs	4.4 (0.0–10.7)	3.3 (0.0–7.9)
Dialysis	0	0

* asthma/chronic obstructive pulmonary disease/emphysema

** Use of a wheelchair/cane/walker

Table 3

Weighted percentages and their 95% confidence intervals of household emergency preparedness measures for households in multi-unit dwellings and single-detached homes.

	Multi-Unit Dwelling Weighted % (95% CI)	Single-Detached Home Weighted % (95% CI)
Emergency Plans		
Copies of important documents *	49.3 (37.7–60.9)	76.5 (69.0–84.1)
Evacuation Plan *	49.6 (35.2–64.1)	75.4 (66.2–84.7)
Communication	58.5 (42.7–74.3)	70.5 (62.6–78.3)
Emergency Training		
CPR	37.4 (19.9–54.9)	42.9 (33.6–52.2)
First Aid	32.6 (12.7–52.5)	42.5 (33.0–52.1)
Supply Type		
Working smoke detector	95.2 (89.5–100)	97.0 (93.9–100)
3-day supply of non-perishable food (per person)	77.8 (55.7–99.9)	87.5 (81.2–93.9)
A way to cook without utilities *	47.8 (27.8–67.8)	84.2 (76.2–92.2)
Working fire extinguisher	74.8 (58.3–91.3)	74.3 (66.5–82.1)
Working CO detector *	39.3 (18.3–60.3)	71.0 (59.8–82.2)
Emergency kit	54.4 (35.6–73.3)	70.1 (61.8–78.3)
First aid kit	57.0 (43.2–70.9)	69.9 (58.3–81.4)
3-day supply of water (1 gallon/person/day) *	47.4 (29.4–65.4)	69.5 (61.3–77.6)
Back-up heat source *	13.3 (0.0–28.4)	62.6 (48.5–76.7)
Generator *	2.2 (0.0–6.7)	20.1 (12.9–27.4)

* $p < 0.05$

Table 4

Unadjusted and income-level adjusted Odds Ratios and their 95% CI of household emergency preparedness measures for households in single-detached homes compared to multi-unit dwellings.

Emergency Plans	Unadjusted Odds Ratio (95%CI)	Adjusted Odds Ratio (95%CI)
Copies of important documents *	3.36 (1.84–6.11)	3.12 (1.67–5.82)
Evacuation routes *	3.12 (1.53–6.36)	3.36 (1.55–7.28)
Communication plans	1.69 (0.81–3.51)	1.63 (0.75–3.52)
Emergency Training		
First Aid	1.53 (0.59–3.99)	1.08 (0.50–2.34)
CPR	1.26 (0.56–2.83)	0.89 (0.44–1.71)
Supply Type		
Generator *	11.1 (1.59–77.4)	8.24 (1.23–55.2)
Back-up heat source *	10.9 (2.94–40.3)	8.58 (2.56–28.8)
A way to cook without utilities *	5.83 (2.33–14.6)	4.73 (1.91–11.7)
Working CO detector **	3.78 (1.43–10.0)	2.84 (0.98–8.23)
3-day supply of water (1 gallon/person/day) *	2.52 (1.12–5.70)	2.29 (1.03–5.11)
3-day supply of non-perishable food (per person)	2.01 (0.51–7.91)	1.64 (0.43–6.20)
Emergency kit	1.96 (0.85–4.54)	1.91 (0.77–4.77)
First aid kit	1.75 (0.79–3.87)	1.13 (0.48–2.65)
Working smoke detector	1.62 (0.35–7.55)	0.99 (0.23–4.31)
Working fire extinguisher	0.97 (0.39–2.45)	0.91 (0.34–2.42)

* $p < 0.05$, both unadjusted and adjusted odds ratios

** $P < 0.05$, unadjusted only