BMJ Open

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Journal:	*BMJ Open*
Manuscript ID	bmjopen-2019-032462
Article Type:	Research
Date Submitted by the Author:	24-Jun-2019
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Keywords:	ACCIDENT & EMERGENCY MEDICINE, PUBLIC HEALTH, Health & safety < HEALTH SERVICES ADMINISTRATION & MANAGEMENT

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Word count: Main Text word count: 3393;

Conflict of interest statement:

We declare that we have no financial and personal relationships with other people or organizations that can inappropriately influence our work, there is no professional or other personal interest of any nature or kind in any product, service or company that could be construed as influencing the position presented in our study. Our study sponsor: Professor Yanhua Hao(corresponding) Organized surveyors to conduct field research for getting the first-hand survey data nonprofitable, then her graduate students to input these data into computer software Epidata, analyzing the results of this research only for academic research, finally, we decide to submit the report for publication.

Abstract

Objective This study aimed to assess household preparedness for emergency events and its determinants in China. D**esign:** A cross-sectional questionnaire survey was conducted on 3,541 households in China in 2015. **Participants:** Households were selected using a stratified cluster sampling strategy, representing central, eastern, western and southern regions of China. The designed questionnaires were administered through face-to-face interviews. **Outcome Measures:** Household emergency preparedness was measured with 14 indicators, tapping into the supply of nine emergency necessities (food and water, extra batteries, battery-powered radio, battery-operated flashlight, first aid kit, gas mask, fire extinguisher, escape ropes, whistle), coverage of accident insurance, knowledge of local emergency response systems (emergency numbers, exit routes and shelters), and availability of a household evacuation plan. If an individual acted on nine of the 14 indicators, they were deemed well-prepared. Logistic regression models were established to identify predictors of well-preparedness based on 3,541 returned questionnaires containing no missing values. **Results:** Only 9.9% of households were well-prepared for emergencies: 53.6% did not know what to do and 31.6% did not want to think about it. A higher level of preparedness was found in the respondents who participated in emergency training activities (AOR=2.458), had better emergency knowledge (AOR=2.278), reported less fate-submissiveness (AOR=1.622) and more self-reliance (AOR=1.376), had a higher income (AOR=1.400), and held more positive attitudes toward preparedness (AOR=1.295). **Conclusion:** Household preparedness for emergency events is poor in China. lack of motivation, negative attitude to preparedness and knowledge shortfall are major but remediable barriers for household preparedness.

Key word: household preparedness, emergency preparedness, disaster preparedness

Strengths and limitations

- Firstly investigated the situation with international commonly used indictors, to identify the factors & barriers preventing residents from preparing for emergency events.
- Except for some predictors consistent with previous researches, some interesting findings closely related with Chinese Auspicious culture contributed to the poor household preparedness.
- But one adult respondent was invited to represent each household in this study, and opinions from family members are not always consistent.
- The 14 emergency items included in this study are not exhaustive. An emphasis on other aspects may lead to different results.

Introduction

No community is immune from the risk of emergencies and disasters in today's increasingly interconnected world. Many emergency events may be difficult to prevent. Inadequate preparation in response to these events can cause a tremendous loss in terms of human lives and health, property and infrastructure. It was estimated that natural disasters alone cost over US$ 100 billion annually wordwide.[1] According to the *2016 Humanitarian Response Plan* launched by the World Health Organization (WHO), US$ 2.2 billion was needed to provide lifesaving health services to more than 79 million people in more than 30 countries due to protracted emergencies that year.[2] In the first half year of 2016, 68.77 million people in China were affected by floods, hail and geological disasters, resulting in 505 deaths and a direct economic loss of 89.04 billion Chinese Yuan (US$12.9645 billion).[3]

Strengthening emergency responses can effectively reduce human casualties and contribute to sustainable post-event development. It is deemed a cost-effective investment in preventing losses and is considered one of the four priority areas in the Sendai Framework for Disaster Risk Reduction 2015-2030, which was endorsed by the third United Nations World Conference in Japan.[4] Over the past few decades, emergency response efforts have evolved from a focus on top-down relief assistance to a more comprehensive strategy with a greater emphasis on community participation and pre-event preparedness for better risk management. This is because emergency victims often face geographical isolation as a result of damage to local infrastructure such as energy, road and communication facilities.[5] Consequently, the arrival of external rescue support may experience two or more days of delay.[6] But rescue efforts in the first couple of days in disastrous events are critical.[7] Community and household preparedness in self-rescue efforts prior to the arrival of external assistance may result in the difference between the chance of survival and death.[8] Empirical evidence shows that sufficient household preparedness can significantly mitigate the negative consequences of emergency events.[9]

The United Nations International Strategy for Disaster Reduction (UNISDR) defined preparedness as the

"knowledge, capacities and actions to effectively respond to the effects of hazard events, whether or not they have occurred".[10] Preparedness activities can be developed at the individual, household, community and governmental levels. Household preparedness plays a critical role because it is an integral part of any individual and community effort. Household emergency preparedness requires stockpiling emergency supplies, planning for emergency events and other actions like buying accident insurance.[11-12]

Previous studies revealed poor household preparedness for disastrous events across a range of different settings.[13-14] Despite a rise in the number of publications on household preparedness in developed countries, there is a serious shortage of literature documenting the situation in developing countries. Empirical evidence shows that household preparedness is associated with many factors, including knowledge, risk awareness, prior exposure to disasters, attitudes toward emergency preparedness,[15] and trust in the government.[16] Socioeconomic status may also play an important role.[17-18,] Developing countries are facing ever-increasing challenges and costs associated with disastrous events.[19] But experiences from developed countries cannot be extrapolated to developing countries without consideration of the local contexts.

China is a disaster-prone country with the largest population and high population density. But little is known about the household preparedness of China in response to emergencies.[12] This study aimed to assess the level of household emergency preparedness in China and identify the factors associated with household preparedness. The findings of the study can provide evidence for better planning for the emergency response system.

METHODS

A cross-sectional questionnaire survey was conducted on 3,541 households in four regions of China.

Study population

A multistage stratified sampling strategy was adopted to select participating households. In the first stage, we identified four regions purposively considering diversities in geographic location and socioeconomic development: Beijing is the capital of China; Guangdong represents the most developed region in eastern China; Heilongjiang and Sichuan represent the less developed regions in central and western China, respectively. These four regions have a total population of more than 25 million, accounting for over 18% of the entire population in China. Of the four regions, Sichuan is an earthquake-prone area and recently experienced the Jiuzhaigou earthquake in 2017 and the Wenchuan earthquake in 2008. Guangdong is most frequently affected by typhoons. Meanwhile, many infectious diseases erupted in Guangdong, such as SARS in 2003 and dengue fever in 2014.

The second stage involved a selection of two municipalities in each province (two districts in Beijing) with

varied social and economic conditions. We then randomly selected one urban and one rural residential community from each participating municipality/district. A total of 3,650 households in these communities were approached and invited to participate in this study: 1000 in Beijing, 850 in Guangdong, 900 in Heilongjiang and 900 in Sichuan.

Data collection

Data were collected from April to September 2015. A research team comprising ten trained researchers and postgraduate students from Harbin Medical University visited the selected households. Verbal informed consent was obtained prior to the survey. One adult member from each household was interviewed. The questionnaire was administered anonymously, which took about 20 minutes to complete. Of the 3,650 invited households, 3,580 (98.1%) completed the questionnaire survey. The final data analyses included 3,541 (98.9%) questionnaires that contained no missing values.

Dependent variable

Household preparedness was measured by 14 items that were commonly used in previous studies. These included the supply of nine emergency necessities (three-day-supply of non-perishable food and water, battery-powered radio, extra batteries, battery-operated flashlight, first aid kit, gas mask, fire extinguisher, escape ropes, whistle) as recommended by the national public education "ready" program in the US,[20] coverage of accident insurance, knowledge of local emergency response systems (emergency numbers, exit routes and shelters), and availability of an evacuation plan.[21-22]

Independent variables

The selection of independent variables was guided by two behavioral theories: the KAP (Knowledge, Attitudes and Practice) theory and the Theory of Reasoned Action (TRA). The KAP theory addresses the intertwined effects between knowledge, attitudes and behaviors, whereas, the TRA emphasizes the importance of human reasoning as many contextual factors can weigh into human decision on actions.[23-24]

The independent variables tested in this study included:

Demographic and socioeconomic characteristics: age, region and residency (urban vs rural), educational attainments, and monthly household income (estimated in Chinese Yuan). Previous studies showed that socioeconomic factors not only determine the available resources, but also predict the knowledge and attitudes of an individual toward human actions, in particular those for preventive purposes. People with low socioeconomic status are less likely to invest and act on risk prevention and risk management activities.[25-26]

Knowledge: 16 statements were designed based on the national guidelines for emergency responses in China to test the relevant knowledge of respondents. They were asked to judge whether these statements

were correct, incorrect, or if they were unsure. A correct answer was given a score of one point. This generated an overall knowledge score for each respondent ranging from 0 to 16.

Risk awareness: respondents were asked to rate their concerns about natural and man-made disasters, social safety events, and public health emergencies on a five-point Likert scale (1-5). A summed score was calculated for each respondent (ranging from 4 to 20), with a higher score indicating a higher level of concern.

Attitudes: respondents were asked to rate on a five-point Likert scale (1-5) their interests in gathering information regarding emergency responses, perceived importance of such information, and willingness to discuss this topic with others. A summed score was calculated (ranging from 3 to 15), with a higher score indicating a higher level of endorsement with emergency preparedness.

Fate-submissiveness and self-reliance: respondents were asked to rate on a five-point Likert scale (1-5) their inclination of submissiveness to fate or luck, in comparison with the determination of self-rescue in emergency events.

Past experience: prior exposure to emergency events and participation in emergency training activities over the past year were measured in this study. Experiences play a pivotal role in the development of human behaviors.[27]

Respondents were also asked to choose all the reasons that prevented "people from preparing for emergencies" from the following list: (1) "do not know what to do"; (2) "do not want to think about it"; (3) "nothing can be done"; (4) "it takes too much time"; (5) "it takes too much money"; (6) "do not have the ability to prepare"; (7) "professionals will do the rescue job"; (8) "do not believe emergency will happen to the family"; (9) "do not have enough information from the government and the public media". The list was developed based on findings of previous studies.[28-29]

Statistical analysis

We estimated the number and percentage of households acting on each of the 14 indicators for emergency preparedness. Differences in actions across households were tested using chi-square tests.

If an individual acted on 14 indicators, they were considered to be well-prepared.[21] A multivariate logistic regression model was established to identify independent variables associated with well-preparedness. In the regression model, independent variables measuring knowledge, risk awareness, attitudes, fate-submissiveness and self-reliance were transformed into a nominal measure: 'above average score' versus 'on/below average score'. The model employed an enter approach based on the maximum likelihood estimation method, with an enter/exit criterion (α) of 0.05/0.01. All statistical analyses were performed using SPSS V.22.0.

Ethics approval

The research Ethical Committee of Harbin Medical University approved the study protocol.

RESULTS

Characteristics of respondents

Nearly half (47.9%) of the respondents were aged between 31 to 50 years; 54.4% were women; 41.7% held a college degree; 53.1% had a monthly household income of above ¥3500. Most (64.3%) respondents lived in urban areas. The majority (79.2%) were married at the time of the survey (Table 1).

Table 1. Socio-demographic characteristics of respondents

Characteristics	N	%
Gender		
Male	1614	45.6
Female	1927	54.4
Age (Years)		
18-30	1010	28.5
31-50	1687	47.6
51+	844	23.9
Education		
College degree or above	1476	41.7
No college degree	2065	58.3
Residency		
Urban	2277	64.3
Rural	1264	35.7
Region		
Beijing	988	27.9
Heilongjiang	862	24.3
Guangdong	811	22.9
Sichuan	880	24.9
Monthly household income (Yuan)		

0-3499	1659	46.9
3500+	1882	53.1
Marital status		
Married	2803	79.2
Not married	738	20.8

Household emergency preparedness

The respondents had relatively good knowledge of their local emergency response systems, with 93.9% knowing the emergency numbers, 74.9% being aware of the evacuation exit routes, and 62.4% being able to locate the emergency shelters. But less than half of the households were well-prepared in terms of necessities (apart from 80% having a battery-operated flashlight), having accident insurance coverage, and having developed an evacuation plan. Overall, households in Beijing performed worse than those in the other regions. Urban households outperformed their rural counterparts in insurance coverage and knowledge of local emergency response systems. But rural households were more likely to have an evacuation plan and stockpile food/water, radio, flashlight and escape ropes. Only a small number of households (9.9%) were deemed well-prepared, acting on nine or more of the emergency indicators s (Table 2).

Table 2. Number and percentage (%) of households acting on emergency items

Action	Total N=3541	Regions					Residency	
		Beijing N=988	Heilongjiang N=862	Guangdong N=811	Sichuan N=880	P	Urban N=2266	Rural N=1275
Possession of emergency necessities								
three-day supply of food and	1101 (31.1)	230 (23.3)	350 (40.6)	264 (32.6)	257 (29.2)	0.000	684 (30.2)	417 (32.7)*

water								
extra batteries	1151 (32.5)	261 (26.4)	313 (36.3)	268 (33.0)	309 (35.1)	0.000	728 (32.1)	423 (33.2)
battery-powered radio	990 (28.0)	187 (18.9)	338 (39.2)	239 (29.5)	226 (25.7)	0.000	600 (26.5)	390 (30.6)*
battery-operated flashlight	2843 (80.3)	718 (72.7)	704 (81.7)	651 (80.3)	770 (87.5)	0.000	1760 (77.7)	1083 (84.9)*
first aid kit	1215 (34.3)	307 (31.1)	237 (27.5)	382 (47.1)	289 (32.8)	0.000	881 (38.9)*	334 (26.2)
gas mask	164 (4.6)	36 (3.6)	39 (4.5)	58 (7.2)	31 (3.5)	0.001	113 (5.0)	51 (4.0)
fire extinguisher	931 (26.3)	174 (17.6)	148 (17.2)	315 (38.8)	294 (33.4)	0.000	625 (27.6)*	306 (24.0)
escape rope	403 (11.4)	69 (7.0)	141 (16.4)	94 (11.6)	99 (11.3)	0.000	233 (10.3)	170 (13.3)*
whistle	387 (10.9)	95 (9.6)	117 (13.6)	73 (9.0)	102 (11.6)	0.010	264 (11.7)*	123 (9.6)
Coverage of accident insurane	819 (23.1)	291 (29.5)	147 (17.1)	132 (16.3)	249 (28.3)	0.000	582 (25.7)*	237 (18.6)
Household evacuation plan	1083 (30.6)	151(15.3)	255 (29.6)	292 (36.0)	385 (43.8)	0.000	673 (29.7)	446 (35.0)*
Knowledge of local emergency response systems								
Evacuation route	2652 (74.9)	742 (75.1)	599 (69.5)	626 (77.2)	685 (77.8)	0.003	1767 (78.0)*	885 (69.4)
Emergency shelter	2210 (62.4)	584 (59.1)	523 (60.7)	500 (61.7)	603 (68.5)	0.001	1447 (63.9)	763 (59.8)
Emergency phone numbers	3325 (93.9)	915 (92.6)	788 (91.4)	781 (96.3)	841 (95.6)	0.000	2170 (95.8)*	1155 (90.6)
Actions on nine or more indicators	352 (9.9)	48 (4.9)	91 (10.6)	92 (11.3)	121 (13.8)	0.001	236 (10.4)	116 (9.1)

**p<0.05 in urban-rural comparisons.*

Factors associated with emergency preparedness

The level of well-preparedness varied by region, household income, emergency training, knowledge and

attitudes toward emergency preparedness, self-reliance, and fate submissiveness ($p<0.05$ in chi-square tests, Table 3). However, no significant differences in the level of well-preparedness were found in respondents of a different gender, age, education, residency, prior exposure to emergency events, and risk awareness ($p>0.05$ in chi-square tests, Table 3).

Table 3. Factors associated with emergency preparedness: results of logistic regression models (n=3541)

Independent variable	N	N (%) of well-prepared	AOR	(95% Confidence Interval)		*P*
Gender						
Male (reference)	1614	169 (10.5)				
Female	1927	183 (9.5)	0.871	(0.692,	1.096)	0.238
Age (Years)						0.131
18-30 (reference)	1010	98 (9.7)				
31-50	1687	166 (9.8)	1.003	(0.760,	1.324)	0.981
51+	844	88 (10.4)	1.329	(0.959,	1.840)	0.087
Education						
College degree or above	1476	152 (10.3)	0.979	(0.777,	1.234)	0.858
No college degree (reference)	2065	200 (9.7)				
Residency						
Urban	2277	236 (10.4)	1.079	(0.816,	1.426)	0.595
Rural (reference)	1264	116 (9.2)				
Region*						
Beijing (reference)	988	48 (4.9)				
Heilongjiang	862	91 (10.6)	3.473	(2.359	5.115)	0.000
Guangdong	811	92 (11.3)	3.590	(2.413	5.342)	0.000
Sichuan	880	121 (13.8)	3.692	(2.547,	5.354)	0.000
Monthly household income (Yuan)*						
0-3499 (reference)	1659	147 (8.9)				
3500+	1882	205 (10.9)	1.400	(1.067,	1.838)	0.015
Prior exposure to emergency events						
Yes	1332	155 (11.6)	1.254	(0.965,	1.629)	0.091
No (reference)	2209	197 (8.9)				
Participation in emergency training*						
Yes	957	158 (16.5)	2.458	(1.937,	3.119)	0.000
No (reference)	2584	194 (7.5)				
Emergency knowledge score*						
> average	3127	333 (10.6)	2.278	(1.403,	3.699)	0.001
≤ average (reference)	414	19 (4.6)				
Risk awareness score						
> average	1302	145 (11.1)	1.173	(0.922,	1.493)	0.195
≤ average (reference)	2239	207 (9.2)				
Attitudes toward emergency*						
> average	1947	216 (11.1)	1.295	(1.012,	1.657)	0.040
≤ average (reference)	1594	136 (8.5)				
Self-reliance*						
> average	2378	263 (11.1)	1.376	(1.059,	1.787)	0.017
≤ average (reference)	1163	86 (7.4)				
Fate submissiveness*						
> average (reference)	431	31 (7.2)				
≤ average	3110	321 (10.3)	1.622	(1.080,	2.437)	0.020
Constants			0.000			0.000

* $p<0.05$ in univariate chi-square tests

The logistic regression model confirmed that socio-economic status, knowledge and attitudes toward emergency preparedness were significant predictors of the level of well-preparedness after adjustments for variations in other variables. A higher level of preparedness was found in respondents who participated in emergency training activities (AOR=2.458), had better emergency knowledge (AOR=2.278), reported less fate-submissiveness (AOR=1.622) and more self-reliance (AOR=1.376), had a higher income (AOR=1.400), and held more positive attitudes toward preparedness (AOR=1.295) (Table 3).

The perceived barriers reported by the respondents for hindering household preparedness echoed well with the findings of the logistic model. More than half (53.6%) of the respondents cited knowledge shortage as a major barrier. This was followed by inertia: 31.6% did not want to think about it; 28.1% believed that emergency professionals would do the rescue job for them; 21.5% did not believe an emergency would happen to the family. In addition, 24.4% of respondents blamed the government and the public media for the limited availability of information. Resource restrictions were not perceived as a major barrier for household emergency preparedness: less than 20% respondents cited the lack of time, money and personal ability as a barrier (Figure 1).

DISCUSSION

Low level of household preparedness in China

Overall, the level of household emergency preparedness in China is low, with less than 10% of households acting on nine or more emergency indicators out of a possible 14. This result is consistent with the findings of studies conducted elsewhere in China.[23] Poor household preparedness for emergency events is common in many developing countries, such as Turkey and Iran.[17,19] The performance of developed countries, although better than in developing countries, is also far from satisfactory. In Australia, about one-fifth of households have sufficient supplies of items for emergency events such as a torch, radio, mobile phone, first aid kit, appropriate batteries and an emergency contact list.[24] A study in the US revealed that 12.3% of American households possessed a three-day supply of water and nonperishable food, an evacuation plan, a working flashlight and radio.[25] Similarly, 30% of households in Japan stockpiled food and drinking water for emergency events.[17]

Factors contributing to the low level of household preparedness

Findings of the logistic regression model and ranking of perceived barriers reported by the respondents point to the same conclusion: knowledge is a major determinant of household emergency preparedness (Figure 2). The odds of well-preparedness doubles for respondents with a higher than average level of

knowledge. Training would also double the odds of well-preparedness, possibly through filling knowledge gaps. This is echoed by over half of the respondents who reported knowledge shortage as the major barrier to preparing for emergency events.

However, it is important to note that great efforts need to be made in community mobilization. Fate-submissiveness and a lack of recognition of self-reliance were identified as a significant predictor of poor-preparedness in the logistic regression model. Similarly, a lack of motivation to act ("do not want to think about it" and "leave it to professionals") was reported as the second most significant barrier in household emergency preparedness.

Surprisingly, the most developed region, Beijing, was found to be the worst performer, despite the fact that higher household income is associated with well-preparedness. The underlying reasons are unknown. But clearly, it cannot be fully explained by individual factors. This study also failed to confirm the significant effects of age, gender, education, prior experience and risk awareness as revealed in previous studies.[14, 26]

Policy implications

Large improvements can be made in relation to emergency preparedness in China. Public knowledge on emergency responses is universally poor in China.[23] Educational campaigns, if designed and implemented properly, can effectively improve public knowledge. However, this has to be done through multiple avenues. Governmental agencies can coordinate the timely provision of adequate information about emergency events. Emergency training can be offered through specifically designed drill exercise,[30] or as part of the national essential education system. In Japan, a disaster-prone country for example, disaster mitigation has been integrated into its national school curriculum.[31]

However, knowledge improvement by itself is not enough. The mentality of inertia in the public needs to be addressed. A positive correlation between the recognition of self–reliance and better household preparedness is evident as confirmed in this study and others.[32] But unfortunately, many traditional cultures encourage fate submissiveness.[18] A study in Saudi Arabia found that most (93%) respondents believed that floods, earthquakes and other natural disasters are signs of God.[33] Fatalism is an attitude of self-defeatism which may lead individuals into helpless, undermining their efforts of individual preparedness.[34-35] Chinese society also embraces an auspicious culture, encouraging people to pursue luck and avoid ominous things. It is taboo to talk about bad things, such as disaster and death. People prefer to pin their hopes on illusory things, rather than be prepared for real threats. [36-37]

Lessons learnt from past experiences may help change the mentality of inertia. In Australia, for example, bush fires impose a regular risk for many households. The preparedness of individual households can make a difference between life and death. The National Partnership Agreement on Natural Disaster Resilience in Australia therefore emphasizes the significance of involving multiple parties including individuals.[38] Emergency response systems are often complex and adaptive. A highly participatory strategy would

encourage individuals to take more responsibility, become less dependent on the government, and leave more resources for others.[39] Trust in the government is important given that it is most likely to play a coordinating role in emergency events.[40] However, over-reliance on the government and professional workers could dampen household efforts for future disasters.[41] A study of post-earthquake survivors in China showed that high expectations of the public on the government are associated with high trust in the government, leading to increased complacency in individual efforts in preparedness.[16] In China, governmental response to disasters from the military force has often been extraordinarily rapid and efficient. For example, an earthquake-relief headquarter was established by the army 18 minutes after the earthquake strike in Ya'an and 5000-6000 rescue workers were deployed on the same day. But people need to realize that there is always a gap before the full functioning of external rescue assistance, a gap which needs to be filled by the survivors of disasters.[7] Poor cooperation from those being rescued can also jeopardize professional efforts.

Conclusion

The overall level of household emergency preparedness in China is extremely low. A lack of knowledge presents a great barrier to household preparedness. Although training can be an effective measure for improving knowledge, a more comprehensive strategy needs to be adopted to address issues associated with the lack of motivation,. Emergency response systems should emphasize individual responsibilities as well as those from the government and professional workers.

Strengths and limitations

Strengths: As disaster–prone country, few studies on household preparedness were conducted in China. This study firstly investigated the situation with international commonly used indictors, to identify the factors & barriers preventing Chinese residents from preparing for emergency events. Except for some predictors consistent with previous researches, some interesting findings closely related with Chinese Auspicious culture contributed to the poor household preparedness. This paper could provide evidences for understanding and making targeted education programs for improving household disaster preparedness.

Limitations: There are several limitations in this study. One adult respondent was invited to represent each household in this study. But opinions from family members are not always consistent.[13] Household preparedness can involve many aspects. The 14 emergency items included in this study are not exhaustive. An emphasis on other aspects may lead to different results.

Data sharing statement No additional data are available.

Open access

Author contributions

YJ analyzed the data and drafted the manuscript. YH and QH took overall responsibility for the study design, coordinated and conducted the survey, and participated in writing this manuscript. WX, WLX, NN,

CY, LL, LG, ZK,TS, WS,RC participated in the design of the research and conducted the survey. CJ interpreted the results of statistical analyses, articulated the storyline, and wrote the manuscript. YJ, WX, WLX and NN contributed equally. Y H and QW as co-corresponding authors.

Conflicts of interests statement

We declare that we have no financial and personal relationships with other people or organizations that can inappropriately influence our work, there is no professional or other personal interest of any nature or kind in any product, service or company that could be construed as influencing the position presented in our study.

Patient and public involvement: No patient involved

Funding

This work was supported by the National Natural Scientific Fund of China grant number (71673072, 71173064, 71473065), and the Ministry of Health Public Benefit Fund for Health Sector (201002028), Heilongjiang Province philosophy & Social Science Fund (18GLD302).

Participant consent: Obtained.

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Figure legend/caption

Table 1. Socio-demographic characteristics of respondents

Table 2. Number and percentage (%) of households acting on emergency items

**p<0.05 in urban-rural comparisons.*

Table 3. Factors associated with emergency preparedness: results of logistic regression models (n=3541)

* $p<0.05$ in univariate chi-square tests

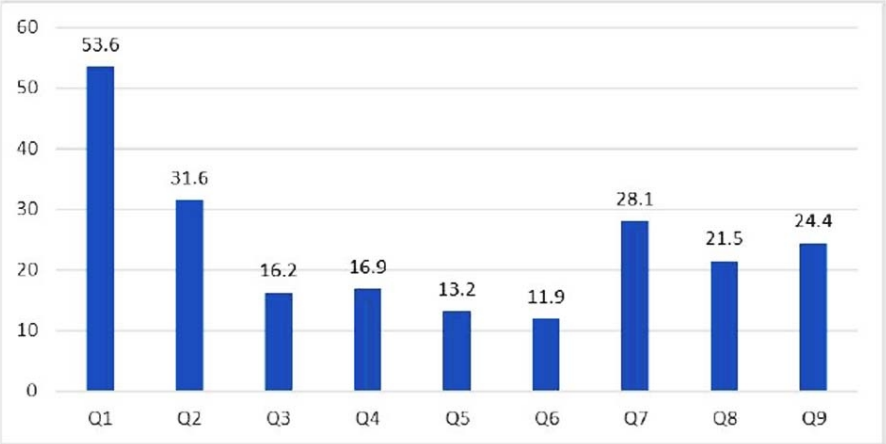
Figure 1. Barriers reported by respondents (%) for not preparing for emergencies

Figure 1 Note: Q1 "do not know what to do"; Q2 "do not want to think about it"; Q3 "nothing can be done"; Q4 "it takes too much time"; Q5 "it takes too much money"; Q6 "do not have the ability to prepare"; Q7 "professionals will do the rescue job"; Q8 "do not believe emergency will happen to the

family"; Q9 "do not have enough information from the government and the public media".

Figure 2. Link between perceived barriers and factors predicting well-preparedness

Figure 1. Barriers reported by respondents (%) for not preparing for emergencies



Note: Q1 "do not know what to do"; Q2 "do not want to think about it"; Q3 "nothing can be done"; Q4 "it takes too much time"; Q5 "it takes too much money"; Q6 "do not have the ability to prepare"; Q7 "professionals will do the rescue job"; Q8 "do not believe emergency will happen to the family"; Q9 "do not have enough information from the government and the public media".

Figure 1. Barriers reported by respondents (%) for not preparing for emergencies

90x90mm (300 x 300 DPI)

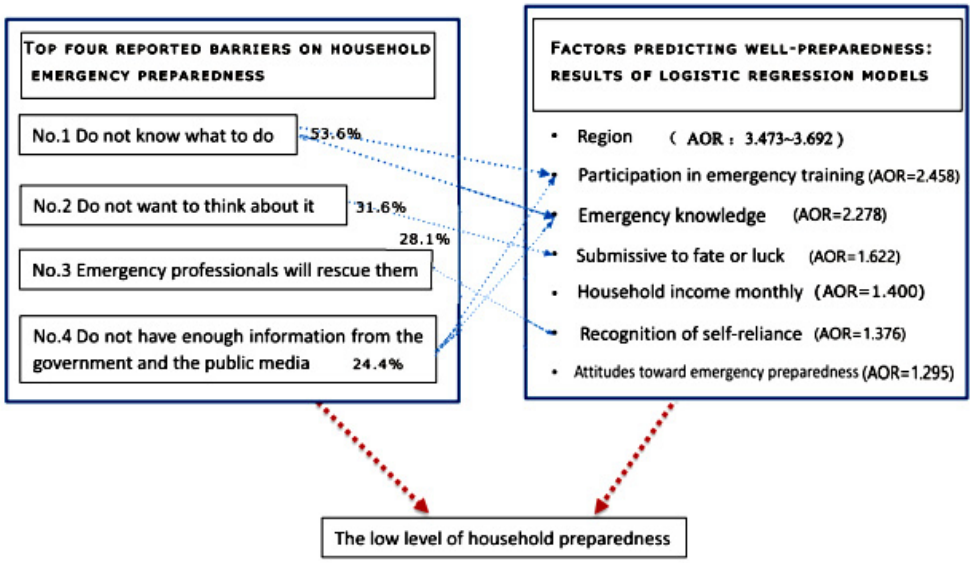


Figure 2. Link between perceived barriers and factors predicting well-preparedness

STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Page No	Recommendation
Title and abstract	1 √	2	(*a*) Indicate the study's design with a commonly used term in the title or the abstract
		2	(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found
Introduction			
Background/rationale	2 √	2	Explain the scientific background and rationale for the investigation being reported
Objectives	3 √	3	State specific objectives, including any prespecified hypotheses
Methods			
Study design	4 √	4	Present key elements of study design early in the paper
Setting	5 √	4	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection
Participants	6 √	4	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants
Variables	7 √	5	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable
Data sources/ measurement	8* √	6	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group
Bias	9		Describe any efforts to address potential sources of bias
Study size	10 √	6	Explain how the study size was arrived at
Quantitative variables	11 √	6	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why
Statistical methods	12 √	6	(*a*) Describe all statistical methods, including those used to control for confounding
		6	(*b*) Describe any methods used to examine subgroups and interactions
		6	(*c*) Explain how missing data were addressed
		6	(*d*) If applicable, describe analytical methods taking account of sampling strategy
			(*e*) Describe any sensitivity analyses
Results			
Participants	13* √	7	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed
			(b) Give reasons for non-participation at each stage
			(c) Consider use of a flow diagram
Descriptive data	14* √	7	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders
			(b) Indicate number of participants with missing data for each

			variable of interest
Outcome data	15* √	8	Report numbers of outcome events or summary measures
Main results	16 √	8-9	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included
		9	(*b*) Report category boundaries when continuous variables were categorized
		9	(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period
Other analyses	17		Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses
Discussion			
Key results	18 √	10-11	Summarise key results with reference to study objectives
Limitations	19 √	12	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias
Interpretation	20		Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence
Generalisability	21 √	12	Discuss the generalisability (external validity) of the study results
Other information			
Funding	22 √	13	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

BMJ Open

Household Emergency Preparedness In China: A Cross-Sectional Survey

Journal:	*BMJ Open*
Manuscript ID	bmjopen-2019-032462.R1
Article Type:	Original research
Date Submitted by the Author:	10-Sep-2019
Complete List of Authors:	Chen, Chao yi; Harbin Medical University, Social Medicine; Xu, Wei Dai, Yajun Xu, Weilan Liu, Chaojie; La Trobe University, Public Health Wu, Qunhong; Harbin Medical University, Social Medicine Gao, Lijun; Harbin Medical University, Social Medicine Kang, Zheng; Harbin Medical University, Health policy; Hao, Yanhua; Harbin Medical University, Social Medicine Ning, Ning; Harbin Medical University, Social Medicine
Primary Subject Heading:	Public health
Secondary Subject Heading:	Emergency medicine, Public health
Keywords:	ACCIDENT & EMERGENCY MEDICINE, PUBLIC HEALTH, Risk management < HEALTH SERVICES ADMINISTRATION & MANAGEMENT

Household Emergency Preparedness In China: A Cross-Sectional Survey
Title Page

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Word count: Main Text word count: 3180;

Conflict of interest statement:

We declare that we have no financial and personal relationships with other people or organizations that can inappropriately influence our work, there is no professional or other personal interest of any nature or kind in any product, service or company that could be construed as influencing the position presented in our study. Our study sponsor: Professor Yanhua Hao (corresponding author) initiated and coordinated the study. All of the data were collected from field surveys. The funders play no role in the design, data collection, data analyses, and writing of the manuscript.

Abstract

Objective This study aimed to assess household preparedness for emergency events and its determinants in China. **Design:** A cross-sectional questionnaire survey was conducted on 3,541 households in China in 2015. **Participants:** Households were selected using a stratified cluster sampling strategy, representing central, eastern, western and southern regions of China. The designed questionnaires were administered through face-to-face interviews. **Outcome Measures:** Household emergency preparedness was measured with 14 indicators, tapping into the supply of nine emergency necessities (food and water, extra batteries, battery-powered radio, battery-operated flashlight, first aid kit, gas mask, fire extinguisher, escape ropes, whistle), coverage of accident insurance, knowledge of local emergency response systems (emergency numbers, exit routes and shelters), and availability of a household evacuation plan. If an individual acted on nine of the 14 indicators, they were deemed well-prepared. Logistic regression models were established to identify predictors of well-preparedness based on 3,541 returned questionnaires containing no missing values. **Results:** Only 9.9% of households were well-prepared for emergencies: 53.6% did not know what to do and 31.6% did not want to think about it. A higher level of preparedness was found in the respondents who have attained higher education(AOR=0.826 compared with the higher level), participated in emergency training activities (AOR=2.299), had better emergency knowledge (AOR=2.043), reported less fate-submissiveness (AOR=1.385) and more self-reliance (AOR=1.349), prior exposure to emergency events(AOR=1.280), and held more positive attitudes toward preparedness (AOR=1.286). **Conclusion:** Household preparedness for emergency events is poor in China. Lack of motivation, negative attitude to preparedness and knowledge shortfall are major but remediable barriers for household preparedness.

Key word: household preparedness, emergency preparedness, disaster preparedness

Strengths and limitations

- This study quantified household preparedness for emergency events for the first time in China and identified factors associated with emergency preparedness
- The findings of the determinants of poor household preparedness are closely aligned with the Chinese Auspicious culture.
- One adult respondent from each household was invited to complete the survey. But opinions from the family members may not always been consistent.
- The 14 emergency items included in this study reflected priorities in emergency responses in China, which may not be exhaustive. The importance of the emergency items was not differentiated either.
- We presented the results of both logistic regression and linear regression analyses, which are largely consistent.

Introduction

No community is immune from the risk of emergencies and disasters in today's increasingly interconnected world. Many emergency events may be difficult to prevent. Inadequate preparation in response to these events can cause a tremendous loss in terms of human lives and health, property and infrastructure. It was estimated that natural disasters alone cost over US$ 100 billion annually worldwide.[1] According to the *2016*

Humanitarian Response Plan launched by the World Health Organization (WHO), US$ 2.2 billion was needed to provide lifesaving health services to more than 79 million people in more than 30 countries due to protracted emergencies that year.[2] In the first half year of 2016, 68.77 million people in China were affected by floods, hail and geological disasters, resulting in 505 deaths and a direct economic loss of 89.04 billion Chinese Yuan (US$12.9645 billion).[3]

Strengthening emergency responses can effectively reduce human casualties and contribute to sustainable post-event development. It is deemed a cost-effective investment in preventing losses and is considered one of the four priority areas in the Sendai Framework for Disaster Risk Reduction 2015-2030, which was endorsed by the third United Nations World Conference in Japan.[4] Over the past few decades, emergency response efforts have evolved from a focus on top-down relief assistance to a more comprehensive strategy with a greater emphasis on community participation and pre-event preparedness for better risk management. This is because emergency victims often face geographical isolation as a result of damage to local infrastructure such as energy, road and communication facilities.[5] Consequently, the arrival of external rescue support may experience two or more days of delay.[6] But rescue efforts in the first couple of days in disastrous events are critical.[7] Community and household preparedness in self-rescue efforts prior to the arrival of external assistance may result in the difference between the chance of survival and death.[8] Empirical evidence shows that sufficient household preparedness can significantly mitigate the negative consequences of emergency events.[9]

The United Nations International Strategy for Disaster Reduction (UNISDR) defined preparedness as the "knowledge, capacities and actions to effectively respond to the effects of hazard events, whether or not they have occurred".[10] Preparedness activities can be developed at the individual, household, community and governmental levels. Household preparedness plays a critical role because it is an integral part of any individual and community effort. The concept of household preparedness emphasizes household responsibilities and the capability to reduce risks and damage,[11] which requires stockpiling emergency supplies, planning for emergency events and other actions like buying accident insurance.[12-13]

Previous studies revealed poor household preparedness for disastrous events across a range of different settings.[14-15] Despite a rise in the number of publications on household preparedness in developed countries, there is a serious shortage of literature documenting the situation in developing countries. Empirical evidence shows that household preparedness is associated with many factors, including knowledge, risk awareness, prior exposure to disasters, attitudes toward emergency preparedness,[16] and trust in the government. Socioeconomic status may also play an important role.[17-18,] Developing countries are facing ever-increasing challenges and costs associated with disastrous events.But experiences from developed countries cannot be extrapolated to developing countries without consideration of the local contexts.

China is a disaster-prone country with the largest population and high population density. But little is known about the household preparedness of China in response to emergencies. This study aimed to assess the level of household emergency preparedness in China and identify the factors associated with household

preparedness. The findings of the study can provide evidence for better planning for the emergency response system.

METHODS

A cross-sectional questionnaire survey was conducted on 3,541 households in four regions of China.

Study population

A multistage stratified sampling strategy was adopted to select participating households. In the first stage, we identified four regions purposively considering diversities in geographic location and socioeconomic development: Beijing is the capital of China; Guangdong represents the most developed region in eastern China; Heilongjiang and Sichuan represent the less developed regions in central and western China, respectively. These four regions have a total population of more than 25 million, accounting for over 18% of the entire population in China. Of the four regions, Sichuan is an earthquake-prone area and recently experienced the Jiuzhaigou earthquake in 2017 and the Wenchuan earthquake in 2008. Guangdong is most frequently affected by typhoons. Meanwhile, many infectious diseases erupted in Guangdong, such as SARS in 2003 and dengue fever in 2014.

The second stage involved a selection of two municipalities in each province (two districts in Beijing) with varied social and economic conditions. We then randomly selected one urban and one rural residential community from each participating municipality/district. A total of 3,650 households in these communities were approached and invited to participate in this study: 1000 in Beijing, 850 in Guangdong, 900 in Heilongjiang and 900 in Sichuan.

Data collection

Data were collected from April to September 2015. A research team comprising ten trained researchers and postgraduate students from Harbin Medical University visited the selected households. One adult member from each household was interviewed. Verbal informed consent was obtained prior to the survey. The questionnaire was administered anonymously, which took about 20 minutes to complete. Of the 3,650 invited households, 3,580 (98.1%) completed the questionnaire survey. The final data analyses included 3,541 (98.9%) questionnaires that contained no missing values.

Dependent variable

Household preparedness was measured by 14 items that were commonly used in previous studies. A list of emergency items was generated through literature review. The selection of the emergency items in this study considered the relevance of the emergency items to the common disastrous events in China. The relevant emergency items were prioritized in accordance with the National Disaster Prevention Manual published by the Ministry of Civil Affairs of China and the CDC Behavioral Risk Factor Surveillance

System. These included nine general emergency necessities (three-day-supply of non-perishable food and water, battery-powered radio, extra batteries, battery-operated flashlight, first aid kit, gas mask, fire extinguisher, escape ropes, whistle) as recommended by the national public education "ready" program in the US and some preparedness items source from the General Preparedness Module,[18,19] as well as coverage of accident insurance, knowledge of local emergency response systems (emergency numbers, exit routes and shelters), and availability of an evacuation plan.[20-21]

Independent variables

The selection of independent variables was guided by two behavioral theories: the KAP (Knowledge, Attitudes and Practice) theory and the Theory of Reasoned Action (TRA). The KAP theory addresses the intertwined effects between knowledge, attitudes and behaviors, whereas, the TRA emphasizes the importance of human reasoning as many contextual factors can weigh into human decision on actions.[22-23]

The independent variables tested in this study included:

Demographic and socioeconomic characteristics: age, region and residency (urban vs rural), educational attainments, and monthly household income (estimated in Chinese Yuan). Previous studies showed that socioeconomic factors not only determine the available resources, but also predict the knowledge and attitudes of an individual toward human actions, in particular those for preventive purposes. People with low socioeconomic status are less likely to invest and act on risk prevention and risk management activities.[24-25]

Knowledge: 16 statements were designed based on the national guidelines for emergency responses in China to test the relevant knowledge of respondents. They were asked to judge whether these statements were correct, incorrect, or if they were unsure. A correct answer was given a score of one point. This generated an overall knowledge score for each respondent ranging from 0 to 16.

Risk awareness: respondents were asked to rate their concerns about natural and man-made disasters, social safety events, and public health emergencies on a five-point Likert scale (1-5). A summed score was calculated for each respondent (ranging from 4 to 20), with a higher score indicating a higher level of concern.

Attitudes: respondents were asked to rate on a five-point Likert scale (1-5) their interests in gathering information regarding emergency responses, perceived importance of such information, and willingness to discuss this topic with others. A summed score was calculated (ranging from 3 to 15), with a higher score indicating a higher level of endorsement with emergency preparedness.

Fate-submissiveness and self-reliance: respondents were asked to rate on a five-point Likert scale (1-5) their inclination of submissiveness to fate or luck, in comparison with the determination of self-rescue in emergency events.

Past experience: prior exposure to emergency events and participation in emergency training activities over the past year were measured in this study. Experiences play a pivotal role in the development of human behaviors.[26]

Respondents were also asked to choose all the reasons that prevented "people from preparing for emergencies" from the following list: (1) "do not know what to do"; (2) "do not want to think about it"; (3) "nothing can be done"; (4) "it takes too much time"; (5) "it takes too much money"; (6) "do not have the ability to prepare"; (7) "professionals will do the rescue job"; (8) "do not believe emergency will happen to the family"; (9) "do not have enough information from the government and the public media". The list was developed based on findings of previous studies.[27-28]

Statistical analysis

We estimated the number and percentage of households acting on each of the 14 indicators for emergency preparedness. These indicators were commonly used for measuring the preparedness of the household. Each positive answer was given 1 point. A score of actions on over nine out of the 14 points was categorized as well prepared. Differences in actions across households were tested using chi-square tests.

A multivariate logistic regression model was established to identify independent variables associated with well-preparedness. We also performed a linear regression analysis using the "summed points" as a dependent variable.

In the regression models, independent variables measuring knowledge, risk awareness, attitudes, fate-submissiveness and self-reliance were transformed into a nominal measure: 'above average score' versus 'on/below average score'. The models employed an enter approach based on the maximum likelihood estimation method, with an enter/exit criterion (α) of 0.05/0.01. All statistical analyses were performed using SPSS V.22.0.

Ethics approval

This study was funded by the National Natural Science Foundation of China. Ethics approval for the study protocol was obtained from the Ethics Committee of Harbin Medical University.

RESULTS

Characteristics of respondents

Nearly half (47.9%) of the respondents were aged between 31 to 50 years; 54.4% were women; 41.7% held a college degree or above; 72.1% had a monthly household income of above ¥3500. Most (64.3%) respondents lived in urban areas. The majority (79.2%) were married at the time of the survey (Table 1).

Table 1. Socio-demographic characteristics of respondents

Characteristics	N	%
Gender		
Male	1614	45.6
Female	1927	54.4
Age (Years)		
18-24	359	10.1
25-44	1882	53.2
45-64	994	28.1
>64	282	8.6
Education		
Secondary education or below	1325	37.4
High school education	740	20.9
College or above	1476	41.7
Residency		
Urban	2277	64.3
Rural	1264	35.7
Region		
Beijing	988	27.9
Heilongjiang	862	24.3
Guangdong	811	22.9
Sichuan	880	24.9
Monthly household income (Yuan)		
0-3499	987	27.9
3500+	2554	72.1
Marital status		
Married	2803	79.2
Not married	738	20.8

Household emergency preparedness

The respondents had relatively good knowledge of their local emergency response systems, with 93.9% knowing the emergency numbers, 74.9% being aware of the evacuation exit routes, and 62.4% being able to locate the emergency shelters. But less than half of the households were well-prepared in terms of necessities (apart from 80% having a battery-operated flashlight), having accident insurance coverage, and having developed an evacuation plan. Overall, households in Beijing performed worse than those in the other regions. Urban households outperformed their rural counterparts in insurance coverage and knowledge of local emergency response systems. But rural households were more likely to have an evacuation plan and stockpile food/water, radio, flashlight and escape ropes. Only a small number of households (9.9%) were deemed well-prepared, acting on nine or more of the emergency indicators s

(Table 2).

Table 2. Number and percentage (%) of households acting on emergency items

Action	Total N=3541	Regions					Residency	
		Beijing N=988	Heilongjiang N=862	Guangdong N=811	Sichuan N=880	P	Urban N=2266	Rural N=1275
Possession of emergency necessities								
three-day supply of food and water	1101 (31.1)	230 (23.3)	350 (40.6)	264 (32.6)	257 (29.2)	<0.001	684 (30.2)	417 (32.7)*
extra batteries	1151 (32.5)	261 (26.4)	313 (36.3)	268 (33.0)	309 (35.1)	<0.001	728 (32.1)	423 (33.2)
battery-powered radio	990 (28.0)	187 (18.9)	338 (39.2)	239 (29.5)	226 (25.7)	<0.001	600 (26.5)	390 (30.6)*
battery-operated flashlight	2843 (80.3)	718 (72.7)	704 (81.7)	651 (80.3)	770 (87.5)	<0.001	1760 (77.7)	1083 (84.9)*
first aid kit	1215 (34.3)	307 (31.1)	237 (27.5)	382 (47.1)	289 (32.8)	<0.001	881 (38.9)*	334 (26.2)
gas mask	164 (4.6)	36 (3.6)	39 (4.5)	58 (7.2)	31 (3.5)	0.001	113 (5.0)	51 (4.0)
fire extinguisher	931 (26.3)	174 (17.6)	148 (17.2)	315 (38.8)	294 (33.4)	<0.001	625 (27.6)*	306 (24.0)
escape rope	403 (11.4)	69 (7.0)	141 (16.4)	94 (11.6)	99 (11.3)	<0.001	233 (10.3)	170 (13.3)*
whistle	387 (10.9)	95 (9.6)	117 (13.6)	73 (9.0)	102 (11.6)	0.010	264 (11.7)*	123 (9.6)
Coverage of accident insurance	819 (23.1)	291 (29.5)	147 (17.1)	132 (16.3)	249 (28.3)	<0.001	582 (25.7)*	237 (18.6)
Household evacuation plan	1083 (30.6)	151(15.3)	255 (29.6)	292 (36.0)	385 (43.8)	<0.001	673 (29.7)	446 (35.0)*
Knowledge of local emergency response systems								
Evacuation route	2652 (74.9)	742 (75.1)	599 (69.5)	626 (77.2)	685 (77.8)	0.003	1767 (78.0)*	885 (69.4)
Emergency shelter	2210 (62.4)	584 (59.1)	523 (60.7)	500 (61.7)	603 (68.5)	0.001	1447 (63.9)	763 (59.8)
Emergency phone numbers	3325 (93.9)	915 (92.6)	788 (91.4)	781 (96.3)	841 (95.6)	<0.001	2170 (95.8)*	1155 (90.6)
Actions on nine or more indicators	352 (9.9)	48 (4.9)	91 (10.6)	92 (11.3)	121 (13.8)	0.001	236 (10.4)	116 (9.1)

**p<0.05 in urban-rural comparisons.*

About 0.4% of households did not prepare any emergency items at home, compared with 2.3% having one item and 10.9% having three items. The majority of households owned 5 emergency items. About 10% owned over 9 emergency items (Figure 1).

Factors associated with emergency preparedness

The level of well-preparedness varied by region, prior exposure to emergency events , emergency training, knowledge and attitudes toward emergency preparedness, education, self-reliance, and fate submissiveness ($p<0.05$ in chi-square tests, Table 3). However, no significant differences in the level of well-preparedness were found in respondents of a different gender, age, residency, and risk awareness ($p>0.05$ in chi-square tests, Table 3).

The logistic regression model confirmed that socio-economic status, knowledge and attitudes toward emergency preparedness were significant predictors of the level of well-preparedness after adjustments for variations in other variables. Higher levels of preparedness were associated with higher educational attainments, participation in emergency training activities (AOR=2.299), better emergency knowledge (AOR=2.043), less fate-submissiveness (AOR=1.385) and more self-reliance (AOR=1.349), prior exposure to emergency events (AOR=1.280) and more positive attitudes toward preparedness (AOR=1.286) (Table 3). The linear regression analysis generated similar results (Supplementary file).

Table 3. Factors associated with emergency preparedness: results of logistic regression models (n=3541)

Independent variable	N	N (%) of well-prepared	AOR	(95% Confidence Interval)		*P*
Gender						
Male (reference)	1614	169 (10.5)	1.134	(0.949,	1.356)	0.167
Female	1927	183 (9.5)				
Age (Years)						
18-24 (reference)	359	67(1.9)				
25-44	1882	371(10.5)	0.773	(0.539,	1.110)	0.440
45-64	994	161(4.6)	0.939	(0.666,	1.322)	0.716
>64	282	51(1.5)	0.846	(0.553,	1.829)	0.440
Education*						
Secondary education or below	1325	257(7.3)	0.757	(0.591,	0.970)	0.028
High school education	740	123(3.5)	0.826	(0.677,	1.007)	0.059
College or above (reference)	1476	275(7.8)				
Residency						
Urban	2277	236 (10.4)	1.142	(0.940,	1.382)	0.181
Rural (reference)	1264	116 (9.2)				
Region*						
Beijing (reference)	988	48 (4.9)				
Heilongjiang	862	91 (10.6)	3.409	(2.531,	4.592)	0.000
Guangdong	811	92 (11.3)	3.890	(2.910,	5.199)	0.000
Sichuan	880	121 (13.8)	3.450	(2.574,	4.625)	0.000
Monthly household income (Yuan)						
0-3499 (reference)	987	191 (5.4)				
3500+	2554	464 (13.1)	1.202	(0.972,	1.486)	0.089
Prior exposure to emergency events*						
Yes	1332	155 (11.6)	1.280	(1.042,	1.571)	0.019
No (reference)	2209	197 (8.9)				
Participation in emergency training* last year						
Yes	957	158 (16.5)	2.299	(1.902,	2.779)	0.000
No (reference)	2584	194 (7.5)				
Emergency knowledge score*						
> average	3127	333 (10.6)	2.043	(1.460,	2.859)	0.000
≤ average (reference)	414	19 (4.6)				
Risk awareness score						
> average	1302	145 (11.1)	1.047	(0.866,	1.265)	0.638
≤ average (reference)	2239	207 (9.2)				
Attitudes toward emergency preparedness*						
> average	1947	216 (11.1)	1.286	(1.067,	1.575)	0.011
≤ average (reference)	1594	136 (8.5)				
Self-reliance*						
> average	2378	263 (11.1)	1.349	(1.059,	1.562)	0.018
≤ average (reference)	1163	86 (7.4)				
Fate submissiveness*						
> average (reference)	431	31 (7.2)				
≤ average	3110	321 (10.3)	1.385	(1.028,	1.868)	0.033
Constants			0.015			0.000

* $p<0.05$ in univariate chi-square tests

The perceived barriers reported by the respondents for hindering household preparedness echoed well with the findings of the regression models. More than half (53.6%) of the respondents cited knowledge shortage as a major barrier. This was followed by inertia: 31.6% did not want to think about it; 28.1% believed that emergency professionals would do the rescue job for them; 21.5% did not believe an emergency would happen to the family. In addition, 24.4% of respondents blamed the government and the public media for the limited availability of information. Resource restrictions were not perceived as a major barrier for household emergency preparedness: less than 20% respondents cited the lack of time, money and personal ability as a barrier (Figure 2).

DISCUSSION

Low level of household preparedness in China

Overall, the level of household emergency preparedness in China is low, with less than 10% of households acting on nine or more emergency indicators out of a possible 14. This result is consistent with the findings of studies conducted elsewhere in China. Poor household preparedness for emergency events is common in many developing countries, such as Turkey and Iran.[29] The performance of developed countries, although better than in developing countries, is also far from satisfactory. In Australia, about one-fifth of households have sufficient supplies of items for emergency events such as a torch, radio, mobile phone, first aid kit, appropriate batteries and an emergency contact list. A study in the US revealed that 12.3% of American households possessed a three-day supply of water and nonperishable food, an evacuation plan, a working flashlight and radio. Similarly, 30% of households in Japan stockpiled food and drinking water for emergency events.[15]

Factors contributing to the low level of household preparedness

Findings of the logistic regression model and ranking of perceived barriers reported by the respondents point to the same conclusion: knowledge is a major determinant of household emergency preparedness (Figure 3). The odds of well-preparedness doubled in the respondents with a higher than average level of knowledge. Training would also double the odds of well-preparedness, possibly through filling knowledge gaps. This is echoed by over half of the respondents who reported knowledge shortage as the major barrier to preparing for emergency events. The association between knowledge and preparedness for emergency events is further supported by the link between education in general and preparedness. Prior exposure to emergency events may also improve the knowledge and attitudes of people, resulting in better preparedness for emergency events. These findings are consistent with previous studies.[30, 31]

Fate-submissiveness and a lack of recognition of self-reliance were identified as a significant predictor of poor-preparedness in the logistic regression model. Similarly, a lack of motivation to act ("do not want to think about it" and "leave it to professionals") was reported as the second most significant barrier in

household emergency preparedness.

Surprisingly, the most developed region, Beijing, was found to be the worst performer. The underlying reasons warrant further studies. Clearly, the results cannot be fully explained by individual differences.

Similar to the results of this study, gender and age were not found to be associated with disaster preparedness in several previous studies.[32,33]

Policy implications

Large improvements can be made in relation to emergency preparedness in China. Public knowledge on emergency responses is universally poor in China. Educational campaigns, if designed and implemented properly, can effectively improve public knowledge. However, this has to be done through multiple avenues. Governmental agencies can coordinate the timely provision of adequate information about emergency events. Emergency training can be offered through specifically designed drill exercise,[34] or as part of the national essential education system. In Japan, a disaster-prone country for example, disaster mitigation has been integrated into its national school curriculum.[35]

However, knowledge improvement by itself is not enough. The mentality of inertia in the public needs to be addressed. A positive correlation between the recognition of self–reliance and better household preparedness is evident as confirmed in this study and others.[36] But unfortunately, many traditional cultures encourage fate submissiveness. A study in Saudi Arabia found that most (93%) respondents believed that floods, earthquakes and other natural disasters are signs of God.[37] Fatalism is an attitude of self-defeatism which may lead individuals into helpless, undermining their efforts of individual preparedness.[38-39] The Chinese society also embraces an auspicious culture, encouraging people to pursue luck and avoid ominous things. It is taboo to talk about bad things, such as disaster and death. People prefer to pin their hopes on illusory things, rather than be prepared for real threats. [40-41]

Lessons learned from past disaster experiences may help change the mentality of inertia and risk perception. In Australia, for example, bush fires impose a regular risk for many households. The preparedness of individual households can make a difference between life and death. The National Partnership Agreement on Natural Disaster Resilience in Australia therefore emphasizes the significance of involving multiple parties including individuals.[42] Emergency response systems are often complex and adaptive. A highly participatory strategy would encourage individuals to take more responsibility, become less dependent on the government, and leave more resources for others.[43] Trust in the government is important given that it is most likely to play a coordinating role in emergency events.[44] However, over-reliance on the government and professional workers could dampen household efforts for future disasters.[45] A study of post-earthquake survivors in China showed that high expectations of the public on the government are associated with high trust in the government, leading to increased complacency in individual efforts in preparedness.[16] In China, governmental response to disasters from the military force has often been extraordinarily rapid and efficient.

For example, an earthquake-relief headquarter was established by the army 18 minutes after the earthquake strike in Ya'an and 5000-6000 rescue workers were deployed on the same day. But people need to realize that there is always a gap before the full functioning of external rescue assistance, a gap which needs to be filled by the survivors of disasters.[7] Poor cooperation from those being rescued can also jeopardize professional efforts.

Conclusion

The overall level of household emergency preparedness in China is extremely low. A lack of knowledge presents a great barrier to household preparedness. Although training can be an effective measure for improving knowledge, a more comprehensive strategy needs to be adopted to address issues associated with the lack of motivation. Emergency response systems should emphasize individual responsibilities as well as those from the government and professional workers.

Data sharing statement All data relevant to the study are included in the article or uploaded as supplementary information.

Author contributions

CY，WX，YJ,and WLX analyzed the data and drafted the manuscript. YH and NN took overall responsibility for the study design, coordinated and conducted the survey, and participated in writing and modifying this manuscript. QW, LG, and ZK participated in the design of the study, data collection, and writing of the manuscript. Chaojie Liu interpreted the results of statistical analyses, articulated the storyline, and wrote the manuscript.* CY, WX these two authors contributed equally.

Acknowledgement

The authors are grateful to the support of local officials including three senior researchers(Tie Song, Wei Sun, Ruoxiang Cao in data collection in the sampled municipalities) lead the investigation in different parts of China. Additionally, we thank Mingli Jiao, Hong Sun and Libo Liang for their advice in this study. We are grateful to the participants of the study and the postgraduate students who helped collection and preparation of the data.

Conflicts of interests statement

We declare that we have no financial and personal relationships with other people or organizations that can inappropriately influence our work, there is no professional or other personal interest of any nature or kind

in any product, service or company that could be construed as influencing the position presented in our study.

Patient and public involvement: Patients and the public were not involved in the design or planning of the study.

Funding

This work was supported by the National Natural Scientific Fund of China grant number (71673072, 71173064, 71473065), and the Ministry of Health Public Benefit Fund for Health Sector (201002028), Heilongjiang Province philosophy & Social Science Fund (18GLD302).

Participant consent: Obtained in this study.

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Figure legend/caption

Table 1. Socio-demographic characteristics of respondents

Table 2. Number and percentage (%) of households acting on emergency items

**p<0.05 in urban-rural comparisons.*

Table 3. Factors associated with emergency preparedness: results of logistic regression models (n=3541)

* $p<0.05$ in univariate chi-square tests

Figure 1. Distribution (%) of households preparedness of 14 emergency items

Figure 2. Barriers reported by respondents (%) for not preparing for emergencies

Figure 2 Note: Q1 "do not know what to do"; Q2 "do not want to think about it"; Q3 "nothing can be done"; Q4 "it takes too much time"; Q5 "it takes too much money"; Q6 "do not have the ability to prepare"; Q7 "professionals will do the rescue job"; Q8 "do not believe emergency will happen to the family"; Q9 "do not have enough information from the government and the public media".

Figure 3. Link between perceived barriers and factors predicting well-preparedness

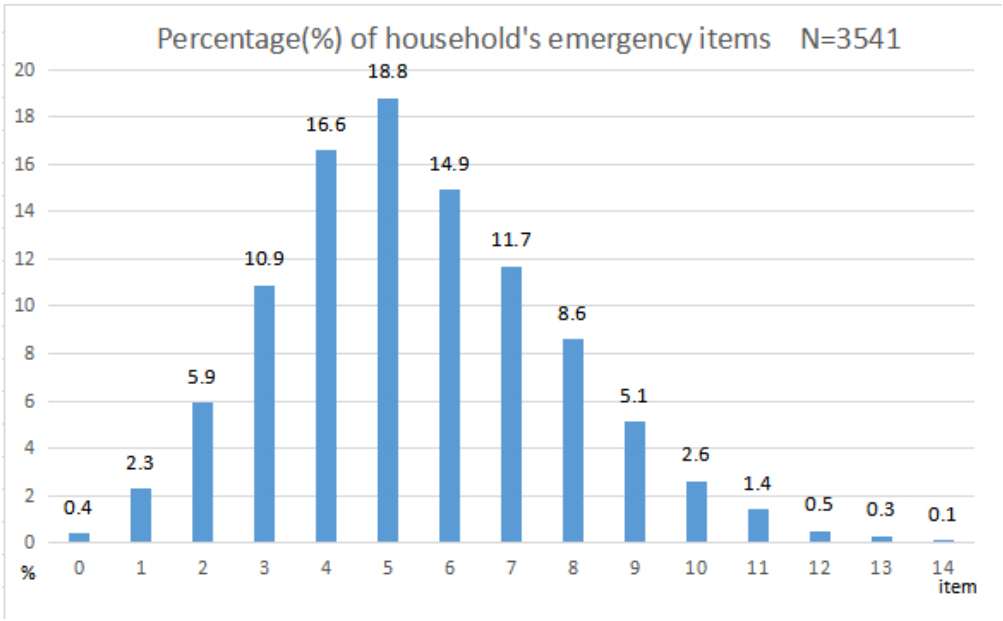
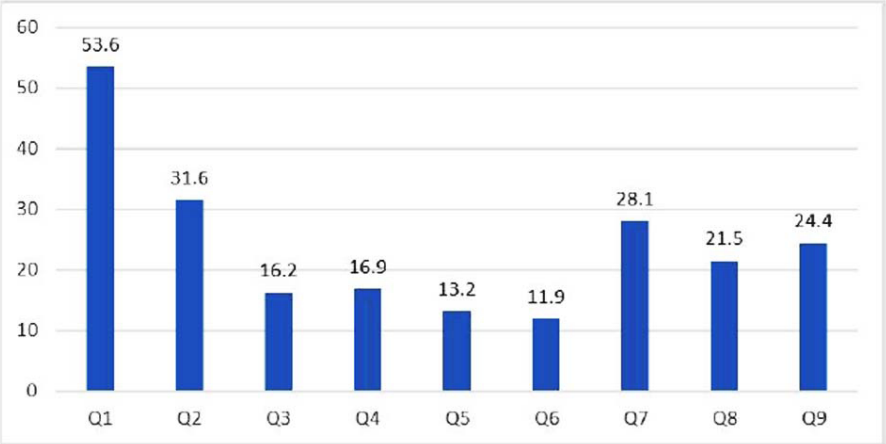

Percentage(%) of household's emergency items N=3541
20
18
16
14
12
10
8
6
4
2
0
%
0.4
2.3
5.9
10.9
16.6
18.8
14.9
11.7
8.6
5.1
2.6
1.4
0.5
0.3
0.1
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14
item

Figure 2. Barriers reported by respondents (%) for not preparing for emergencies



Note: Q1 "do not know what to do"; Q2 "do not want to think about it"; Q3 "nothing can be done"; Q4 "it takes too much time"; Q5 "it takes too much money"; Q6 "do not have the ability to prepare"; Q7 "professionals will do the rescue job"; Q8 "do not believe emergency will happen to the family"; Q9 "do not have enough information from the government and the public media".

Figure 2

Figure 3. Link between perceived barriers and factors predicting well-preparedness

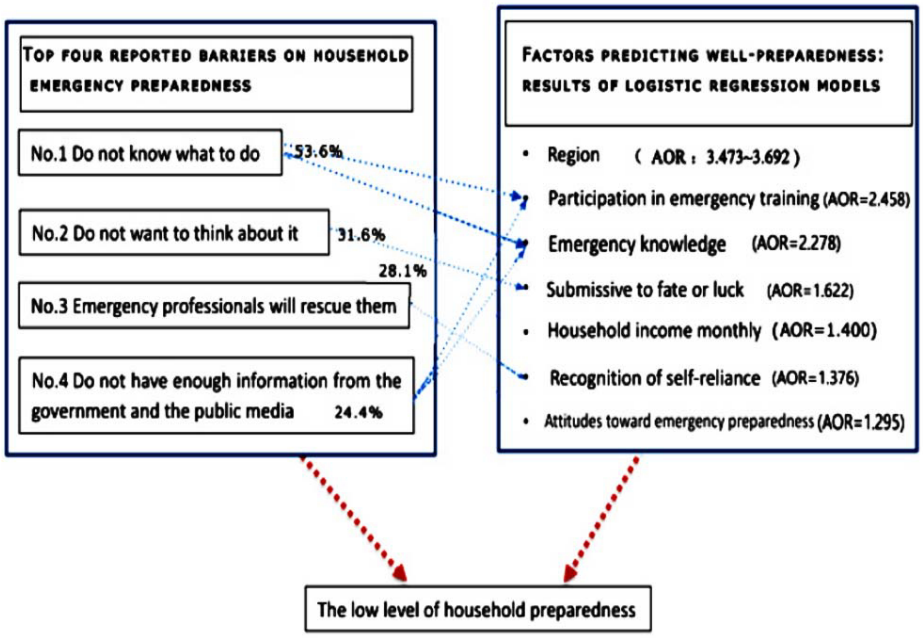


Figure 3

Attachment 1. Re-analyze the data by multiple linear regression approach.

	Non-standardization coefficient		Standardized beta	T	p
	β	Standard error			
Constants	4.936	.188		26.202	<.001
Participation in emergency training	.958	.084	.186	11.409	<.001
Region	-.304	.034	-.151	-8.838	<.001
Emergency knowledge	.815	.116	.115	7.027	<.001
Self-reliance	.460	.095	.080	4.840	<.001
Emergency experience	.316	.080	.067	3.959	<.001
Attitudes toward emergency preparedness	.345	.082	.075	4.228	<.001
Fate submissiveness	-.330	.097	-.059	-3.397	.001
Gender	-.190	.074	-.041	-2.551	.011

After multiple linear regression analysis, five factors were excluded, and total of eight factors were identified in the regression equation. The variables affecting the total emergency preparedness of household were gender, participation in emergency training, emergency experience, province, self-efficacy, etc. Compared with the results of logistic regression, it is only increase the gender variable as significant one. However, this survey is mainly conducted on the household preparedness level, thus, gender cannot be a key Influential variable. After analysis of variance, $F=40.533$ $P<0.01$, indicating that the model is statistically significant, with $R^2=0.083$ after adjustment. The Durbin-Waston test is used to analyze whether the residuals are independent of each other. The DW value is 1.733, indicating that the residuals are independent of each other. At the same time, the variance expansion factor VIF is between 1.000-1.208, both <10 (that is, the tolerance is >0.1), indicating that there is no multicollinearity between the variables. (**Attachment 1**)

STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Page No	Recommendation
Title and abstract	1 √	2	(*a*) Indicate the study's design with a commonly used term in the title or the abstract
		2	(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found
Introduction			
Background/rationale	2 √	2	Explain the scientific background and rationale for the investigation being reported
Objectives	3 √	3	State specific objectives, including any prespecified hypotheses
Methods			
Study design	4 √	4	Present key elements of study design early in the paper
Setting	5 √	4	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection
Participants	6 √	4	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants
Variables	7 √	5	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable
Data sources/ measurement	8* √	6	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group
Bias	9		Describe any efforts to address potential sources of bias
Study size	10 √	6	Explain how the study size was arrived at
Quantitative variables	11 √	6	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why
Statistical methods	12 √	6	(*a*) Describe all statistical methods, including those used to control for confounding
		6	(*b*) Describe any methods used to examine subgroups and interactions
		6	(*c*) Explain how missing data were addressed
		6	(*d*) If applicable, describe analytical methods taking account of sampling strategy
			(*e*) Describe any sensitivity analyses
Results			
Participants	13* √	7	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed
			(b) Give reasons for non-participation at each stage
			(c) Consider use of a flow diagram
Descriptive data	14* √	7	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders
			(b) Indicate number of participants with missing data for each

			variable of interest
Outcome data	15* √	8	Report numbers of outcome events or summary measures
Main results	16 √	8-9	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included
		9	(*b*) Report category boundaries when continuous variables were categorized
		9	(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period
Other analyses	17		Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses
Discussion			
Key results	18 √	10-11	Summarise key results with reference to study objectives
Limitations	19 √	12	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias
Interpretation	20		Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence
Generalisability	21 √	12	Discuss the generalisability (external validity) of the study results
Other information			
Funding	22 √	13	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

BMJ Open

Household Preparedness for Emergency Events: a cross-sectional survey on residents in four regions of China

Journal:	*BMJ Open*
Manuscript ID	bmjopen-2019-032462.R2
Article Type:	Original research
Date Submitted by the Author:	10-Oct-2019
Complete List of Authors:	Chen, Chao yi; Harbin Medical University, Social Medicine; Xu, Wei; Harbin Medical University, Scoool of Health Management Dai, Yajun; Harbin Medical University, the school of Public Health Xu, Weilan; Harbin Medical University, the school of Public Health Liu, Chaojie; La Trobe University, Public Health Wu, Qunhong; Harbin Medical University, the School of Health Management Gao, Lijun; Harbin Medical University, the School of Health Management Kang, Zheng; Harbin Medical University, The School of Health Management; Hao, Yanhua; Harbin Medical University, The school of Health Management Ning, Ning; Harbin Medical University, Social Medicine
Primary Subject Heading:	Public health
Secondary Subject Heading:	Emergency medicine, Public health
Keywords:	ACCIDENT & EMERGENCY MEDICINE, PUBLIC HEALTH, Risk management < HEALTH SERVICES ADMINISTRATION & MANAGEMENT

Household Preparedness for Emergency Events: a cross-sectional survey on residents in four regions of China

Title Page

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Word count: Main Text word count: 3750;

Conflict of interest statement:

We declare that we have no financial and personal relationships with other people or organizations that can inappropriately influence our work, there is no professional or other personal interest of any nature or kind in any product, service or company that could be construed as influencing the position presented in our study. Our study sponsor: Professor Yanhua Hao (corresponding author) initiated and coordinated the study. All of the data were collected from field surveys. The funders play no role in the design, data collection, data analyses, and writing of the manuscript.

Abstract

Objective This study aimed to assess household preparedness for emergency events and its determinants in China. **Design:** A cross-sectional questionnaire survey was conducted on 3,541 households in China in 2015. **Participants:** Households were selected using a stratified cluster sampling strategy, representing central, eastern, western and southern regions of China. The designed questionnaires were administered through face-to-face interviews. **Outcome Measures:** Household emergency preparedness was measured with 14 indicators, tapping into the supply of nine emergency necessities (food and water, extra batteries, battery-powered radio, battery-operated flashlight, first aid kit, gas mask, fire extinguisher, escape ropes, whistle), coverage of accident insurance, knowledge of local emergency response systems (emergency numbers, exit routes and shelters), and availability of a household evacuation plan. If an individual acted on nine of the 14 indicators, they were deemed well-prepared. Logistic regression models were established to identify predictors of well-preparedness based on 3,541 returned questionnaires containing no missing values. **Results:** Only 9.9% of households were well-prepared for emergencies: 53.6% did not know what to do and 31.6% did not want to think about it. A higher level of preparedness was found in the respondents who have attained higher education(AOR=0.826 compared with the higher level), participated in emergency training activities (AOR=2.299), had better emergency knowledge (AOR=2.043), reported less fate-submissiveness (AOR=1.385) and more self-reliance (AOR=1.349), prior exposure to emergency events(AOR=1.280), and held more positive attitudes toward preparedness (AOR=1.286). **Conclusion:** Household preparedness for emergency events is poor in China. Lack of motivation, negative attitude to preparedness and knowledge shortfall are major but remediable barriers for household preparedness.

Key word: household preparedness, emergency preparedness, disaster preparedness

Strengths and limitations

- This study quantified household preparedness for emergency events for the first time in China and identified factors associated with emergency preparedness
- The findings of the determinants of poor household preparedness are closely aligned with the Chinese Auspicious culture.
- One adult respondent from each household was invited to complete the survey. But opinions from the family members may not always been consistent.
- The 14 emergency items included in this study reflected priorities in emergency responses in China, which may not be exhaustive. The importance of the emergency items was not differentiated either.
- We presented the results of both logistic regression and linear regression analyses, which are largely consistent.

Introduction

No community is immune from the risk of emergencies and disasters in today's increasingly interconnected world. Many emergency events may be difficult to prevent. Inadequate preparation in response to these events can cause a tremendous loss in terms of human lives and health, property and infrastructure. It was

estimated that natural disasters alone cost over US$ 100 billion annually worldwide.[1] According to the *2016 Humanitarian Response Plan* launched by the World Health Organization (WHO), US$ 2.2 billion was needed to provide lifesaving health services to more than 79 million people in more than 30 countries due to protracted emergencies that year.[2] In the first half year of 2016, 68.77 million people in China were affected by floods, hail and geological disasters, resulting in 505 deaths and a direct economic loss of 89.04 billion Chinese Yuan (US$12.9645 billion).[3]

Strengthening emergency responses can effectively reduce human casualties and contribute to sustainable post-event development. It is deemed a cost-effective investment in preventing losses and is considered one of the four priority areas in the Sendai Framework for Disaster Risk Reduction 2015-2030, which was endorsed by the third United Nations World Conference in Japan.[4] Over the past few decades, emergency response efforts have evolved from a focus on top-down relief assistance to a more comprehensive strategy with a greater emphasis on community participation and pre-event preparedness for better risk management. This is because emergency victims often face geographical isolation as a result of damage to local infrastructure such as energy, road and communication facilities.[5] Consequently, the arrival of external rescue support may experience two or more days of delay.[6] But rescue efforts in the first couple of days in disastrous events are critical.[7] Community and household preparedness in self-rescue efforts prior to the arrival of external assistance may result in the difference between the chance of survival and death.[8] Empirical evidence shows that sufficient household preparedness can significantly mitigate the negative consequences of emergency events.[9]

The United Nations International Strategy for Disaster Reduction (UNISDR) defined preparedness as the "knowledge, capacities and actions to effectively respond to the effects of hazard events, whether or not they have occurred".[10] Preparedness activities can be developed at the individual, household, community and governmental levels. Household preparedness plays a critical role because it is an integral part of any individual and community effort. The concept of household preparedness emphasizes household responsibilities and the capability to reduce risks and damage,[11] which requires stockpiling emergency supplies, planning for emergency events and other actions like buying accident insurance.[12-13]

Previous studies revealed poor household preparedness for disastrous events across a range of different settings.[14-15] Despite a rise in the number of publications on household preparedness in developed countries, there is a serious shortage of literature documenting the situation in developing countries. Empirical evidence shows that household preparedness is associated with many factors, including knowledge, risk awareness, prior exposure to disasters, attitudes toward emergency preparedness,[16] and trust in the government. Socioeconomic status may also play an important role.[17-18,] Developing countries are facing ever-increasing challenges and costs associated with disastrous events.But experiences from developed countries cannot be extrapolated to developing countries without consideration of the local contexts.

China is a disaster-prone country with the largest population and high population density. But little is known about the household preparedness of China in response to emergencies. This study aimed to assess

the level of household emergency preparedness in China and identify the factors associated with household preparedness. The findings of the study can provide evidence for better planning for the emergency response system.

METHODS

A cross-sectional questionnaire survey was conducted on 3,541 households in four regions of China.

Study population

A multistage stratified sampling strategy was adopted to select participating households. In the first stage, we identified four regions purposively considering diversities in geographic location and socioeconomic development: Beijing is the capital of China; Guangdong represents the most developed region in eastern China; Heilongjiang and Sichuan represent the less developed regions in central and western China, respectively. These four regions have a total population of more than 25 million, accounting for over 18% of the entire population in China. Of the four regions, Sichuan is an earthquake-prone area and recently experienced the Jiuzhaigou earthquake in 2017 and the Wenchuan earthquake in 2008. Guangdong is most frequently affected by typhoons. Meanwhile, many infectious diseases erupted in Guangdong, such as SARS in 2003 and dengue fever in 2014.

The second stage involved a selection of two municipalities in each province (two districts in Beijing) with varied social and economic conditions. We then randomly selected one urban and one rural residential community from each participating municipality/district. A total of 3,650 households in these communities were approached and invited to participate in this study: 1000 in Beijing, 850 in Guangdong, 900 in Heilongjiang and 900 in Sichuan.

Data collection

Data were collected from April to September 2015. A research team comprising ten trained researchers and postgraduate students from Harbin Medical University visited the selected households. One adult member from each household was interviewed. Verbal informed consent was obtained prior to the survey. The questionnaire was administered anonymously, which took about 20 minutes to complete. Of the 3,650 invited households, 3,580 (98.1%) completed the questionnaire survey. The final data analyses included 3,541 (98.9%) questionnaires that contained no missing values.

Dependent variable

Household preparedness was measured by 14 items that were commonly used in previous studies. A list of emergency items was generated through literature review. The selection of the emergency items in this study considered the relevance of the emergency items to the common disastrous events in China. The relevant emergency items were prioritized in accordance with the National Disaster Prevention Manual

published by the Ministry of Civil Affairs of China and the CDC Behavioral Risk Factor Surveillance System. These included nine general emergency necessities (three-day-supply of non-perishable food and water, battery-powered radio, extra batteries, battery-operated flashlight, first aid kit, gas mask, fire extinguisher, escape ropes, whistle) as recommended by the national public education "ready" program in the US and some preparedness items source from the General Preparedness Module,[18,19] as well as coverage of accident insurance, knowledge of local emergency response systems (emergency numbers, exit routes and shelters), and availability of an evacuation plan.[20-21]

Independent variables

The selection of independent variables was guided by two behavioral theories: the KAP (Knowledge, Attitudes and Practice) theory and the Theory of Reasoned Action (TRA). The KAP theory addresses the intertwined effects between knowledge, attitudes and behaviors, whereas, the TRA emphasizes the importance of human reasoning as many contextual factors can weigh into human decision on actions.[22-23]

The independent variables tested in this study included:

Demographic and socioeconomic characteristics: age, region and residency (urban vs rural), educational attainments, and monthly household income (estimated in Chinese Yuan). Previous studies showed that socioeconomic factors not only determine the available resources, but also predict the knowledge and attitudes of an individual toward human actions, in particular those for preventive purposes. People with low socioeconomic status are less likely to invest and act on risk prevention and risk management activities.[24-25]

Knowledge: 16 statements were designed based on the national guidelines for emergency responses in China to test the relevant knowledge of respondents. They were asked to judge whether these statements were correct, incorrect, or if they were unsure. A correct answer was given a score of one point. This generated an overall knowledge score for each respondent ranging from 0 to 16.

Risk awareness: respondents were asked to rate their concerns about natural and man-made disasters, social safety events, and public health emergencies on a five-point Likert scale (1-5). A summed score was calculated for each respondent (ranging from 4 to 20), with a higher score indicating a higher level of concern.

Attitudes: respondents were asked to rate on a five-point Likert scale (1-5) their interests in gathering information regarding emergency responses, perceived importance of such information, and willingness to discuss this topic with others. A summed score was calculated (ranging from 3 to 15), with a higher score indicating a higher level of endorsement with emergency preparedness.

Fate-submissiveness and self-reliance: respondents were asked to rate on a five-point Likert scale (1-5) their inclination of submissiveness to fate or luck, in comparison with the determination of self-rescue in

emergency events.

Past experience: prior exposure to emergency events and participation in emergency training activities over the past year were measured in this study. Experiences play a pivotal role in the development of human behaviors.[26]

Respondents were also asked to choose all the reasons that prevented "people from preparing for emergencies" from the following list: (1) "do not know what to do"; (2) "do not want to think about it"; (3) "nothing can be done"; (4) "it takes too much time"; (5) "it takes too much money"; (6) "do not have the ability to prepare"; (7) "professionals will do the rescue job"; (8) "do not believe emergency will happen to the family"; (9) "do not have enough information from the government and the public media". The list was developed based on findings of previous studies.[27-28]

Statistical analysis

We estimated the number and percentage of households acting on each of the 14 indicators for emergency preparedness. These indicators were commonly used for measuring the preparedness of the household. Each positive answer was given 1 point. A score of actions on over nine out of the 14 points was categorized as well prepared. Differences in actions across households were tested using chi-square tests.

A multivariate logistic regression model was established to identify independent variables associated with well-preparedness. We also performed a linear regression analysis using the "summed points" as a dependent variable.

In the regression models, independent variables measuring knowledge, risk awareness, attitudes, fate-submissiveness and self-reliance were transformed into a nominal measure: 'above average score' versus 'on/below average score'. The models employed an enter approach based on the maximum likelihood estimation method, with an enter/exit criterion (α) of 0.05/0.01. All statistical analyses were performed using SPSS V.22.0.

Ethics approval

This study was funded by the National Natural Science Foundation of China. Ethics approval for the study protocol was obtained from the Ethics Committee of Harbin Medical University.

RESULTS

Characteristics of respondents

Nearly half (47.9%) of the respondents were aged between 31 to 50 years; 54.4% were women; 41.7% held a college degree or above; 72.1% had a monthly household income of above ¥3500. Most (64.3%) respondents lived in urban areas. The majority (79.2%) were married at the time of the survey (Table 1).

Table 1. Socio-demographic characteristics of respondents

Characteristics	N	%
Gender		
Male	1614	45.6
Female	1927	54.4
Age (Years)		
18-24	359	10.1
25-44	1882	53.2
45-64	994	28.1
>64	282	8.6
Education		
Secondary education or below	1325	37.4
High school education	740	20.9
College or above	1476	41.7
Residency		
Urban	2277	64.3
Rural	1264	35.7
Region		
Beijing	988	27.9
Heilongjiang	862	24.3
Guangdong	811	22.9
Sichuan	880	24.9
Monthly household income (Yuan)		
0-3499	987	27.9
3500+	2554	72.1
Marital status		
Married	2803	79.2
Not married	738	20.8

Household emergency preparedness

The respondents had relatively good knowledge of their local emergency response systems, with 93.9% knowing the emergency numbers, 74.9% being aware of the evacuation exit routes, and 62.4% being able to locate the emergency shelters. But less than half of the households were well-prepared in terms of necessities (apart from 80% having a battery-operated flashlight), having accident insurance coverage, and having developed an evacuation plan. Overall, households in Beijing performed worse than those in the other regions. Urban households outperformed their rural counterparts in insurance coverage and knowledge of local emergency response systems. But rural households were more likely to have an

evacuation plan and stockpile food/water, radio, flashlight and escape ropes. Only a small number of households (9.9%) were deemed well-prepared, acting on nine or more of the emergency indicators s (Table 2).

Table 2. Number and percentage (%) of households acting on emergency items

Action	Total N=3541	Regions					Residency	
		Beijing N=988	Heilongjiang N=862	Guangdong N=811	Sichuan N=880	P	Urban N=2266	Rural N=1275
Possession of emergency necessities								
three-day supply of food and water	1101 (31.1)	230 (23.3)	350 (40.6)	264 (32.6)	257 (29.2)	<0.001	684 (30.2)	417 (32.7)*
extra batteries	1151 (32.5)	261 (26.4)	313 (36.3)	268 (33.0)	309 (35.1)	<0.001	728 (32.1)	423 (33.2)
battery-powered radio	990 (28.0)	187 (18.9)	338 (39.2)	239 (29.5)	226 (25.7)	<0.001	600 (26.5)	390 (30.6)*
battery-operated flashlight	2843 (80.3)	718 (72.7)	704 (81.7)	651 (80.3)	770 (87.5)	<0.001	1760 (77.7)	1083 (84.9)*
first aid kit	1215 (34.3)	307 (31.1)	237 (27.5)	382 (47.1)	289 (32.8)	<0.001	881 (38.9)*	334 (26.2)
gas mask	164 (4.6)	36 (3.6)	39 (4.5)	58 (7.2)	31 (3.5)	0.001	113 (5.0)	51 (4.0)
fire extinguisher	931 (26.3)	174 (17.6)	148 (17.2)	315 (38.8)	294 (33.4)	<0.001	625 (27.6)*	306 (24.0)
escape rope	403 (11.4)	69 (7.0)	141 (16.4)	94 (11.6)	99 (11.3)	<0.001	233 (10.3)	170 (13.3)*
whistle	387 (10.9)	95 (9.6)	117 (13.6)	73 (9.0)	102 (11.6)	0.010	264 (11.7)*	123 (9.6)
Coverage of accident insurance	819 (23.1)	291 (29.5)	147 (17.1)	132 (16.3)	249 (28.3)	<0.001	582 (25.7)*	237 (18.6)
Household evacuation plan	1083 (30.6)	151(15.3)	255 (29.6)	292 (36.0)	385 (43.8)	<0.001	673 (29.7)	446 (35.0)*
Knowledge of local emergency response systems								
Evacuation route	2652 (74.9)	742 (75.1)	599 (69.5)	626 (77.2)	685 (77.8)	0.003	1767 (78.0)*	885 (69.4)
Emergency shelter	2210 (62.4)	584 (59.1)	523 (60.7)	500 (61.7)	603 (68.5)	0.001	1447 (63.9)	763 (59.8)
Emergency phone numbers	3325 (93.9)	915 (92.6)	788 (91.4)	781 (96.3)	841 (95.6)	<0.001	2170 (95.8)*	1155 (90.6)
Actions on nine or more indicators	352 (9.9)	48 (4.9)	91 (10.6)	92 (11.3)	121 (13.8)	0.001	236 (10.4)	116 (9.1)

**p<0.05 in urban-rural comparisons.*

About 0.4% of households did not prepare any emergency items at home, compared with 2.3% having one item and 10.9% having three items. The majority of households owned 5 emergency items. About 10% owned over 9 emergency items (Figure 1).

Factors associated with emergency preparedness

The level of well-preparedness varied by region, prior exposure to emergency events , emergency training, knowledge and attitudes toward emergency preparedness, education, self-reliance, and fate submissiveness ($p<0.05$ in chi-square tests, Table 3). However, no significant differences in the level of well-preparedness were found in respondents of a different gender, age, residency, and risk awareness ($p>0.05$ in chi-square tests, Table 3).

The logistic regression model confirmed that socio-economic status, knowledge and attitudes toward emergency preparedness were significant predictors of the level of well-preparedness after adjustments for variations in other variables. Higher levels of preparedness were associated with higher educational attainments, participation in emergency training activities (AOR=2.299), better emergency knowledge (AOR=2.043), less fate-submissiveness (AOR=1.385) and more self-reliance (AOR=1.349), prior exposure to emergency events (AOR=1.280) and more positive attitudes toward preparedness (AOR=1.286) (Table 3).

Table 3. Factors associated with emergency preparedness: results of logistic regression models (n=3541)

Independent variable	N	N (%) of well-prepared	AOR	(95% Confidence Interval)		*P*
Gender						
Male (reference)	1614	169 (10.5)	1.134	(0.949,	1.356)	0.167
Female	1927	183 (9.5)				
Age (Years)						
18-24 (reference)	359	67(1.9)				
25-44	1882	371(10.5)	0.773	(0.539,	1.110)	0.440
45-64	994	161(4.6)	0.939	(0.666,	1.322)	0.716
>64	282	51(1.5)	0.846	(0.553,	1.829)	0.440
Education*						
Secondary education or below	1325	257(7.3)	0.757	(0.591,	0.970)	0.028
High school education	740	123(3.5)	0.826	(0.677,	1.007)	0.059
College or above (reference)	1476	275(7.8)				
Residency						
Urban	2277	236 (10.4)	1.142	(0.940,	1.382)	0.181
Rural (reference)	1264	116 (9.2)				
Region*						
Beijing (reference)	988	48 (4.9)				
Heilongjiang	862	91 (10.6)	3.409	(2.531,	4.592)	0.000
Guangdong	811	92 (11.3)	3.890	(2.910,	5.199)	0.000
Sichuan	880	121 (13.8)	3.450	(2.574,	4.625)	0.000
Monthly household income (Yuan)						
0-3499 (reference)	987	191 (5.4)				
3500+	2554	464 (13.1)	1.202	(0.972,	1.486)	0.089
Prior exposure to emergency events*						
Yes	1332	155 (11.6)	1.280	(1.042,	1.571)	0.019
No (reference)	2209	197 (8.9)				
Participation in emergency training* last year						
Yes	957	158 (16.5)	2.299	(1.902,	2.779)	0.000
No (reference)	2584	194 (7.5)				
Emergency knowledge score*						
> average	3127	333 (10.6)	2.043	(1.460,	2.859)	0.000
≤ average (reference)	414	19 (4.6)				
Risk awareness score						
> average	1302	145 (11.1)	1.047	(0.866,	1.265)	0.638
≤ average (reference)	2239	207 (9.2)				
Attitudes toward emergency preparedness*						
> average	1947	216 (11.1)	1.286	(1.067,	1.575)	0.011
≤ average (reference)	1594	136 (8.5)				
Self-reliance*						
> average	2378	263 (11.1)	1.349	(1.059,	1.562)	0.018
≤ average (reference)	1163	86 (7.4)				
Fate submissiveness*						
> average (reference)	431	31 (7.2)				
≤ average	3110	321 (10.3)	1.385	(1.028,	1.868)	0.033
Constants			0.015			0.000

* $p<0.05$ in univariate chi-square tests

The perceived barriers reported by the respondents for hindering household preparedness echoed well with the findings of the regression models. More than half (53.6%) of the respondents cited knowledge shortage as a major barrier. This was followed by inertia: 31.6% did not want to think about it; 28.1% believed that emergency professionals would do the rescue job for them; 21.5% did not believe an emergency would happen to the family. In addition, 24.4% of respondents blamed the government and the public media for the limited availability of information. Resource restrictions were not perceived as a major barrier for household emergency preparedness: less than 20% respondents cited the lack of time, money and personal ability as a barrier (Figure 2).

DISCUSSION

Low level of household preparedness in China

Overall, the level of household emergency preparedness in China is low, with less than 10% of households acting on nine or more emergency indicators out of a possible 14. This result is consistent with the findings of studies conducted elsewhere in China. Poor household preparedness for emergency events is common in many developing countries, such as Turkey and Iran.[29] The performance of developed countries, although better than in developing countries, is also far from satisfactory. In Australia, about one-fifth of households have sufficient supplies of items for emergency events such as a torch, radio, mobile phone, first aid kit, appropriate batteries and an emergency contact list. A study in the US revealed that 12.3% of American households possessed a three-day supply of water and nonperishable food, an evacuation plan, a working flashlight and radio. Similarly, 30% of households in Japan stockpiled food and drinking water for emergency events.[15]

Factors contributing to the low level of household preparedness

Findings of the logistic regression model and ranking of perceived barriers reported by the respondents point to the same conclusion: knowledge is a major determinant of household emergency preparedness (Figure 3). The odds of well-preparedness doubled in the respondents with a higher than average level of knowledge. Training would also double the odds of well-preparedness, possibly through filling knowledge gaps. This is echoed by over half of the respondents who reported knowledge shortage as the major barrier to preparing for emergency events. The association between knowledge and preparedness for emergency events is further supported by the link between education in general and preparedness. Prior exposure to emergency events may also improve the knowledge and attitudes of people, resulting in better preparedness for emergency events. These findings are consistent with previous studies.[30, 31]

Fate-submissiveness and a lack of recognition of self-reliance were identified as a significant predictor of poor-preparedness in the logistic regression model. Similarly, a lack of motivation to act ("do not want to think about it" and "leave it to professionals") was reported as the second most significant barrier in

household emergency preparedness.

Surprisingly, the most developed region, Beijing, was found to be the worst performer. The underlying reasons warrant further studies. Clearly, the results cannot be fully explained by individual differences.

Similar to the results of this study, gender and age were not found to be associated with disaster preparedness in several previous studies.[32,33]

Policy implications

Large improvements can be made in relation to emergency preparedness in China. Public knowledge on emergency responses is universally poor in China. Educational campaigns, if designed and implemented properly, can effectively improve public knowledge. However, this has to be done through multiple avenues. Governmental agencies can coordinate the timely provision of adequate information about emergency events. Emergency training can be offered through specifically designed drill exercise,[34] or as part of the national essential education system. In Japan, a disaster-prone country for example, disaster mitigation has been integrated into its national school curriculum.[35]

However, knowledge improvement by itself is not enough. The mentality of inertia in the public needs to be addressed. A positive correlation between the recognition of self–reliance and better household preparedness is evident as confirmed in this study and others.[36] But unfortunately, many traditional cultures encourage fate submissiveness. A study in Saudi Arabia found that most (93%) respondents believed that floods, earthquakes and other natural disasters are signs of God.[37] Fatalism is an attitude of self-defeatism which may lead individuals into helpless, undermining their efforts of individual preparedness.[38-39] The Chinese society also embraces an auspicious culture, encouraging people to pursue luck and avoid ominous things. It is taboo to talk about bad things, such as disaster and death. People prefer to pin their hopes on illusory things, rather than be prepared for real threats. [40-41]

Lessons learned from past disaster experiences may help change the mentality of inertia and risk perception. In Australia, for example, bush fires impose a regular risk for many households. The preparedness of individual households can make a difference between life and death. The National Partnership Agreement on Natural Disaster Resilience in Australia therefore emphasizes the significance of involving multiple parties including individuals.[42] Emergency response systems are often complex and adaptive. A highly participatory strategy would encourage individuals to take more responsibility, become less dependent on the government, and leave more resources for others.[43] Trust in the government is important given that it is most likely to play a coordinating role in emergency events.[44] However, over-reliance on the government and professional workers could dampen household efforts for future disasters.[45] A study of post-earthquake survivors in China showed that high expectations of the public on the government are associated with high trust in the government, leading to increased complacency in individual efforts in preparedness.[16] In China, governmental response to disasters from the military force has often been extraordinarily rapid and efficient.

For example, an earthquake-relief headquarter was established by the army 18 minutes after the earthquake strike in Ya'an and 5000-6000 rescue workers were deployed on the same day. But people need to realize that there is always a gap before the full functioning of external rescue assistance, a gap which needs to be filled by the survivors of disasters.[7] Poor cooperation from those being rescued can also jeopardize professional efforts.

Limitation

There are several limitations in this study. Although this study drew large samples from four representative regions in China, the participants were not completely randomly selected. One adult respondent was invited to represent each household in this study. But opinions from family members may not always been consistent. Household preparedness can involve many aspects. The 14 emergency items included in this study may not be exhaustive. Although the 14 items are not equally important, their importance varies with different emergency events. This makes it difficult to attach a fixed weight to each item in terms of their importance. For example, in a fire emergency, "escape rope" and "gas mask" are more important than having food and water. But this is not necessarily the case in an event when the survivors are isolated from the outside world. Therefore, we did not differentiate the importance of the emergency items. The dichotomization of the dependent variable is somehow arbitrary. Although it enabled easy interpretation of the results, certain information might get lost in the statistical analyses. However, the linear regression analysis generated consistent results. It is important to note that the study adopted a cross-sectional design, no causal relationships should be assumed.

Conclusion

The overall level of household emergency preparedness in China is extremely low. A lack of knowledge presents a great barrier to household preparedness. Although training can be an effective measure for improving knowledge, a more comprehensive strategy needs to be adopted to address issues associated with the lack of motivation. Emergency response systems should emphasize individual responsibilities as well as those from the government and professional workers.

Data sharing statement All data relevant to the study are included in the article or uploaded as supplementary information.

Open access

Author contributions

CY， WX， YJD, and WLX analyzed the data and drafted the manuscript. YH and NN took overall responsibility for the study design, coordinated and conducted the survey, and participated in writing and modifying this manuscript. QHW, LJG, and ZK participated in the design of the study, data collection, and writing of the manuscript. Chaojie Liu interpreted the results of statistical analyses, articulated the storyline, and wrote the manuscript.* CY, WX,WLX these three authors contributed equally.

Acknowledgement

The authors are grateful to the support of local officials including three senior researchers(Tie Song, Wei Sun, Ruoxiang Cao in data collection in the sampled municipalities) lead the investigation in different parts of China. Additionally, we thank Mingli Jiao, Hong Sun and Libo Liang for their advice in this study. We are grateful to the participants of the study and the postgraduate students who helped collection and preparation of the data.

Conflicts of interests statement

We declare that we have no financial and personal relationships with other people or organizations that can inappropriately influence our work, there is no professional or other personal interest of any nature or kind in any product, service or company that could be construed as influencing the position presented in our study.

Patient and public involvement : Patients and the public were not involved in the design or planning of the study.

Funding

This work was supported by the National Natural Scientific Fund of China grant number (71673072, 71173064, 71473065), and the Ministry of Health Public Benefit Fund for Health Sector (201002028), Heilongjiang Province philosophy & Social Science Fund (18GLD302, QMSI2017B-01).

Competing interests : None declared

Participant consent: Obtained in this study.

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Figure legend/caption

Table 1. Socio-demographic characteristics of respondents

Table 2. Number and percentage (%) of households acting on emergency items

**p<0.05 in urban-rural comparisons.*

Table 3. Factors associated with emergency preparedness: results of logistic regression models (n=3541)

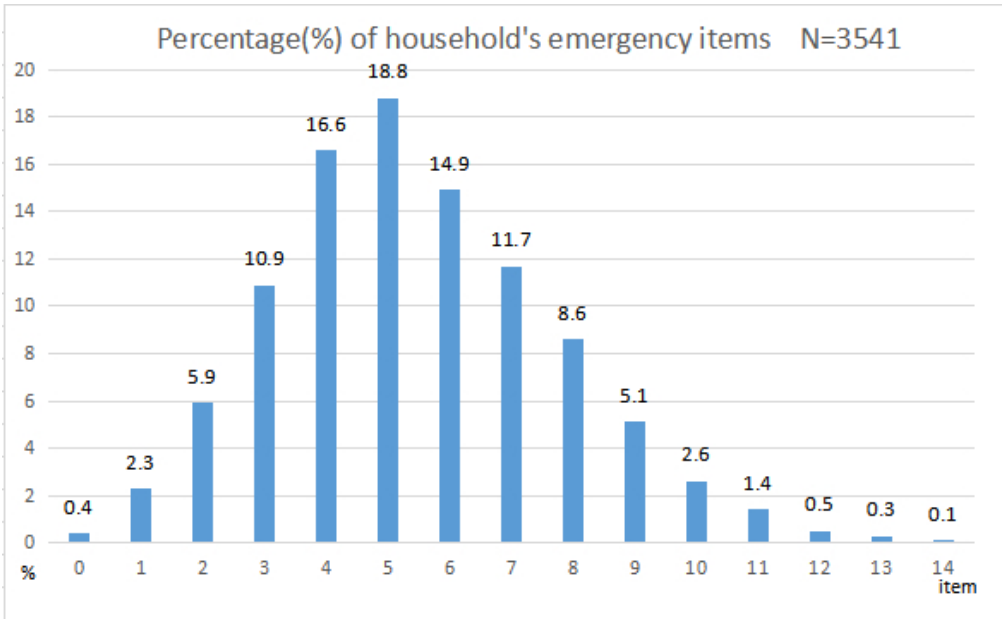
* $p<0.05$ in univariate chi-square tests

Figure 1. Distribution (%) of households preparedness of 14 emergency items

Figure 2. Barriers reported by respondents (%) for not preparing for emergencies

Figure 2 Note: Q1 "do not know what to do"; Q2 "do not want to think about it"; Q3 "nothing can be done"; Q4 "it takes too much time"; Q5 "it takes too much money"; Q6 "do not have the ability to prepare"; Q7 "professionals will do the rescue job"; Q8 "do not believe emergency will happen to the family"; Q9 "do not have enough information from the government and the public media".

Figure 3. Link between perceived barriers and factors predicting well-preparedness


Percentage(%) of household's emergency items N=3541
20
18
16
14
12
10
8
6
4
2
0
%
0.4
2.3
5.9
10.9
16.6
18.8
14.9
11.7
8.6
5.1
2.6
1.4
0.5
0.3
0.1
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13
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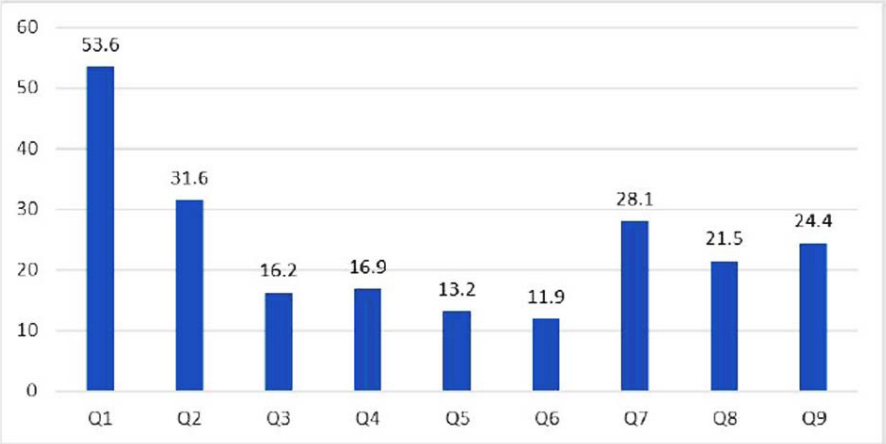
item

Figure 2. Barriers reported by respondents (%) for not preparing for emergencies



Note: Q1 "do not know what to do"; Q2 "do not want to think about it"; Q3 "nothing can be done"; Q4 "it takes too much time"; Q5 "it takes too much money"; Q6 "do not have the ability to prepare"; Q7 "professionals will do the rescue job"; Q8 "do not believe emergency will happen to the family"; Q9 "do not have enough information from the government and the public media".

Figure 2

Figure 3. Link between perceived barriers and factors predicting well-preparedness

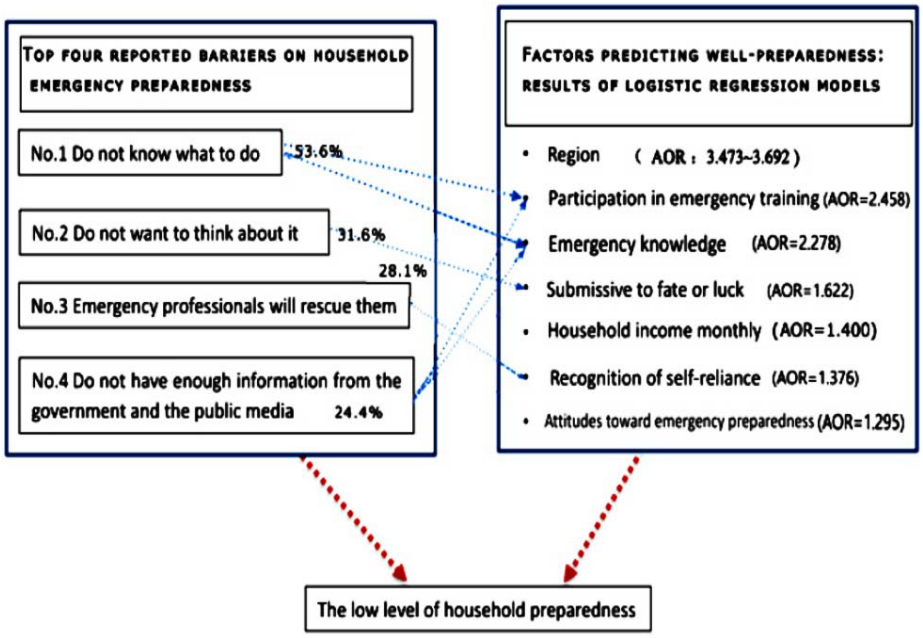


Figure 3

STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Page No	Recommendation
Title and abstract	1 √	2	(*a*) Indicate the study's design with a commonly used term in the title or the abstract
		2	(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found
Introduction			
Background/rationale	2 √	2	Explain the scientific background and rationale for the investigation being reported
Objectives	3 √	3	State specific objectives, including any prespecified hypotheses
Methods			
Study design	4 √	4	Present key elements of study design early in the paper
Setting	5 √	4	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection
Participants	6 √	4	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants
Variables	7 √	5	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable
Data sources/ measurement	8* √	6	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group
Bias	9		Describe any efforts to address potential sources of bias
Study size	10 √	6	Explain how the study size was arrived at
Quantitative variables	11 √	6	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why
Statistical methods	12 √	6	(*a*) Describe all statistical methods, including those used to control for confounding
		6	(*b*) Describe any methods used to examine subgroups and interactions
		6	(*c*) Explain how missing data were addressed
		6	(*d*) If applicable, describe analytical methods taking account of sampling strategy
			(*e*) Describe any sensitivity analyses
Results			
Participants	13* √	7	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed
			(b) Give reasons for non-participation at each stage
			(c) Consider use of a flow diagram
Descriptive data	14* √	7	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders
			(b) Indicate number of participants with missing data for each

			variable of interest
Outcome data	15* √	8	Report numbers of outcome events or summary measures
Main results	16 √	8-9	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included
		9	(*b*) Report category boundaries when continuous variables were categorized
		9	(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period
Other analyses	17		Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses
Discussion			
Key results	18 √	10-11	Summarise key results with reference to study objectives
Limitations	19 √	12	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias
Interpretation	20		Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence
Generalisability	21 √	12	Discuss the generalisability (external validity) of the study results
Other information			
Funding	22 √	13	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.