Health Emergency and Disaster Risk Management (Health-EDRM) in Remote Ethnic Minority Areas of Rural China: The Case of a Flood-Prone Village in Sichuan

Emily Ying Yang Chan^{1,2,3} · Chunlan Guo¹ · Poyi Lee¹ · Sida Liu¹ · Carman Ka Man Mark¹

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Abstract Remote, rural ethnic-minority communities face greater disaster-related public health risks due to their lack of resources and limited access to health care. The Ethnic Minority Health Project (EMHP) was initiated in 2009 to work with remote, disaster-prone ethnic-minority villages that live in extreme poverty. One of the project's aims is to develop and evaluate bottom-up health risk reduction efforts in emergency and disaster risk management (Health-EDRM). This article shares project updates and describes field intervention results from the Yi ethnic community of Hongyan village in China's Sichuan Province, an area that experiences recurrent floods. It was found that 64% of the village respondents had never considered any form of disaster preparation, even with the recurrent flood risks. Health intervention participants showed sustained knowledge retention and were nine times more likely to know the correct composition of oral rehydration solution (ORS) after the intervention. Participants also retained the improved knowledge on ORS and disaster preparedness kit ownership 12 months after the intervention.

Keywords Disaster preparedness kit · Disaster risk reduction · Ethnic minority · Health emergency and

disaster risk management (Health-EDRM) · Oral rehydration solution · Recurrent floods · Rural China

1 Introduction

In remote, resource-poor rural communities, bottom-up (rather than top-down) disaster preparedness efforts can build emergency resilience. Bottom-up preparedness is of particular importance in remote regions because timely external assistance in the event of disasters is often absent. In 2009, the Collaborating Centre for Oxford University and CUHK for Disaster and Medical Humanitarian Response (CCOUC) established the Ethnic Minority Health Project (EMHP). One of the aims of the EMHP is to develop and evaluate bottom-up health and emergency and disaster risk management (Health-EDRM) for vulnerable populations in remote areas in Asia. In China, the EMHP project team has established 14 project village sites across nine provinces based on four selection criteria—geographical remoteness, ethnic minority representation, economic vulnerability (living on under USD 1.25/person/day), and disaster proneness. The project has an outreach area that encompasses more than 17,000 villagers in communities of the northwest Ancient Silk Road, the southwest Ancient Tea Horse Road, the southwest border region adjacent to the Golden Triangle, the Tibetan Plateau, the Loess Plateau of the Yellow River basin, the source area of the Yangtze River, and the northeast “Rust Belt” (Fig. 1).

2 Study Context: Hongyan Village in Sichuan Province

Hongyan village is an ethnic minority-based community that is 91% Yi ethnicity (1% Han Chinese, 8% other ethnic groups). The village is an agricultural, non-migrant

✉ Emily Ying Yang Chan
emily.chan@cuhk.edu.hk

¹ Collaborating Centre for Oxford University and CUHK for Disaster and Medical Humanitarian Response (CCOUC), The Jockey Club School of Public Health and Primary Care, The Chinese University of Hong Kong, Hong Kong, China

² Nuffield Department of Medicine, University of Oxford, Oxford OX1 2JD, UK

³ FXB Centre of Health and Human Rights, Harvard University, Cambridge, MA 02138, USA

Fig. 1 Project sites of the CCOUC Ethnic Minority Health Project in China (as of April 2017)

based village composed of 217 households and 826 residents. It is one of the 169 villages in Xide County, in the Liangshan Yi Autonomous Prefecture that is situated in the southern area of Sichuan Province. In 2014, the majority of families lived under the United Nations international extreme poverty line (USD 1.25 per day during the study period), with an annual household income around USD 100–120 in 2014.

A major flood occurred on 31 August 2012 in Xide County where Hongyan village is located. The flood caused massive local damage with an estimated total economic loss of RMB 3.16 billion Yuan in the county (equivalent to the local government's budget for 30 years) (Liu 2012). Due to geographic remoteness and infrastructural collapse (Fig. 2), the Hongyan villagers were isolated from the outside world for more than 2 months.

Fig. 2 Isolation of Hongyan village, Xide County, Sichuan Province, China after the 31 August 2012 flood. The flood collapsed the bridge and disconnected the villagers from the outside world for more than 2 months. *Source* Photograph by Emily Y.Y. Chan and Sida Liu, October 2012

3 Project Description and Evaluation

Through the support of the China Ministry of Civil Affairs and recommendation by the Wu Zhi Qiao Charitable Foundation, a 3-year project, from 2012 to 2015, was established in Hongyan village after the August 2012 flood. This article summarizes some of the key findings on the effectiveness of a bottom-up training intervention conducted in 2014.

Baseline and post-intervention data were collected through cross-sectional interviewer-administered questionnaire surveys in 2012, 2014, and 2015. Qualitative data were collected through key informant interviews and focus groups in 2012 and 2015. Verbal consent was obtained for all study participants. While all village residents were invited to join the interventions, 54 households (25% of the village community) were selected randomly from the official household register list to participate in periodic cross-sectional household-based surveys to evaluate the project's impact.

Based on the 2012 needs assessment findings, health and disaster risk reduction promotion interventions, each lasting about 30–45 min, were planned and implemented 28 March–1 April 2014. Although diarrhea and water- and vector-borne diseases are preventable post-disaster health problems, these risks are often neglected by remote communities in western China (Gustafsson and Ding 2009; WHO 2014; Chan 2017). Community training sessions on general health risk awareness (the importance of washing hands, for example), household disaster kit preparation, and the preparation of a homemade oral rehydration solution (ORS) were conducted. Field interventions included education in general water safety and sanitation, indoor environment maintenance, waste management, and other health behaviors. Low-cost and locally accessible items according to the five essential health needs (water/sanitation, food/nutrition, non-food items including shelter/clothing, health care, and information/communication) were included in

disaster preparedness kit preparation (Bolton 2006; Chan 2017). Due to the low literacy rate, educational interventions mainly relied on graphical information and dramatized presentations. Validated questionnaires (30 questions) were administered to evaluate intervention effectiveness by comparing the results before and immediately after the interventions. This was followed with an evaluation of the overall project impact 12 months later, in March 2015.

All data were double entered and cleaned by trained staff. Descriptive statistics were generated and group differences were analyzed using Chi square tests ($\alpha = 0.05$). All statistical analyses were conducted with SPSS version 21.0. Ethics approval was obtained from the sponsoring university.

4 Key Program Findings

Despite the recurrent flood threats, up to 72.5% of the village respondents did not have any form of disaster preparedness before the August 2012 flood. Health intervention participants showed sustained knowledge retention. They were nine times more likely to know the correct composition of oral rehydration solution, and retained the improved knowledge on ORS and disaster preparedness kit ownership 12 months after the intervention.

4.1 The Sample Population

The sociodemographic characteristics of the 2014 study sample, in comparison with those of Sichuan Province and the latest available data from China, are shown in Table 1. Most of the sociodemographic characteristics of Hongyan village are comparable to those of Sichuan Province and national data. Major differences were observed in literacy rate and occupation between the Han majority in Sichuan Province and China and the Yi minority in Hongyan village.

Table 1 Comparison of sociodemographic characteristics of Hongyan, Sichuan, and China

	Hongyan village 2014 ^a	Sichuan Province 2014 ^b	China ^c
Male to female ratio	1:0.97	1:1.06	1:0.95 (2015)
Average age	42.2	37.4	37.1 (2016)
Yi ethnicity	91%	3.3% (2010)	0.7% (2010)
Han ethnicity	1.0%	93.9% (2010)	91.5% (2010)
Agricultural sector occupation	86.0%	41.5%	28.3% (2015)
Educational attainment			
Non-literate	55.0%	5.4%	5.4% (2014)
Primary school	16.0%	34.6%	26.2% (2014)
Junior high	6.0%	34.9%	40.2% (2014)
Senior high	2.0%	11.3%	16.7% (2014)
Tertiary education	0%	6.7%	11.5% (2014)
Mean household size			
Rural	4.23	3.86	3.9 (2012)
Urban	N/A	2.92	2.9 (2012)

^a The 54 households of the tracking cohort among the 217 households

^b Sichuan provincial data (SBOS 2014)

^c China national data (NBOSC 2010, 2012, 2014, 2015); World Factbook (2016)

4.2 Disaster Preparedness and Health Impacts of the August 2012 Flood

Of the village respondents, 80% reported that they had experienced a disaster in the previous 3 years.¹ However, 72.5% of the village respondents did not have any disaster preparation before the August 2012 flood, and 64% had never thought about disaster preparedness at all. Barriers to not preparing were the lack of knowledge/awareness of how to prepare a household disaster kit, the formulation of ORS, the purpose of ORS, the disaster implications associated with the villagers' living environment, and everyday health behaviors (with respect to, for example, water procurement, food safety management (for example, storage and preparation), sanitation and hygiene practices, and control of vector-borne diseases).

No flood-related casualty was reported among these sample households, but 45% had one family member who experienced at least one episode of diarrhea within the first month after the flood. Moreover, children were the vulnerable group who reported more water, food, and vector-borne (mosquitoes) health issues than the other age groups. Outside communication, information, and support were interrupted for an average 7–14 days. Village respondents reported spending an average of 62 days in temporary shelters, and 86% of sample households reported the loss of all cash crops during the August 2012 floods.

¹ Data were acquired from the 2014 household survey in Hongyan village (CCOUC 2014).

4.3 Evaluation of Intervention Effectiveness

Of the 217 households, 47% ($n = 102$) participated in the intervention training sessions and completed the pre- and post-intervention questionnaires in 2014. The final valid sample size in 2014 was 100.

4.3.1 Disaster Preparedness Kit

Over 80% of the participants regarded disaster preparedness kits as necessary, but less than half knew what items should be included. After the intervention, the knowledge of essential items that should be included in a disaster preparedness kit showed statistically significant changes—most of the necessary items showed a significant increase, while most of the unnecessary items showed a significant decrease (Table 2).

4.3.2 Oral Rehydration Solution (ORS) Preparation

Pre-intervention, approximately half of the participating households reported to have some knowledge associated with dehydration, but only 13% reported being able to prepare a homemade oral rehydration solution. The knowledge of ORS composition improved nine-fold after the intervention (Table 3). Results from the 12-months follow-up showed significant differences in knowledge of ORS preparation and reported ownership of disaster preparedness kits between those who had attended the 2014 intervention and those who had not attended (Table 4). One pattern that is unexpected on the knowledge and attitude change between participants and

Table 2 List of items covered in the 2014 pre- and post-intervention household questionnaire on the content of a disaster preparedness kit ($n = 100$) in Hongyan village (necessary items in bold)

Item		Pre-intervention (%)	Post-intervention (%)	% Change
Information and communication	Whistle	50	73	+23*
	Torch	73	81	+8
	ID card	62	79	+17*
Non-food items including shelter and clothing	Multiple-purpose knife	16	29	+13*
	Emergency blanket	36	52	+16*
	Umbrella	48	33	-15*
Health care	Medication box	42	61	+19*
	Long-term medication	43	56	+13*
Food and nutrition	Fire-starter	40	74	+34*
	Rice cooker	43	26	-17*
Water and sanitation	Water	47	47	0
Others	Watch	39	23	-16*
	Farming tools	24	22	-2

$N = 102$, Valid questionnaires $n = 100$. Items included are adapted from the core principles of maintaining health in the SPHERE standard (SPHERE 2011) and in Chan (2017)

The items listed here are not exhaustive. These items are those that were included in the questionnaire testing the knowledge level after the intervention. For the full content of the disaster preparedness kit, please refer to the Training Manual on Health and Disaster Preparedness in Rural China available at <http://www.ccouc.org>

* Chi square p value <0.05

Table 3 Results of the 2014 pre- and post-intervention household questionnaire on ORS-related knowledge ($n = 100$) in Hongyan village

	Pre-intervention (%)	Immediately post-intervention (%)	% Change
<i>Preparation of ORS</i>			
How to prepare ORS	13	76	+63*
Composition of ORS	8	74	+66*
Regard ORS preparation as difficult	44	47	+3
<i>Knowledge of ORS health benefits</i>			
Agree diarrhea causes dehydration	53	78	+25*
Agree dehydration leads to death	40	73	+33*

$N = 102$, Valid questionnaires $n = 100$

* Chi square p -value <0.05

non-participants is on the confidence of disaster kit preparation. Non-participants (68%), lacking awareness on the content of the disaster kit, are reported to be more confident than participants (55%). This higher self-reported confidence of non-participants was over-rated since only 31% of them have a disaster kit at home.

4.3.3 Health Risk Management

While gastroenteritis was the most commonly reported and preventable health problem (accounts for 80% of the health care-seeking behavior in the village), 40% of the responding villagers reported no regular habit of handwashing in spite of the stable access to water sources

(CCOUC 2014). Although the handwashing intervention did not show a statistically significant effect, more respondents reported handwashing before meals (Table 5). In particular, the 2012 data showed that the diarrhea prevalence was 45% while 54.6% of respondents drank water without any treatment. A surge of diarrhea cases in the 2012 survey may be due to poor hygiene after the flood. Meanwhile, the contaminated water supply after the flood might explain why fewer respondents drank untreated water. In 2015, the data indicated that self-reported diarrhea cases decreased to 35.6% and a significant rise of reports on drinking water without any treatment (81.4%). Overall, the 2015 data reflects the usual scenario of both the diarrhea pattern and water treatment in the village.

Table 4 Knowledge and attitude change 12 months post-intervention (2015), comparing the 2014 health intervention participants and non-participants ($n = 59$)

	Participants % Correct	Non-participants % Correct
Know the correct composition of ORS	25% (10)	0% (0)*
Know the correct proportion of ORS components	5% (2)	0% (0)*
	% Agree	% Agree
Feel confident when making ORS	30% (12)	11% (2)*
Feel confident when preparing disaster kit	55% (22)	68% (13)*
Have a disaster kit at home (Ownership)	60% (24)	31% (6)*
Feel that it is necessary to take a disaster kit in the event of a disaster	85% (34)	79% (15)*

Among the 59 respondents, 40 were participants in 2014 health intervention and 19 were non-participants

* Chi square p -value <0.05

Table 5 Comparison of various self-reported health-related beliefs and practices in Hongyan village

Items	Health risk-mitigating practices	2012 ($n = 54$)	2015 ($n = 59$) (%)	% Change
Water and sanitation	Obtained from pipe water	NA	69.5	NA
	Drink water without any treatment	54.6%	81.4	+26.8%*
Handwashing ^a	Before eating	56.6%	66.1	+9.5%
	After using toilet	54.7%	52.5	-2.2%
	Soap or detergent use observed when handwashing	NA	23.7	NA
Waste management	Recycling of plastic bottles	49.2%	50.8	+1.6%
	Dump on land	53.7%	50.8	-2.9%
Disaster preparedness ^a	Think preparing a disaster kit is important in case of a disaster	58.0%	92.5	+34.5*
	Think family has the ability to protect health and safety when disaster comes in future	42.0%	67.8	+25.8%*
ORS ^a	Know how to make ORS	9.5	40.7	31.2%*

Data in 2012 were obtained 4-month after the August 2012 flood whereas the data in 2015 were obtained at the evaluation phase

* Chi square p -value <0.05

^a Indicates the topics of disaster and health risk reduction intervention raised by the project team in 2014

5 Discussion and Lessons Identified

Since 2000, China has had the highest number of floods (UNISDR 2015) in the world. Though many Hongyan villagers had experienced devastating economic losses from previous floods, disaster risk perceptions, health risk awareness, and disaster preparedness were remarkably low. These findings are largely consistent with other studies conducted in similar socioeconomic contexts in China (Chan et al. 2014).

Extreme poverty remains a strong barrier that prevents resource deficit communities from acquiring the materials needed for the preparation of disaster preparedness kits. But the bottom-up health risk reduction intervention demonstrated its effectiveness to enhance community disaster preparedness. For all targeted disaster health risk reduction interventions, sustained knowledge enhancement (12 months post-intervention) was demonstrated. Although

ORS preparation might be an important low-cost, readily available solution to support disaster health risk reduction, especially for children (Molla et al. 1989; Sillah et al. 2013), the knowledge and use of ORS remain low among rural communities in the world. There was generally limited awareness of ORS as a potential supportive self-help treatment in rural communities.

Despite the effectiveness of the intervention, certain limitations are recognized. First, although an overall effect was observed, it was difficult to differentiate the effective components and messages within the intervention. Complex community intervention trials should be attempted in future studies (Hohmann and Shear 2002; Grant 2013). The decrease of self-reported diarrhea cases in 2015 (12-month post-intervention) from 2012 (4-month post-flood) in the community should be interpreted with caution as there might be a general surge of diarrhea cases immediately after flooding. Nevertheless, a focus group

discussion found that participants regarded handwashing habit education as the main reason the overall diarrhea prevalence decreased during the 12 months after the intervention. Second, most field-based interventions promoted by nongovernment or government groups might not be grounded on theoretical models, which makes evaluation challenging. For this project, the precaution adoption process model (Jasempour et al. 2014) proved valuable to support the planning of the health intervention to train up disaster preparedness. Language barriers and low education levels may contribute to any reporting and recall bias.

The long-term impact sustainability beyond 12 months and the results of other risk reduction interventions (for example, water boiling, food safety, and vector control) will be evaluated in future reports. This article aims to communicate that low-cost interventions still hold their value in poor and disaster-prone rural communities.

6 Conclusion

The findings indicate that in remote and resource-poor areas, health risk awareness and disaster preparedness are limited even though these communities are frequently exposed to recurrent disasters, such as floods. Areas with recurrent disasters will need to strengthen their bottom-up resilience in Health-EDRM to improve preparedness, response capacity, and overall health outcomes. This project progress report highlights that a low-cost health educational approach remains an important bottom-up model to empower remote rural communities to build resilience and reduce health risks associated with disasters and health emergencies. Future studies will be necessary to understand the health emergency and disaster risks and to ascertain the optimal strategies for improving health and reducing disaster risks in remote communities. For more information related to this project or CCOUC, please visit: <http://www.ccouc.org>.

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