Int J Disaster Risk Sci (2019) 10:439–448
https://doi.org/10.1007/s13753-019-00240-2

www.ijdrs.com
www.springer.com/13753

ARTICLE

Cross-Cultural Adaptation and Validation of the 10-Item Conjoint Community Resiliency Assessment Measurement in a Community-Based Sample in Southwest China

Ke Cui[1] · Ziqiang Han[2]

Published online: 2 December 2019

Abstract Community resilience has received growing attention in disaster risk management policies and practices, especially in China. However, few applicable instruments are available as a baseline for profiling and estimating a community's resiliency in the face of disasters. The purpose of this study is to cross-culturally adapt and validate the original version of the 10-Item Conjoint Community Resiliency Assessment Measurement (CCRAM-10) in China. Our study further investigates if and to what extent community members translate their participation in disaster risk reduction (DRR) activities into perceived community resilience. A Chinese version of CCRAM-10 was generated and applied to 369 participants from a rural and an urban community in southwest China affected by the 2008 Wenchuan Earthquake. Internal consistency reliability and confirmatory factor analyses were performed to test the assessment instrument's applicability. The Communities Advancing Resilience Toolkit Assessment Survey was used to establish the convergent validity for the Chinese version of CCRAM-10. Multiple linear regression models were used to explore the correlations between respondents' participation in activities and their perception of community resilience, while controlling for basic socio-demographic variables. Analysis results demonstrated good internal consistency reliability (Cronbach's alpha = 0.85) and satisfactory convergent validity for the Chinese version of the CCRAM-10. Construct validity was also confirmed ($\chi^2/df = 2.161$; CFI = 0.977; GFI = 0.971; NFI = 0.958; RMSEA = 0.056; SRMR = 0.030). The regression analysis results indicated that respondents' participation in DRR activities was positively correlated with their perception of community resilience. This study contributes to the wider collection of disaster studies by providing a tested tool for assessing community resilience in the context of China. Community workers and practice researchers may be interested in applying CCRAM-10 to evaluate the effect of specific DRR programmatic activities for improving community resilience.

Keywords Assessment survey · CCRAM-10 · China · Community resilience · Disaster risk management

1 Introduction

Strengthening the resilience of communities and countries to disasters has been widely recognized as vital in disaster risk management by international agreement represented by the landmark *Sendai Framework for Disaster Risk Reduction 2015–2030* (UNISDR 2015). The goal of Sendai Framework is to prevent new and reduce existing disaster risk and thus strengthen resilience through the implementation of integrated multisystematic measures that prevent and reduce hazard exposure and vulnerabilities to disaster, and increase disaster preparedness. Community resilience is usually defined as a community's ability to function in the case of sudden disturbance, to withstand adversities, and eventually to be able to absorb the losses, recover from the adverse event, or even adapt and evolve into a better situation than the one prior to the disruptions (Chandra et al. 2013; Cohen et al. 2013; Rapaport et al. 2018).

✉ Ziqiang Han
ziqiang.han@sdu.edu.cn

[1] School of Public Administration, Sichuan University, Chengdu 610065, China

[2] Institute of Contemporary Socialism/School of Political Science and Public Administration, Shandong University, Qingdao 266237, China

Along with its progress from a concept to becoming a guiding framework for disaster risk reduction planning and programming, debates around community resilience are increasingly focusing on the identification of its essential dimensions and the creation of an appropriate index with which to measure resilience effectively (Eisenman et al. 2016; Sharifi 2016; Baxter 2019). For instance, the disaster resilience of place (DROP) model, which incorporated the six dimensions of ecological, social, economic, institutional, infrastructural, and community competence (Cutter et al. 2008), was among one of the initial attempts to assess disaster resilience at the community level. By utilizing the concept of inherent resilience suggested by DROP, an empirically based disaster resilience assessment metric called the baseline resilience indicators for communities was created and tested subsequently using southeastern US counties (Cutter et al. 2010). Chandra et al. (2013) not only established a conceptual model of community resilience with five core components, such as effective risk communication, but also identified eight levers (wellness, access, education, engagement, self-sufficiency, partnership, quality, and efficiency) as means of addressing these core components. Guided by these levers, Eisenman et al. (2016) developed an index with the specific intention to evaluate the outcomes of community resilience programs.

The increased attention that has been paid to measuring community resilience is significant because it can help communities identify priority needs, measure the presence of protective resources, analyze disaster risks, and then plan and implement community-based programs of disaster mitigation and preparedness for future uncertainties (Burton 2015). Assessing community resilience in collaboration with community members is also being encouraged to simultaneously improve group understanding of resilience and promote a sense of responsibility and involvement in the process of disaster planning and preparation (Sharifi 2016). For communities employing a bottom-up approach, it also becomes essential for them to adopt simple measurement solutions to monitor their own baseline conditions, capacities, and assets (Cutter 2016).

In this regard, the Conjoint Community Resiliency Assessment Measurement (CCRAM), which was developed to be used with community members, is at a particular advantage due to its practical implications for a better understanding of community members' perceptions, attitudes, and ability to cope with sudden adversity (Leykin et al. 2013). The five factors of the CCRAM-10 include: (1) Leadership; (2) Collective efficacy; (3) Preparedness; (4) Place attachment; and (5) Social trust, each of which is composed of two items (Leykin et al. 2013). The items for the CCRAM were derived from the collective characteristics of communities and designed in a more resource-based manner to form another feature of the CCRAM (Rapaport et al. 2018). The advantage of CCRAM also lies in its efficiency, as it provides a valid brief version of 10 items (CCRAM-10) that yield the same five primary factors included in the longer 28-item version (CCRAM-28). Confirmatory factor analysis was conducted for the CCRAM-10 among communities in Israel and the results suggested excellent fit to the data ($\chi^2/df = 2.39$; RMSEA = 0.051; CFI = 0.985; AIC = 119.81) (Leykin et al. 2013). The brevity of assessment instruments has already been widely recognized as helping to reduce the burden on respondents while being equally valid as longer measures of the same construct (Smith et al. 2012; Kaufman et al. 2016). Practical considerations in this regard become especially important in emergency situations when the quick diagnoses of communities' existing capacities are usually required for timely action. Another unique strength of the CCRAM is its validation with a state representative sample comprised of ordinary residents that were drawn from different types of communities, including urban, suburban, and rural communities (Leykin et al. 2013).

China is a country prone to multiple natural hazards. Its population might be exposed to higher disaster risks as a result of the vast changes in social structure that the country has experienced over the past decades (Yang et al. 2015). To respond to such a situation, recent disaster management policy and planning emphasizes disaster mitigation and prevention rather than the previous focus of post-disaster response and recovery (Shi et al. 2014). In the meantime, conceptual research about disaster vulnerabilities and disaster risks from a resilience perceptive has also witnessed significant growth in China (Lei et al. 2014; Xue et al. 2018). However, research about resilience at the community level is just emerging, with relevant studies still predominantly focusing on the identification of the essential factors associated with community resilience in China (Li et al. 2016; Qin et al. 2017). In practice, along with recent global and national policy advocacies, disaster risk reduction programs implemented to enhance community disaster resilience are not uncommon, especially in southwest China (ODI 2015). However, few of these programs have clarified the theoretical framework used for their program design, nor did these initiatives make efforts to examine and evaluate the effectiveness of their practical interventions in enhancing community resilience. This could be attributed to the blurred conceptual framework of community resilience in a Chinese context, which has led to the absence of culturally applicable measurements of community resilience at the operational level.

In light of these gaps, the current study aims to translate the original English version of the CCRAM-10 into Chinese, to adapt its measurement items in accordance with the Chinese context, and subsequently to test the reliability and validity of the Chinese version of CCRAM-10 with

communities in southwest China, for a practical purpose—to assess and evaluate community disaster resilience.

2 Method

This section explains the procedure for cross-cultural adaptation of CCRAM-10 in the beginning. It then describes the sampling method and introduces the two communities where our study participants come from. Data for this study were gathered through a questionnaire composed by the Chinese Version of CCRAM-10, the CART Assessment Survey, and a basic information section. Data analysis methods include internal consistency reliability and convergent validity tests, confirmatory factor analysis, and multiple linear regression analysis.

2.1 Procedure for Cross-Cultural Adaptation

The principal investigator received permission from the developer of the CCRAM to use the original English version for translation. The cross-cultural adaptation process of the original scale was carried out step by step with reference to the proposed guidelines (Beaton et al. 2000).

Three translators were recruited to create, independently, initial translations of the original CCRAM scale from English to simplified Chinese. All three translators were native Chinese speakers who majored in sociology and had an excellent grasp of the English language. Subsequently, the authors of the current study and the three translators came together to synthesize the three Chinese versions with particular attention to inconsistent or ambiguous wording. Then, the combined Chinese version was sent to three more independent professional translators, who were native Chinese speakers and were totally blind to the original scale, for back translation. Next, the authors compared the back-translated version with the original scale to make sure that the translated version reflected the same item meanings as the original version. In addition to this process, a group of experts from the field of disaster management was invited to review this work in terms of semantic, idiomatic, experiential, and conceptual equivalence, with the aim of obtaining a draft of the Chinese version of the 10-item CCRAM. Finally, a pilot study was carried out using this draft in the target community with nine ordinary community members and three community workers in order to identify any items that were not clear to Chinese readers or not applicable to local Chinese communities. Some minor changes were made following the suggestions of the pilot study participants. For instance, the term "municipal authority" from the original scale was translated as "local government" in the Chinese version to conform to the indigenous political system. The final Chinese version of the CCRAM with 10 items (hereafter referred to as the Chinese Version of CCRAM-10) was eventually constructed through this process.

2.2 Sampling and Participants

The participants for this study were recruited from one rural community and one urban community as previous research had highlighted the discrepancy in our understanding of community resilience between urban and rural communities (Cutter et al. 2016). Both communities were located in areas that were affected by the catastrophic Wenchuan Earthquake (Mw 7.9) that occurred on 12 May 2008. Previous activity related to community-based disaster risk reduction (DRR) was another criterion for selecting the research sites for this study to investigate if and to what extent community members translate their participation in DRR activities into perceived community resilience. The selected rural community in particular was very close to the epicenter of the Wenchuan Earthquake. Although the entire community had undergone several rounds of prominent government-led reconstruction work after the disaster, it continued to face the risk of secondary hazards such as landslides and debris flows. In response to this, the local government made substantial efforts towards disaster risk reduction and the emergency management of geological hazards (Cui et al. 2018). Regarding the selected urban community, even though it experienced far less damage from the Wenchuan Earthquake compared to the selected rural community, it was still undergoing secondary hazards triggered by the devastating earthquake. For the sake of people's safety and well-being, the local government carried out different forms of DRR activities in the community. These representative actions included training for community emergency response teams and performing community-based evacuation drills. Another determining factor in the selection of the aforementioned communities was access authorization from their local governments.

The survey was carried out from July to October 2017. In each community, the household registration record was obtained from the local authority from which 200 households (about 10% of the total households in each community) were selected using a simple random sampling strategy. One person in each household was chosen according to their availability with a preference for the head of the household. Two resident social workers were hired to contact each selected household and invite them to participate in the survey. Then, each potential participant who gave verbal informed consent to the social worker received one hard copy of the survey questionnaire. The participants were given a week to fill out the questionnaire after which period the social workers returned to the participants one by one and collected their questionnaires.

Eventually, 189 complete questionnaires were collected from the rural community, and180 from the urban community. The response rates were 94.5% and 90%, respectively. All the information collected was anonymous and kept confidential.

2.3 Measurement Instruments Used for Data Collection

Consistent with the original CCRAM-10, the Chinese Version of CCRAM-10 also contains 10 items that are categorized into five dimensions. A 5-point Likert-type scale is used in which "5" = strongly agree and "1" = strongly disagree. Participants were also invited to complete a section on their background information, and another self-administered section about community resilience called the Communities Advancing Resilience Toolkit (CART) Assessment Survey.

The background information section was mainly about sociodemographic characteristics (gender, age, education, marital status, income level, and place of residence). Their participation in community-based disaster preparation and risk reduction activities (hereafter referred to as DRR activities) was also surveyed by two questions, "Have you received any training on geological disasters?" and "Have you ever participated in an evacuation drill?" The answers to these two questions were set as dummy variables.

The Communities Advancing Resilience Toolkit (CART) Assessment Survey was developed as a theory-based and field-tested questionnaire to collect baseline information about community resilience (Pfefferbaum et al. 2013; Pfefferbaum et al. 2015; Pfefferbaum and North 2016). The CART survey has already been translated from English to Chinese and has also been tested in Chinese communities (Hu et al. 2017). Therefore, the Chinese version of the CART Assessment Survey was utilized in this study as a cross-validation instrument to establish the preliminary evidence for the convergent validity of the Chinese Version of CCRAM-10. This instrument contains 26 items covering five interrelated domains: Connection and Caring (5 items), Resources (5 items), Transformative Potential (8 items), Disaster Management (4 items), and Information and Communication (4 items). A 5-point Likert scale denoting the extent of agreement (from "1" = strongly disagree to "5" = strongly agree) is used for each item. The CART demonstrated good internal reliability (Cronbach's alpha) within each domain for the current sample—0.87 for the Connection and Caring subscale, 0.88 for the Resources subscale, 0.94 for the Transformative Potential subscale, 0.92 for the Disaster Management subscale, and 0.85 for the Information and Communication subscale.

2.4 Data Analysis Strategy

Internal consistency reliability, confirmatory factor analysis, and convergent validity were performed in this analysis (Chan 2014; Bolarinwa 2015). Descriptive statistics of frequency and percentage were performed for the six demographic variables (sex, age, education level, marital status, income level, and place of residence) and for the two DRR activities variables (disaster training and evacuation drills). Response options for the 10 core community resilience items ranged from 1 (strongly disagree) to 5 (strongly agree), with a midpoint of 3 (neither disagree nor agree). A participant's response for each factor of CCRAM-10's Chinese Version was calculated by taking the average score of the items under that factor. The total community resilience score was computed using the mean score of the five factors. The internal consistency of the Chinese Version of CCRAM-10 was tested using Cronbach's alpha statistics.

Confirmatory factor analysis (CFA) was conducted to test the construct validity of the Chinese Version of CCRAM-10. The analysis was performed using the statistical software IBM SPSS Amos 23.0, and the goodness-of-fit indices, including Chi square (χ^2), goodness-of-fit (GFI), comparative fit index (CFI), normed fit index (NFI), root mean squared error of approximation (RMSEA), and standardized root square mean residual (SRMR), were reported. The convergent validity was then examined by correlating the Chinese Version of CCRAM-10 and its five subscales with the validation scale of CART using Pearson's correlation coefficients. Positive correlations for the two scales were expected.

In addition, multiple linear regression models were used to explore the correlations between respondents' participation in DRR activities and their perceptions of community resilience as measured by the Chinese Version of CCRAM-10, controlling for necessary sociodemographic variables. Two hypotheses were expected to be supported: (1) having attended disaster training is positively correlated with the perception of community resilience; (2) participation in evacuation drills is positively correlated with the perception of community resilience.

3 Results of the Aba Prefecture and Chengdu City Case Study in Southwest China

This section first outlines the socio-demographic characteristics of the study participants and their experience of participating in DRR activities, following which it explains the results indicating the validity and reliability of the Chinese Version of CCRAM-10 for use with communities in China. Finally, this section presents the analysis results

of the correlation between respondents' participation in DRR activities and their perceptions of community resilience.

3.1 Descriptive Statistics of the Study Participants

There were 369 residents who participated in this study, 51.2% from the rural community and 48.8% from the urban community. As shown in Table 1, the majority of them were female (67.5%) and married (72.6%). In terms of education level, few participants reported that they did not finish primary school (2.7%), while most of them had completed middle school (29.5%) or high school (34.4%). Most of the participants were aged between 18 and 60 (90%), with only 10% who were either adolescents or seniors. Taking the 2016 per capita disposable income of the local regions respectively—Aba Autonomous Prefecture for the rural residents (RMB 10,702 yuan) and Chengdu City for urban residents (RMB 35,902 yuan)—as reference, 62.6% of the participants regarded their family income as better than the local average condition, while the remaining 37.4% thought their family was poorer than average. More than half (51.8%) of the participants had received training pertaining to geological disasters, and 60.4% reported that they had participated in evacuation drills in their community (Table 1).

3.2 Internal Consistency Reliability

Table 2 provides the factor structure of the Chinese Version of CCRAM-10 and the survey items associated with each factor. As previously stated, the10-item community resilience measurement has five subscales: (1) leadership, (2) collective efficacy, (3) preparedness, (4) place attachment, and (5) social trust. The mean values of the five subscales, calculated by taking the mean values of responses within that cluster, were ranked for collective efficacy (3.95), social trust (3.79), place attachment (3.68), leadership (3.67), and preparedness (3.63), while the overall CCRAM module was found to have an average value of 3.75. The Cronbach's alpha test demonstrated that the Chinese Version of CCRAM-10 has good overall internal consistency (0.85). Among the five subscales, collective efficacy (0.72), preparedness (0.76), place attachment (0.72), and social trust (0.74) were found to have acceptable internal consistency, while only the leadership dimension emerged as having a questionable value (0.66).

3.3 Confirmatory Factor Analysis

The analytical results of the confirmatory factor analysis (Table 3) indicated that the five-factor model of CCRAM-10's Chinese Version yielded excellent fit to the data ($\chi^2/df = 2.161$; CFI = 0.977; GFI = 0.971; NFI = 0.958;

Table 1 Descriptive statistics of the Aba Prefecture and Chengdu City study participants in southwest China

Variable	Percent	Variable	Percent
Gender		Marital status	
Male	32.5	Unmarried	27.4
Female	67.5	Married	72.6
Age		Income level	
< 18	1.9	Lower than the average	37.4
19–30	34.7	Higher than the average	62.6
31–40	21.1	Place of residence	
41–50	23.6	Urban	48.8
51–60	10.6	Rural	51.2
> 60	8.1	Received education on disasters	
Education		No	48.2
Unfinished primary	2.7	Yes	51.8
Primary	13.3	Participated in evacuation drills	
Middle	29.5	No	39.6
High	34.4	Yes	60.4
College and above	20		
Total	100	Total	100

Number of Participants: 369

Table 2 Mean, standard deviation, and percentage of agreement with community resilience factors and items of the 10-item Conjoint Community Resilience Assessment Measurement in Aba Prefecture and Chengdu City, southwest China

Factor structure of CCRAM-10	Mean (SD)	Percent of agreement	Cronbach's alpha
Leadership	3.67 (0.73)		
1. The local government of my community functions well.	3.70 (0.84)	61.8	0.66
2. I trust the local decision makers.	3.65 (0.84)	60.4	
Collective efficacy	3.95 (0.67)		
3. There is mutual assistance and people care for one another.	4.04 (0.73)	81.8	0.72
4. I can count on people in my community to help me in a crisis situation.	3.87 (0.77)	75.1	
Preparedness	3.63 (0.74)		
5. My community is prepared for an emergency situation.	3.63 (0.85)	60.4	0.76
6. Residents are aware of their roles in an emergency situation.	3.65 (0.79)	64.2	
Place attachment	3.68 (0.82)		
7. I am proud to tell others where I live.	3.75 (0.92)	66.9	0.72
8. I have a sense of belonging to my community.	3.63 (0.91)	62.3	
Social trust	3.79 (0.70)		
9. Good relationships exist between various groups.	3.81 (0.78)	71.8	0.74
10. Residents in my community trust each other.	3.79 (0.78)	70.7	
Overall Community Resilience	3.75 (0.54)		0.85

Number of participants: 369

Table 3 Goodness-of-fit indices for the Chinese Version of the 10-item Conjoint Community Resilience Assessment Measurement in Aba Prefecture and Chengdu City, southwest China

χ^2	χ^2/df	Goodness-of-fit indices				
		CFI	GFI	NFI	RMSEA	SRMR
54.014	2.161	0.977	0.971	0.958	0.056	0.030

Number of participants: 369

RMSEA = 0.056; SRMR = 0.030). Statisticians and scholars have suggested that RMSEA is acceptable for values below 0.08 and is excellent when below 0.05, NFI and CFI are excellent values when they are higher than 0.97 and are admissible values when they are greater than 0.95, SRMR is excellent when values are below 0.05, and GFI values greater than 0.95 are indicative of good model fit (Hu and Bentler 1999; Schumacker and Lomax 2004). Regarding the Chi square quantification, the results represent an acceptable fit if they are in the range of 2–3 *df* (Rocchi et al. 2017). The standardized factor loadings of the five-factor correlated model with 10 items ranged from 0.63 to 0.88, and they were all significant at $p < 0.001$ levels. These results supported the five-factor structure of the Chinese Version of CCRAM-10 as loadings higher than 0.60 can be considered reliable regardless of sample size (Liebenberg and Moore 2018).

3.4 Convergent Validity

The CART Assessment Survey was used to assess the convergent validity of CCRAM-10's Chinese Version; the correlation coefficients are reported in Table 4. Scores for the Chinese Version of CCRAM-10 and its five subscales were found to be positively associated with the total CART score, with correlation coefficients ranging from 0.463 to 0.770 ($p < 0.01$). With the exception of the collective efficacy dimension, all of the other four subscales had correlation coefficients larger than 0.50, indicating high correlations (Cohen 1988). Collective efficacy was seen to have a medium correlation with the CART score at 0.463. The overall CCRAM score was strongly correlated with the CART, with a coefficient of 0.77. The results thus provide further convincing evidence for the criterion-related validity of the Chinese Version of CCRAM-10 as an instrument for assessing community resilience.

3.5 Correlation Between Disaster Risk Reduction Activities and Community Resilience

Regression results (Table 5) controlling for socio-demographic variables reveal that respondents' participation in geological disaster training ($p < 0.01$) and evacuation drills ($p < 0.001$) were significantly and positively associated with the overall community resilience scores assessed by the Chinese Version of CCRAM-10. In other words, if a respondent participated in disaster training or

Table 4 Convergent validation between the Communities Advancing Resilience Toolkit (CART) Assessment Survey and the Chinese Version of the10-item Conjoint Community Resilience Assessment Measurement (CCRAM-10) administered in Aba Prefecture and Chengdu City, southwest China

	CCRAM-10 and subscales					Score of total CCRAM-10
	Leadership	Collective efficacy	Preparedness	Place attachment	Social trust	
CART	0.549	0.463	0.605	0.574	0.630	0.770

All correlations are significant at the 0.01 level (2-tailed); Number of participants: 369

Table 5 Linear regression results for the Chinese Version of the 10-item Conjoint Community Resilience Assessment Measurement (CCRAM-10) and its subscales

Variables	Community Resilience Domains					Overall community resilience
	Leadership	Collective efficacy	Preparedness	Place attachment	Social trust	
Disaster training (no = 0)	0.165*	0.082	0.241**	0.127	0.165*	0.149**
	(0.077)	(0.073)	(0.078)	(0.089)	(0.077)	(0.057)
Evacuation drills (no = 0)	0.150	0.206**	0.225**	0.349***	0.210**	0.230***
	(0.077)	(0.073)	(0.078)	(0.088)	(0.076)	(0.057)
Gender (male = 0)	− 0.218**	− 0.084	0.145	0.075	− 0.018	− 0.020
	(0.078)	(0.074)	(0.079)	(0.090)	(0.078)	(0.058)
Marital status (unmarried = 0)	0.153	0.027	0.001	0.119	− 0.074	0.057
	(0.120)	(0.113)	(0.121)	(0.137)	(0.119)	(0.089)
Income level (lower than average = 0)	0.243**	− 0.043	0.183*	0.113	0.081	0.109
	(0.077)	(0.073)	(0.078)	(0.088)	(0.076)	(0.057)
Residence (urban = 0)	− 0.096	0.099	− 0.081	0.010	− 0.029	− 0.013
	(0.087)	(0.082)	(0.088)	(0.099)	(0.086)	(0.064)
Age	0.057	0.010	0.080*	− 0.007	0.089*	0.044
	(0.034)	(0.033)	(0.035)	(0.039)	(0.034)	(0.025)
Education	0.007	− 0.056	− 0.081	− 0.064	− 0.003	− 0.034
	(0.046)	(0.044)	(0.047)	(0.053)	(0.046)	(0.034)
adj. R^2	0.090	0.037	0.105	0.055	0.049	0.097
F	5.551***	2.768**	6.398***	3.666***	3.363**	5.965***

Standard errors in parentheses; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$; Number of participants: 369

evaluation drills, his/her assessment of the community resilience score increased by 0.15 and 0.23, respectively. Regarding the five subscales, participation in evacuation drills was also significantly correlated with collective efficacy, preparedness, place attachment, and social trust. Participation in disaster training was significantly associated with leadership, preparedness, and social trust. These results demonstrate that the community resilience assessed by the Chinese Version of CCRAM-10 has strong positive correlations with individuals' participation in DRR activities as assumed. It was also interesting to find that different types of DRR activities influenced particular dimensions of community resilience.

4 Discussion

This study adapted the original version of the CCRAM-10 for a Chinese context and subsequently validated this Chinese Version of CCRAM-10 through its application in two communities with a sample of 369 residents. Data analysis results demonstrate that the Chinese Version of CCRAM-10 has good internal consistency, excellent values for goodness-of-fit, all the items loaded strongly onto the expected latent factor, and positive correlations with the scale applied for cross validation. It may thus be safe to conclude that CCRAM-10's Chinese Version is a valid

instrument to use with Chinese communities for the purpose of assessing or evaluating disaster resilience.

Moreover, this study provides evidence that people's participation in DRR activities—disaster training and evacuation drills—is positively correlated with their perception of community resilience as measured by the Chinese Version of CCRAM-10. These findings are consistent with the results of prior empirical research, either in an impoverished urban community in the United States (Pfefferbaum and North 2016) or a disaster-stricken rural community in southwest China (Cui et al. 2018). In both of the latter two studies, community resilience was assessed using the CART Assessment Survey. It reinforces that disaster risk management activities are essential for enhancing community resilience (Cavallo 2014; Cha et al. 2016; Aka et al. 2017), and further underlines the need for interventions for disaster risk reduction (Han et al. 2017; Wu et al. 2018). Understanding how specific activities and approaches influence community resilience is also an integral element of policy advancement for disaster risk management.

No significant differences in community resilience were found between the rural and urban communities selected for this study. However, prior research outside of China has indicated that urban and rural communities demonstrate different levels and patterns of community resilience (Cutter 2016; Rapaport et al. 2018). For example, in the United States, economic capital contributes more to community resilience in urban areas while social capital contributes more to community resilience in rural areas (Cutter 2016). Another study that examined community resilience in Israel using CCRAM revealed that rural communities benefited from their shared ideology and the intense relationships between residents, and thus exhibited the best conditions for all the factors when compared to cities and towns (Rapaport et al. 2018). Even within China, however, a study conducted in Sichuan Province revealed similar results; this study adopted the CART Assessment Survey to analyze the different levels of community resilience between urban and rural communities (Zheng et al. 2017).

The lack of difference between rural and urban communities revealed in the current study might indicate that, first of all, the factors covered in the Chinese Version of CCRAM-10 are not sensitive enough to capture the variations between rural and urban communities in China. This could also be attributed to the sampling criteria, as the two communities being studied were selected based on several shared conditions, such as disaster experience, implementation of DRR programs, and population size. Most importantly, since DRR actions were included in the current regression models, they could be seen as contributing factors in urban communities, especially in terms of promoting social capital. Ultimately, the relationship between the two type of community and residents' perception of resilience is a prominent topic as it will increase our understanding of the different challenges as well as opportunities experienced by those living in urban areas compared to those in rural places (Cutter 2016). This topic is especially worthy of further attention in China given the discrepancy in income levels, housing conditions, public infrastructure, and social services between urban and rural areas (Yang et al. 2015). But we cannot ignore that the vulnerabilities of rural communities might be mitigated by their dynamic social interactions based on kinship networks and neighbors (Cui and Sim 2017).

There were several limitations to the current study. First, the sample size was relatively small (n = 369) and restricted to a single region in southwest China (Sichuan Province). Future studies covering larger, cross-regional, and diverse communities are strongly encouraged. Second, the test–retest reliability of CCRAM-10's Chinese Version was not performed, which could provide confidence in the stability of its factor structure and resilience measure (Wang et al. 2010). Third, only one cross-validation measurement, the CART Assessment Survey, was included to examine the convergent validity of the Chinese Version of CCRAM-10 in this study, while its discriminate validity was not assessed. Thus, the Chinese Version of CCRAM-10 needs further evaluation in conjunction with other conceptually related criteria in order to fully establish its validity.

5 Conclusion

This study's findings suggest that the Chinese Version of CCRAM-10 is a promising short measure of community resilience that is applicable to communities in China. It can be used by local decision makers and community workers for effective and efficient assessment of communities' capacity to respond, adapt to, and recover from a calamity. Our study further indicates that ongoing disaster education about risks, preparedness, and coping resources for community residents is important for creating community resilience as it associates with residents' higher trust in the local government leadership and enhanced mutual trust among the residents. Similarly, regular exercise of evacuation drill could be another important approach to address the core components of community resilience, such as by improving collective efficacy and disaster preparedness capacity. Future research is recommended to use the Chinese Version of CCRAM-10 or other available culturally applicable instruments to increase our understanding about the extent to which prevalent community-based DRR interventions have been effective in enhancing community

resilience with a wider coverage of different communities, of which, the place-specific factors are worth of careful consideration in doing so.

Acknowledgements The research is funded by Sichuan University (Grant No. 2018hhf-06) and supported by the Fundamental Research Funds for the Central Universities.

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