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ORIGINAL ARTICLE

Cross-Cultural Adaptation and Validation of the Chinese Versioned Five-by-Five Resilience Scale

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ABSTRACT

Background. Psychological resilience is the ability to cope with stress and is related to mental health. Assessing the psychological resilience of university students is important for formulating effective health promotion strategies to enhance their well-being and health. **Objectives.** This study aimed to validate the Five-by-Five Resilience Scale (5×5RS) in the Chinese context using confirmatory factor analysis (CFA). **Methods.** A cross-sectional study was carried out among 705 university students, with a mean age of 19.73 (SD=1.56) years. The scale was translated into Chinese using standard forward and backward translation procedures. CFA was conducted using Mplus 8.3 software. **Results.** The hypothetical five-factor model was supported by the CFA after removing 9 items and adding correction lines to the residuals of the same factor (RMSEA=0.055, CFI=0.926, TLI=0.901, SRMR=0.065). The Cronbach's alpha values and the composite reliability for the subscales ranged from 0.638~0.784 and 0.639~0.786, respectively. **Conclusion.** The Chinese version of the 5×5RS was considered valid and reliable to assess the psychological resilience among Chinese university students.

KEYWORDS: ***Resilience, Confirmatory Factor Analysis, Reliability, Validity.***

INTRODUCTION

Psychological resilience, a crucial trait linked to an individual's mental toughness, and physical and mental health, is the capacity to swiftly recover and adapt to environmental changes amidst stress, frustration, and adversity (1-3). This resilience not only mitigates the effects of traumatic childhood experiences on adult depression but also empowers individuals to actively mobilize internal and external resources. This enables them to handle stress and prevent succumbing to negative emotions during adverse life events or dilemmas (3, 4).

Various resilience scales have been developed based on different theoretical constructs. The Resilience Scale by Wagnild and Young (5) uses 25 entries and a two-factor structure to assess individuals who successfully cope with major setbacks. The Connor-Davidson Resilience Scale by Connor and Davidson (6) uses 25 entries and five factors to describe the characteristics of psychological resilience in ordinary people and clinical patients. The Resilience Scale for Adults by Friborg et al. (7) focuses on protective resources that aid individuals in recovery and

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health maintenance, using 37 items and five factors. The Brief Resilience Scale by Smith et al. (8) measures an individual's ability to recover from stress and the associated resources and health status, using 6 entries and one factor. The Ego-Resiliency Scale by Klohnen (9) provides a mental health and adaptation description using 26 entries and four factors.

Resilience, as conceptualized by existing scales, is a multidimensional construct encompassing various protective factors. These factors, both internal (like skills and attitudes) and external (like social support), aid in overcoming adversity and impact resilience, necessitating multi-dimensional measurement. However, few scales consider the distinction between internal and external factors, and none directly assess resilience, emotion regulation, or self-efficacy, despite their proven importance in resilience (10-12). In their review, Windle et al. (13) noted the absence of a gold standard among 15 resilience measures, highlighting that many are in early development stages and require further validation. They suggested an optimal measure would capture resilience's complexity, have a replicable factor structure, and possess robust, well-documented psychometric properties. In response, DeSimone et al. (14) developed the 5×5RS, focusing on five protective factors of psychological resilience, expressed in both positive and negative forms. The 5×5RS is a promising tool warranting attention.

However, it is worth noting that there is currently no validated Chinese version of the 5×5 Resilience Scale (5×5RS-C). Therefore, our research focus is on assessing the validity and reliability of the 5×5RS-C among Chinese university students. The unique characteristics of this stage of the population, including their different experiences and understandings of psychological resilience compared to working adults, necessitate a comprehensive evaluation of the applicability and cultural relevance of this scale in this context. Therefore, our research is a crucial prerequisite to ensure that the 5×5RS-C is an effective and reliable tool for measuring the psychological resilience of university students, thereby laying the foundation for more effective research in this field in the future.

MATERIALS AND METHODS

Participants. A total of 705 university students participated in this study. The majority of participants were female (69.36%) and the mean age of participants was 19.73 (SD=1.56) years. All participants were native Chinese speakers.

Measures.

a. Demographic Form.

In addition to the 5×5RS content, basic information about the participants' gender, age, major, and grade, were also included.

b. Five-by-Five Resilience Scale.

The original 5×5RS was developed by DeSimone et al. (14) and it was based on theoretical and empirical considerations. The scale has five dimensions, and five protective factors including adaptability, emotion regulation, optimism, self-efficacy, and social support. Each factor consists of five self-report questions, using a 5-point Likert-type response: 1= Very Inaccurate, 2= Moderately Inaccurate, 3= Neither Inaccurate nor Accurate, 4= Moderately Accurate, 5= Very Accurate. Reverse scoring entries were included in each dimension, and scoring entailed calculating a final score after reverse scoring the negative question items. In DeSimone et al.'s (14) study, the overall 5×5RS as well as each subscale showed adequate internal consistency reliability, with all alpha levels exceeding 0.70.

Questionnaire Translation. We obtained permission to translate the 5×5RS from the original author. Following the model of Brislin's (15) translation, the forward and backward translation method was used, with the aim of the revised scale would be consistent with the original author's intention and also the Chinese cultural context. First, a bilingual author familiar with the content made a forward translation (English to Chinese, content-1). Then another bilingual author made a reverse translation (Chinese to English, content-2). Next, a discussion group of five expert panels from related areas (two of whom have been working in the field of exercise and health for over 10 years) reviewed the translated content of content-1 and content-2, comparing each item with the original English version, making changes to ensure that the content of the response questionnaire was appropriate for Chinese culture and university students' perceptions, and forming content-3. Finally, after inviting five university students to pre-respond to content-3, interviews were conducted to check whether the questionnaire entries could be clearly understood. Student

feedback on the 5×5RS-C was clearer and easier to understand, with no ambiguity. This means that the questionnaire entries had a good degree of generalisability, which led to the final test version of the scale.

Data Collection. A cross-sectional research design was used for this study, with participants completing the online questionnaire themselves. Convenience sampling methods were used for participant recruitment. Data were collected between June 2022 and July 2022. The Universiti Sains Malaysia Human Research Ethics Committee (USM/JEPeM/22040240) approved the study, which was carried out in conformity with the Helsinki Declaration.

A link to the online questionnaire was developed using the Questionnaire Star platform (online platform). Posters were made and posted on the walls of the dormitories and in the library (permission was obtained from the relevant department for this action). The poster included the purpose of the study, the content of the study, and the participants' own interests. Participants who are interested in taking part in the study could scan the QR code to answer the questionnaire. In order to increase the exposure of the experiment, the link was forwarded to multiple WeChat groups such as the student union and class groups to increase the number of participants recruited. Informed consent was obtained through an online platform before participants responded to the survey, the questionnaire was anonymous throughout and participants' data were guaranteed to be confidential. There was no reward for participants at the end of the completion of the investigation. Finally, 753 questionnaires were collected online, 48 unqualified data were screened out (including most of the answers selected were consistent, incomplete or incorrect basic information, too short time to complete, etc.), with 705 reliable data, the rate of usable data was 93.63%. In addition, participants were asked at the initial test if they would like to take part in the test-retest study, and if so, they could join the test-retest WeChat group and fill in the questionnaire again a week later. A total of 44 people joined the test-retest group. The initial and retest data were matched according to the contact information. 42 completed questionnaires were finally obtained.

Statistical Analysis. Data were analyzed using SPSS 26.0 and Mplus 8.3 software, with measurement data expressed as ($\bar{x}$±s) and enumeration data expressed as frequencies and percentages. After examination, the data did not meet the assumption of normality, hence MLM method is used in the CFA analysis. A significant factor loading of less than 0.4 was used as a criterion for retaining or removing items from the measurement model (16). The following fit indices were chosen: Tucker-Lewis Index (TLI), comparative fit indices (CFI); root mean square error of approximation (RMSEA), and standardized root mean square residual (SRMR). According to Hair et al.'s (17) recommendations, a standard value of greater than 0.90 for TLI and CFI; less than 0.08 for RMSEA; and SRMR should be less than 0.08. Cronbach's alpha was used to evaluate the internal consistency of the 5-factor model, and a value greater than 0.6 reached an acceptable threshold (18). In the case of error correlation, Cronbach's alpha may cause an underestimation of reliability, so composite reliability (CR) needed to be computed in conjunction with the structural equation model for a thorough evaluation, and the critical value of CR was set at no less than 0.60 (19). The test of discriminant validity used the magnitude of the correlation between the factors in the model. If the correlation coefficient between the factors is less than 0.85, the discriminant validity can be determined (20). The Intraclass Correlation Coefficient (ICC) was used to analyze the test-retest reliability among 42 university students at one-week intervals. From 0 to 1, the ICC reliability values can be classified as poor (<0.4), fair (0.4-0.6), good (0.6-0.75), and excellent (>0.75) (21).

RESULTS

A total of 705 university students participated in the study. The mean age of the sample was 19.73 years, with an age range of 18~26 years. All participants were native Chinese speakers and were able to recognize and understand Chinese characters clearly. The majority of the participants were female. In terms of professional classification, the majority of participants were medical students; in terms of year distribution, the largest number of participants were freshmen and sophomores. See Table 1 for more information.

Measurement Model for the 5×5RS-C. The hypothetical model of the 5×5RS-C at the beginning was composed of 25 items containing 5 factors. The results of the initial hypothetical model (Model 1) showed poor model fit indicators.

Table 1. The demographic characteristics (*n*=705)

Characteristics	Frequency	Percentage	Mean±SD
Gender			
Male	216	30.64%	
Female	489	69.36%	
Age (years)			19.73±1.56
Major			
Science and Engineering	13	1.84%	
Medicine	626	88.80%	
Agriculture	2	0.28%	
Economics	12	1.70%	
Management	9	1.28%	
Law	8	1.13%	
Pedagogy	35	4.97%	
Class			
Freshman	337	47.80%	
Sophomore	274	38.86%	
Junior	53	7.52%	
Senior	25	3.55%	
Others	16	2.27%	

In Model 2, entries with factor loadings below 0.40 had been removed. However, in the factor named Emotion Regulation (ER), considering that if all entries with factor loadings below 0.40 were deleted, there would only be two observed variables in the dimension, which would not be sufficient to respond to the content, so the two entries with the lowest loadings in the dimension (ER1 and ER2) were temporarily deleted first. The model fit index was significantly improved by deleting the low loadings. The model was then further modified according to the correction indices to increase the correlation between item residuals within the same factor. After adding residual covariances, the model was improved, and the final model (Model 3) was determined. Table 2 summarises the model fit indices for the 5×5RS-C. Table 3 shows the standardized item loading for the measurement model.

Validity and Reliability. Based on the final model, calculations of Cronbach's alpha values were carried out and the values of the factors ranged from 0.638 to 0.784. The CR values for each subscale ranged from 0.639 to 0.786. The Cronbach alpha and CR values for all structures indicated satisfactory reliability of the structure. The ICC values for each item all exceeded 0.50 (Table 4), indicating more than fair reliability according to the classification of test-retest reliability levels.

Discriminant validity tests were conducted based on the correlation between the factors. After reverse scoring, the correlations between the subscales were analyzed. The correlation values between the factors and their indications of significance for the final model are given in Table 5. All correlation coefficients were below the suggested cut-off of 0.85, indicating good discriminant validity for the five psychological resilience factors. The values of CA, CR, and correlation coefficients are shown in Table 5.

Table 2. A summary of the models' fit indices

Path Models	χ^2	df	RMSEA (90% C.I.)	CFI	TLI	SRMR
Model 1	1903.194	265	0.094 (0.090-0.098)	0.609	0.557	0.141
Model 2[a]	341.798	94	0.061 (0.054-0.068)	0.903	0.876	0.068
Model 3[b]	279.922	90	0.055 (0.048-0.062)	0.926	0.901	0.065

[a]: The measurement model with AD3, AD5, ER2, ER3, OP3, OP4, SE3, SS1, and SS4 deleted. [b]: The measurement model with covariance between the item errors of (ER9 with ER6), (SE1 with SE2), (SE2 with SE4), and (SS2 with SS3); TLI= Tucker-Lewis Index; CFI= Comparative Fit Index; RMSEA= Root Mean Square Error of Approximation; SRMR= Standardised Root Mean Square Residual.

Table 3. Standardized factor loadings for Model 1, Model 2, and Model 3 of the 5×5RS-C

Factors and Items	Factor Loadings Model 1	Model 2	Model 3
Adaptability			
AD1	0.570	0.597	0.589
AD2	0.578	0.579	0.599
AD3	0.323	-	-
AD4	0.611	0.649	0.638
AD5	0.220	-	-
Emotion Regulation			
ER1	0.233	0.252	0.186
ER2	0.177	-	-
ER3	0.208	-	-
ER4	0.716	0.724	0.694
ER5	0.867	0.854	0.882
Optimism			
OP1	0.756	0.767	0.764
OP2	0.781	0.780	0.779
OP3	0.302	-	-
OP4	0.387	-	-
OP5	0.686	0.676	0.681
Self-efficacy			
SE1	0.701	0.708	0.576
SE2	0.756	0.776	0.717
SE3	0.275	-	-
SE4	0.604	0.581	0.704
SE5	0.465	0.472	0.494
Social Support			
SS1	0.288	-	-
SS2	0.779	0.793	0.734
SS3	0.704	0.711	0.646
SS4	0.203	-	-
SS5	0.709	0.704	0.746

Table 4. Test-retest reliabilities of 5×5RS-C

Item	Test 1	Test 2	ICC (95% CI)
n=42	Mean±SD	Mean±SD	
Adaptability			
AD1	3.19±0.74	3.02±0.68	0.642
AD2	3.45±0.77	3.45±0.67	0.654
AD4	3.52±0.77	3.38±0.62	0.769
Emotion Regulation			
ER1	3.6±0.80	3.38±0.76	0.590
ER4	3.31±0.95	3.21±0.90	0.797
ER5	2.93±0.95	2.95±0.80	0.643
Optimism			
OP1	2.76±0.91	2.71±0.86	0.794
OP2	2.48±0.97	2.76±0.79	0.786
OP5	2.57±0.94	2.69±0.90	0.847
Self-efficacy			
SE1	3.36±0.58	3.17±0.62	0.675
SE2	3.1±0.62	3.14±0.52	0.649
SE4	3.67±0.72	3.38±0.66	0.596
SE5	2.9±0.66	2.83±0.70	0.563
Social Support			
SS2	2.74±0.83	2.83±0.82	0.703
SS3	2.95±0.76	2.98±0.64	0.776
SS5	2.55±0.77	2.57±0.74	0.710

CI= Confidence Interval, ICC= Intraclass correlation coefficient.

Table 5. Cronbach's alpha (CA), Composite reliability (CR), test-retest reliabilities, and the factor correlation of the final model for the 5×5RS-C

Subscales	CA	CR	1	2	3	4	5
1. Adaptability	0.638	0.639	1				
2. Emotion Regulation	0.649	0.645	0.018	1			
3. Optimism	0.784	0.786	0.220**	0.471**	1		
4. Self-efficacy	0.723	0.720	0.484**	0.072	0.081*	1	
5. Social Support	0.778	0.752	0.201**	0.372**	0.566**	0.049	1

**: Correlation is significant at the 0.01 level (two-tailed), *: Correlation is significant at the 0.05 level (two-tailed).

DISCUSSION

The 5×5RS is a new measure of psychological resilience that is short and easy to administer for assessing the five protective factors associated with psychological resilience. 5×5RS-C was revised using the original English version. For the validation study, the aim of this study was to verify whether the measurement model consisting of 5 factors had good applicability. The results of the CFA confirmed the validity and reliability of the revised 5×5RS-C. Based on the results of the validity and reliability study, it concluded that the revised scale, with 16 items, is suitable for use among Chinese university students.

Based on factor loadings, the CFA examined the strength of the relationship between the observed measure and the underlying variable or factor (22). When doing CFA, a strong conceptual foundation is needed to guide the specification and evaluation of the factor model. It can be used for psychometric assessment, method effect testing, construct validation, and assessment of measurement variance (23, 24). As the factors and items of 5×5RS have been pre-determined in the previous study (14), the present study only conducted a validation study on the translated version of 5×5RS. In the validation study, the aim was to confirm whether the five-factor measurement model was appropriate for the data. In the initial model, the calculated results showed a poor fit of the model data, possibly related to the low factor loadings on some of the entries in the model. When the entries with low factor loadings were removed, the overall model's data fit metrics improved significantly, although they still did not reach an acceptable threshold. Also, considering the completeness and accuracy of the model structure, Bollen (23) suggested that each dimension generally requires at least three observed variables to reflect its content, so the three entries with the highest factor loadings in the factor ER were retained in Model 2. Subsequently, the model was corrected by adding residual modification lines as suggested by the modification indices. Adding the covariance between the residuals of these items seemed reasonable, as the modification lines added were under the same factor. In model 3, the fit indices of the model had basically reached the critical values and the model was acceptable, determined to be the final model.

In this study, in addition to Cronbach's alpha values, CR values were also calculated. CR has been recommended as a reliability test for the CFA measurement model rather than Cronbach's alpha (25-27). This is because Cronbach's alpha could overestimate or underestimate the reliability of a scale at the population level (28). In this study, the reliability values for all subscales of the CR were satisfactory, being all greater than 0.6. To compare the reliability of the 5×5RS-C with the original 5×5RS study, we calculated the reliability of the 5-factor 5×5RS-C based on Cronbach's alpha. The Cronbach's alpha for the factor Adaptability was 0.638, Emotion Regulation was 0.649, Optimism was 0.784, Self-efficacy was 0.723, and Social Support was 0.778, which were lower than the reliability of the original scale in the two samples (Eugene-Springfield community sample and Mechanical Turk sample). The reliability ranges for the five subscales in the two different samples were 0.72 to 0.76 and 0.85 to 0.93 respectively. This may be caused by cultural diversity and different populations involved, which may lead to differences in the interpretation of the project and its cultural adaptation to that population. The population in this study was university students, whereas in DeSimone et al.'s (14) study the population was a community sample and included a wider range of age stages.

Discriminant validity is used to detect whether different entries in a scale produce the same test effect. In this study, the standardized factor correlation coefficients of the final model ranged

from 0.018 to 0.566, showing the correlation coefficients between the factors were all below 0.85, indicating that the scale could distinguish the dimensions well, with clear attribution of the items and good discriminant validity. For the test-retest reliability, the results of this study showed that all subscales ICC range from 0.563 to 0.847, all with moderate reliability, indicating good stability over the two time periods.

The limitations related to this study still remain. Firstly, this study was a cross-sectional study, excluding any extrapolation of temporal relationships. A longitudinal study of the changes and stability of 5×5RS-C over time would consolidate our findings (29). Secondly, the targeted questionnaire is a self-report investigation, which may be subject to response bias and may reduce the accuracy of the data obtained. To overcome this limitation, we emphasized the importance of informing subjects to provide honest feedback prior to data collection. Thirdly, this study used a convenience sampling method and the data obtained were mainly from female university students. However, the results of one survey showed that the chances of higher education tend to be equal for both sexes (30). In order to obtain an equal proportion of male and female respondents, future studies could use stratified sampling methods on a feasibility basis. Fourth, the participants in this study were a population of university students aged 18 to 26 years, although understanding the resilience of university students has a very important role in their own development and physical and mental health (31), future research could examine the replicability of the 5×5RS-C in people of different ages, occupations, and health states. Finally, other validity tests, such as concurrent validity tests, were not included in this study. The original 5×5RS examined concurrent validity and was well-validated. Future research could further explore the criterion validity of this questionnaire against established questionnaires of the same type and domain.

CONCLUSION

The final measurement model for the 5×5RS-C in this sample consisted of 16 items and 5 factors. The revised scale could be successfully adapted to the Chinese language, had satisfactory reliability and validity among Chinese university students, and could effectively measure the level of psychological resilience. It could be used as an internally consistent predictor of perceptions of life, positive and negative health-related behaviors, anxiety, and depressive symptoms.

APPLICABLE REMARKS

- This study provides evidence that the 5×5RS-C has sufficient reliability and validity to assess the psychological resilience of Chinese university students.
- The 5×5RS-C has five factors (adaptability, emotion regulation, optimism, self-efficacy, social support) and 16 items, it is recommended as a tool to assess psychological resilience.

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AUTHORS' CONTRIBUTIONS

Study concept and design: Mengyuan Zhao, Yee Cheng Kueh, Garry Kuan. Acquisition of data: Mengyuan Zhao, Shiyue Wang. Analysis and interpretation of data: Mengyuan Zhao, Yee Cheng Kueh, Ngien Siong Chin. Drafting the manuscript: Mengyuan Zhao. Critical revision of the manuscript for important intellectual content: Mengyuan Zhao, Ngien Siong Chin, Garry Kuan. Statistical analysis: Mengyuan Zhao, Yee Cheng Kueh, Ngien Siong Chin. Administrative, technical, and material support: Shiyue Wang, Garry Kuan. Study supervision: Yee Cheng Kueh, Garry Kuan.

CONFLICT OF INTEREST

There is no conflict of interest declared by the authors.

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