

Brief Communication

Normative data and psychometric properties of the Connor-Davidson Resilience Scale (CD-RISC) and the abbreviated version (CD-RISC2) among the general population in Hong Kong

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ABSTRACT

Purpose: To examine if the two-item version (CD-RISC2) of the Connor-Davidson Resilience Scale (CD-RISC) has adequate internal consistency and construct validity, as well as significant correlation with the full scale, and to provide normative data for the CD-RISC and the CD-RISC2 in a Chinese general population in Hong Kong.

Methods: 10 997 randomly selected participants aged ≥ 20 years completed the Chinese version of the CD-RISC (including the 2 items of the CD-RISC2), the Patient Health Questionnaire, Family Harmony Scale, Family APGAR, and CAGE Questionnaire. Internal consistency, convergent and discriminant validity of the CD-RISC and CD-RISC2 were assessed.

Results: Cronbach's α for CD-RISC and CD-RISC2 was 0.97 and 0.79, respectively. CD-RISC2 was associated with the 25-item version of the CD-RISC ($r=0.88$), depressive symptoms ($r_s=-0.18$), family harmony ($r=0.20$), family functioning ($r=0.27$), and was not associated with alcohol consumption ($r=0.05$). The mean score for the CD-RISC and CD-RISC2 was 59.99 ($SD=13.92$) and 5.03 ($SD=1.37$), respectively. Men, younger individuals, and those with higher education or higher household income reported higher resilience levels.

Conclusions: The Chinese version of the CD-RISC2 was demonstrated to be a reliable and valid measure in assessing resilience among the general population in Hong Kong.

Keywords: Resilience, Connor-Davidson Resilience Scale, CD-RISC2, Community, Chinese, Adults

INTRODUCTION

Psychological stress can adversely impact health and quality of life, and occurs when perceived environmental demands exceed an individual's ability to cope [1]. Resilience can be viewed as a measure of stress coping ability, and could potentially buffer the adverse effects of traumatic events [2]. Systematic reviews of resilience scales have shown that the 25-item Connor-Davidson Resilience Scale (CD-RISC)[2] has one of the highest quality assessment ratings [3, 4]. An abbreviated form of the scale consisting of two items (CD-RISC2) has been shown to have good test-retest reliability, convergent and discriminant validity as well as significant correlation with the overall CD-RISC score [5].

The Chinese version of the full CD-RISC scale has good reliability and validity [6]. However, the psychometric properties for the 2-item Chinese version, which could reduce operational and respondent burden, have not been examined. In addition, normative data for both the full and abbreviated versions in the Chinese general population are not available. Using a large randomly selected sample (n=10 997), we 1) examined if the abbreviated version of the scale (CD-RISC2) has adequate internal consistency and construct validity, as well as significant correlation with the full scale, and 2) obtained normative data for the CD-RISC and the CD-RISC2 in a Chinese general population in Hong Kong.

METHODS

Participants

The sample was derived from the FAMILY Cohort, a prospective population-based cohort study, described in detail elsewhere [7]. The sampling unit was a family living in the same household, and all family members aged 10 and above were invited to participate. The random core sample was obtained by stratified random sampling of households from all 18 districts in Hong Kong with sample sizes proportionate to each of the district populations. Wave 1 of household visits was conducted from March 2009 to April 2011, and Wave 2 was conducted from August 2011 to March 2014. The CD-RISC were administered face-to-face by trained interviewers during Wave 2 of household visits. The follow-up rate for the household visits was 70.7%, and the Cohen's w effect size for differences in non-response in Wave 2 were small (<0.1) [7]. Compared with Hong Kong census statistics from 2011, households living in public housing and households with low monthly household income were over-represented in the random core sample. Therefore, for normative data for the CD-RISC and CD-RISC2, we weighted the sample by housing type and monthly household income. Informed consent was obtained from all individual participants included in the study. This study was approved by the Institutional Review Board of the University of Hong Kong/Hospital Authority Hong Kong West Cluster.

Measurements

The Connor-Davidson Resilience Scale (CD-RISC) is a 25-item scale using a 5-point Likert-type response scale from not true at all (0) to true nearly all of the time (4) [2]. Participants rated each item with reference to the past month. Total scores range from 0 to 100, with

higher scores corresponding to higher levels of resilience. Two items from the CD-RISC were selected by the originators of the scale as etymologically capturing the essence of resilience to form the abbreviated version (CD-RISC2), including “Able to adapt to change” and “Tend to bounce back after illness or hardship” [5]. The translation and back-translation of the Chinese version for adults have been described in our previous study [6]. The Chinese version of the CD-RISC has good internal consistency (Cronbach’s $\alpha = 0.91$) and test-retest reliability (intraclass correlation coefficient = 0.87) [6].

The Patient Health Questionnaire-9 (PHQ-9) is a reliable and valid measurement for depressive symptoms [8], and the internal consistency within the Chinese population is good (Cronbach’s $\alpha = 0.82$) [9].

Family Harmony Scale-5 (FHS-5) was used to assess family harmony and has demonstrated good internal consistency (Cronbach’s $\alpha = 0.81$) and construct validity in the Chinese population in Hong Kong [10].

Family Adaptation, Partnership, Growth, Affection, Resolve (APGAR) was used to assess family functioning [11], and the internal consistency within the Chinese population is good (Cronbach’s $\alpha = 0.94$) [12].

Alcohol consumption was measured by the number of standard drinks in a typical week. A standard drink was defined as one that contains 10g of pure alcohol (330 ml of beer, 125 ml of wine, or 30 ml of spirits) [13].

Socio-demographic characteristics were collected, including age, sex, marital status, education attainment, employment status, household income and housing type.

Statistical analysis

Internal consistency of the CD-RISC and CD-RISC2 was assessed using the Cronbach's α , which was adjusted using polychoric correlations [14]. The standardized coefficient alpha was calculated for the CD-RISC2 since it is more appropriate for assessing the reliability of a two-item scale [15].

We expected *a priori* that the resilience score would have a positive correlation with family harmony and family functioning [16], a negative correlation with depressive symptoms [17] and no correlation with alcohol consumptions [18]. These constructs (i.e. depressive symptoms and alcohol consumption) have been previously used as external variables to establish convergent and discriminant validity of resilience measurements [17, 18].

Convergent and discriminant validity were calculated using mixed models to adjust for the correlation between the people who live in the same household [19]. Spearman correlations were also computed for PHQ-9 and alcohol consumption as scores were not normally distributed. As the method to compute Spearman correlations in a sample with within group correlation is not well established, we carried out a sensitivity analysis with a subsample with only one participant randomly selected from each household. All analyses were done using R version 3.1.2 and SAS University Edition 2014.

RESULTS

Of the 11 022 participants aged ≥ 20 years in FAMILY Cohort's random core sample (Wave 2), 10 997 (99.8%) had complete data for CD-RISC, and were included. Table 1 compares the weighted random core sample with the census statistics from 2011 with most of the characteristics showing small Cohen's w effect sizes (<0.2) [20].

Reliability of the CD-RISC and CD-RISC2

Cronbach's α for the full scale (CD-RISC) was 0.97. For young adults, middle-aged adults and older adults, α 's were 0.96, 0.97, and 0.98, respectively. Cronbach's α for the abbreviated scale (CD-RISC2) was 0.79 and α 's for young adults, middle-aged adults and older adults were 0.73, 0.76 and 0.86, respectively. Using Nunnally's guideline of $\alpha \geq 0.70$ [21], these are acceptable values for internal consistency.

Construct validity of the CD-RISC and CD-RISC2

The CD-RISC2 was correlated with the 25-item version of the CD-RISC ($r=0.88$, $P<0.001$). The CD-RISC and CD-RISC2 were significantly correlated in the direction expected with depressive symptoms, family harmony, and family functioning (Table 2), with comparable correlation coefficients. As expected, the correlations of CD-RISC and CD-RISC2 with alcohol consumption were less than 0.1.

Spearman correlations for PHQ and alcohol consumption were similar to Pearson correlations, and sensitivity analysis using a sample comprising of one randomly selected

participant from each household yielded similar results for convergent and discriminant validity (not shown).

Normative data

Mean (SD) scores for the CD-RISC and CD-RISC2 were 59.99 (13.92) and 5.03 (1.37), respectively. Men, younger individuals, and those with higher education or higher household income reported higher resilience levels (Table 3).

DISCUSSION

The present study provides evidence for the reliability and validity of CD-RISC and CD-RISC2 in a large random sample drawn from the Hong Kong general population. The CD-RISC2 had a high correlation with the 25-item version of the CD-RISC. Participants with higher CD-RISC or CD-RISC2 scores reported fewer depressive symptoms, higher family harmony and better family functioning as expected. As our sample was randomly selected from the Hong Kong general population, they may experience less stress compared to clinical samples. This may thereby result in lower correlations between resilience and depressive symptoms. Both versions were not correlated with alcohol consumption suggesting discriminant validity. Results were consistent across sex, age groups and education.

To our knowledge, this is the first study to present normative data of the CD-RISC and the CD-RISC2 in a Chinese general population. The mean CD-RISC and CD-RISC2 scores in our study were lower than general population samples in USA [2, 5], but were comparable to

studies in other Asian settings [22]. This may be due to cultural differences, where Chinese respondents were more likely select the midpoint in Likert-type scales involving positive emotions compared to Americans [23]. Cross-cultural studies would therefore be useful to examine whether score patterns vary across samples. Our finding that men reported higher resilience is consistent with other studies [17], although this has not been consistent across the literature. We also found evidence of social patterning for resilience in terms of education, household income and employment status, adjusting for age and sex.

Limitations include the recruitment of complete households in which all adult members had to agree to participate for enrolment. This requirement may have limited the representativeness of the sample as cooperative families may consist of individuals with higher resilience. Second, as the CD-RISC2 was administered together with the CD-RISC, this may have overestimated the reliability of CD-RISC2 due to item-context effects [24]. Third, the scale was not validated against an objective measure such as stress hormones [25] in this study. Fourth, no other resilience measures were used in this study, so the relative performance of the CD-RISC to measures such as the Resilience Scale [26] is not known.

This study provides evidence that the CD-RISC2 as a reliable and valid measure of resilience in a large non-western random sample. We evaluated the psychometric properties of the original two-item scale (CD-RISC2) in Hong Kong to offer consistency and continuity with other settings should cross-cultural comparison questions be of interest. Normative data are also provided as a reference for comparison in future studies. The CD-

RISC2 is a brief measure with psychometric properties comparable to those of the CD-RISC and therefore has particular appeal in primary care and community settings, as well as in large epidemiological studies.

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Competing interests: None declared.

Table 1 Demographic characteristics of the study participants (aged ≥ 20) from randomly selected households compared to 2011 Census population of Hong Kong (aged ≥ 20)

Individual variables	Study sample ^a (n=10 997)		Population in Hong Kong (n=5 570 160)		Effect size ^c
Sex					0.04
Men	5042	45.90%	2 657 028	47.70%	
Women	5955	54.10%	2 913 132	52.30%	
Age group, years					0.12
20-39	3277	29.80%	1 905 419	34.20%	
40-65	6137	55.80%	2 777 255	49.90%	
>65	1583	14.40%	887 486	15.90%	
Marital status					0.14
Never married	2334	21.20%	1 451 924	26.10%	
Married	7612	69.20%	3 472 759	62.30%	
Widowed/divorced/separated	1031	9.40%	645 477	11.60%	
Refused/missing	20	0.20%	NA	NA	
Education					0.20
Primary or below	2416	22.00%	1 732 312	31.10%	
Secondary	4885	44.40%	2 092 387	37.60%	
Matriculation/Tertiary	3686	33.50%	1 745 461	31.30%	
Refused/missing	11	0.10%	NA	NA	
Employment status^b					0.06
Employed	6694	60.90%	3 312 900	59.50%	
Unemployed	140	1.30%	111 600	2.00%	
Economically inactive	4141	37.70%	2 145 660	38.50%	
Refused/missing	22	0.20%	NA	NA	
Household variables	Study sample ^a (n=5583)		Population in Hong Kong (n=2 368 796)		Effect size ^c
Monthly household income (HKD)^d					0.04
Under 10 000	1276	22.90%	563 915	23.80%	
10 000-39 999	2828	50.70%	1 249 345	52.70%	
40 000 or above	1258	22.50%	555 536	23.50%	
Refused/missing	221	4.00%	NA	NA	
Housing type^d					0.03
Public rental housing	1754	31.40%	720 892	30.40%	
Subsidised home ownership scheme housing	908	16.30%	377 615	15.90%	
Private permanent housing	2918	52.30%	1 270 289	53.70%	
Refused/missing	3	0.05%	NA	NA	

^a Weighted according to monthly household income and housing type.

^b Source: 2011 General Household survey, Census and Statistics Department, Government of Hong Kong Special Administrative Region.

^c Cohen's *w* effect size: small, 0.1; medium, 0.3; large, 0.5.

^d Domestic households (includes foreign domestic helpers) in 2011 Population Census, Census and Statistics Department, Government of Hong Kong Special Administrative Region.

Table 2 Convergent and discriminant validity of the Connor-Davidson Resilience Scale (CD-RISC) and its abbreviated version (CD-RISC2)

	Overall		Sex				Age group, years						Education					
			Men		Women		20-39		40-65		>65		Primary and below		Secondary		Matriculation/Tertiary	
	CD-RISC	CD-RISC2	CD-RISC	CD-RISC2	CD-RISC	CD-RISC2	CD-RISC	CD-RISC2	CD-RISC	CD-RISC2	CD-RISC	CD-RISC2	CD-RISC	CD-RISC2	CD-RISC	CD-RISC2	CD-RISC	CD-RISC2
CD-RISC	---	0.88*	---	0.87*	---	0.88*	---	0.84*	---	0.86*	---	0.91*	---	0.89*	---	0.86*	---	0.83*
Depressive symptoms	-0.19*	-0.18*	-0.18*	-0.16*	-0.19*	-0.18*	-0.17*	-0.15*	-0.17*	-0.16*	-0.23*	-0.23*	-0.21*	-0.20*	-0.17*	-0.17*	-0.17*	-0.15*
Family harmony	0.23*	0.20*	0.24*	0.20*	0.21*	0.19*	0.22*	0.19*	0.24*	0.21*	0.19*	0.16*	0.22*	0.20*	0.20*	0.18*	0.21*	0.17*
Family functioning	0.33*	0.27*	0.32*	0.26*	0.32*	0.26*	0.26*	0.18*	0.33*	0.27*	0.32*	0.27*	0.32*	0.27*	0.28*	0.23*	0.32*	0.24*
Alcohol consumption	0.04*	0.05*	0.05	0.06*	0.02	0.01	0.04	0.06	0.03	0.04	0.07*	0.08*	0.07*	0.07*	0.04	0.05	0.03	0.05

* *P* value < 0.001

Table 3 Normative data for Connor-Davidson Resilience Scale (CD-RISC) and its abbreviated version (CD-RISC2) by socio-demographics.

	CD-RISC ^a Mean ± SD (95% CI)	CD-RISC2 ^a Mean ± SD (95% CI)
Overall	59.99±13.92 (59.73, 60.25)	5.03±1.37 (5.00, 5.05)
Sex		
Men	61.23±14.25 (60.85, 61.62)	5.17±1.37 (5.13, 5.20)
Women	58.95±14.38 (58.59, 59.30)	4.91±1.36 (4.87, 4.94)
Age group, years		
20-39	62.51±13.44 (62.06, 62.96)	5.19±1.34 (5.15, 5.23)
40-65	60.72±14.07 (60.38, 61.06)	5.10±1.36 (5.07, 5.13)
>65	51.98±14.24 (51.30, 52.66)	4.40±1.32 (4.34, 4.47)
Education^b		
Primary or below	54.69±14.14 (54.13, 55.26)	4.63±1.38 (4.58, 4.68)
Secondary	58.24±15.31 (57.81, 58.67)	4.91±1.49 (4.87, 4.95)
Matriculation/Tertiary	62.25±15.19 (61.76, 62.74)	5.16±1.48 (5.11, 5.21)
Employment status^b		
Employed	60.29±17.32 (59.88, 60.71)	5.04±1.68 (5.00, 5.09)
Unemployed	58.22±13.43 (56.00, 60.44)	4.87±1.30 (4.65, 5.08)
Economically inactive	56.66±13.98 (56.23, 57.08)	4.77±1.35 (4.73, 4.81)
Monthly household income (HKD)^b		
Under 10 000	56.64±11.05 (56.04, 57.25)	4.79±1.07 (4.73, 4.85)
10 000-39 999	58.19±10.50 (57.80, 58.57)	4.88±1.02 (4.84, 4.92)
40 000 or above	61.16±9.82 (60.62, 61.70)	5.09±0.95 (5.04, 5.15)

^a Weighted according to monthly household income and housing type.

^b Adjusted for age and sex.

References

1. Cohen, S., Kessler, R. C., & Gordon, U. L. (1995). Strategies for measuring stress in studies of psychiatric and physical disorder. In S. Cohen, R. C. Kessler & U. L. Gordon (Eds.), *Measuring Stress: A Guide for Health and Social Scientists* (pp. 3-26). New York: Oxford University Press.
2. Connor, K. M., & Davidson, J. R. T. (2003). Development of a new resilience scale: The Connor-Davidson Resilience Scale (CD-RISC). *Depression and Anxiety, 18*(2), 76-82.
3. Windle, G., Bennett, K., & Noyes, J. (2011). A methodological review of resilience measurement scales. *Health and Quality of Life Outcomes, 9*(1), 8.
4. Pangallo, A., Zibarras, L., Lewis, R., & Flaxman, P. (2015). Resilience through the lens of interactionism: A systematic review. *Psychological Assessment, 27*(1), 1-20.
5. Vaishnavi, S., Connor, K., & Davidson, J. R. T. (2007). An abbreviated version of the Connor-Davidson Resilience Scale (CD-RISC), the CD-RISC2: Psychometric properties and applications in psychopharmacological trials. *Psychiatry Research, 152*(2-3), 293-297.
6. Yu, X. N., & Zhang, J. (2007). Factor analysis and psychometric evaluation of the Connor-Davidson Resilience Scale (CD-RISC) with Chinese people. *Social Behavior and Personality: an international journal, 35*(1), 19-30.
7. Leung, G. M., Ni, M. Y., Wong, P. T. K., Lee, P. H., Chan, B. H. Y., Stewart, S. M., et al. (2015). Cohort Profile: FAMILY Cohort. *International Journal of Epidemiology*. doi: 10.1093/ije/dyu257.
8. Kroenke, K., Spitzer, R. L., & Williams, J. B. (2001). The PHQ-9: validity of a brief depression severity measure. *Journal of General Internal Medicine, 16*, 606-613.
9. Yu, X. N., Tam, W. W. S., Wong, P. T. K., Lam, T. H., & Stewart, S. M. (2012). The Patient Health Questionnaire-9 for measuring depressive symptoms among the general population in Hong Kong. *Comprehensive Psychiatry, 53*, 95-102.
10. Kavikondala, S., Stewart, S. M., Ni, M. Y., McDowell, I., Chan, B. H. Y., Lam, T. H., et al. (2015). Structure and validity of Family Harmony Scale: an instrument for measuring harmony. *Psychological Assessment*, in press.
11. Smilkstein, G. (1978). The family APGAR: A proposal for a family function test and its use by physicians. *The Journal of Family Practice, 6*(6), 1231-1239.
12. Nan, H., Lee, P. H., Ni, M. Y., Chan, B. H. Y., & Lam, T. H. (2013). Effects of Depressive Symptoms and Family Satisfaction on Health Related Quality of Life: The Hong Kong FAMILY Study. *PLoS ONE, 8*(3), e58436.
13. Department of Health. (2011). Action plan to reduce alcohol-related harm in Hong Kong. Hong Kong.
14. Gadermann, A. M., Guhn, M., & Zumbo, B. D. (2012). Estimating ordinal reliability for Likert-type and ordinal item response data: A conceptual, empirical, and practical guide. *Practical Assessment, Research, & Evaluation, 17*.
15. Eisinga, R., Grotenhuis, M., & Pelzer, B. (2013). The reliability of a two-item scale: Pearson, Cronbach, or Spearman-Brown? *International Journal of Public Health, 58*(4), 637-642.

16. Garmezy, N. (1993). Children in Poverty: Resilience Despite Risk. *Psychiatry*, 56(1), 127-136.
17. Yu, X. N., Lau, J. T. F., Mak, W. W. S., Zhang, J., & Lui, W. W. S. (2011). Factor structure and psychometric properties of the Connor-Davidson Resilience Scale among Chinese adolescents. *Comprehensive Psychiatry*, 52(2), 218-224.
18. Goldstein, A. L., Faulkner, B., & Wekerle, C. (2013). The relationship among internal resilience, smoking, alcohol use, and depression symptoms in emerging adults transitioning out of child welfare. *Child Abuse & Neglect*, 37(1), 22-32.
19. Hamlett, A., Ryan, L., Serrano-Trespacios, P., & Wolfinger, R. (2003). Mixed Models for Assessing Correlation in the Presence of Replication. *Journal of the Air & Waste Management Association*, 53(4), 442-450.
20. Cohen, J. (1988). *Statistical Power Analysis for the Behavioral Sciences*. New York: Routledge.
21. Nunnally, J. C. (1978). *Psychometric Theory*. New York: McGraw-Hill.
22. Baek, H. S., Lee, K. U., Joo, E. J., Lee, M. Y., & Choi, K. S. (2010). Reliability and Validity of the Korean Version of the Connor-Davidson Resilience Scale. *Psychiatry Investigation*, 7(2), 109-115.
23. Lee, J. W., Jones, P. S., Mineyama, Y., & Zhang, X. E. (2002). Cultural differences in responses to a likert scale. *Research in Nursing & Health*, 25(4), 295-306.
24. Podsakoff, P. M., MacKenzie, S. B., Jeong-Yeon, L., & Podsakoff, N. P. (2003). Common Method Biases in Behavioral Research: A Critical Review of the Literature and Recommended Remedies. *Journal of Applied Psychology*, 88(5), 879.
25. Davidson, R. J., & McEwen, B. S. (2012). Social influences on neuroplasticity: stress and interventions to promote well-being. *Nature Neuroscience*, 15(5), 689-695.
26. Wagnild, G. M., & Young, H. M. (1993). Development and psychometric evaluation of the Resilience Scale. *Journal of nursing measurement*, 1(2), 165-178.