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SHORT COMMUNICATION

Validation of the Chinese version of the Resilience Scale and its cutoff score for detecting low resilience in Chinese cancer patients

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Abstract
Purpose We aim to investigate the reliability and validity of the Chinese version of the Resilience Scale (RS-14) and to determine the cutoff score of the RS-14 for screening Chinese cancer patients with low resilience.
Methods The current study was divided into two studies. In the first study, we randomly selected 625 people and obtained their scores in the Chinese version of the RS-14 and SF-36 using cross-sectional survey. We then calculated the validity and reliability of the Chinese version of the RS-14. In the second study, we selected 970 hospital cancer patients diagnosed during 2010 to 2011 and assessed for their resilience once and for anxiety, depression, and quality of life on two occasions. We determined the cutoff score of the RS-14 based on the maximum Youden Index, with the scores of anxiety and depression as gold standards.
Results The correlation coefficients for inter-items were in the range of 0.23 to 0.68 ($P<0.001$), whereas those for the item–scale were in the range of 0.62 to 0.82 ($P<0.001$). Two factors represent the factor structure of the RS-14. The correlation coefficient between the RS-14 and SF-36 scores was 0.82 ($P<0.001$). The split-half reliability and test–retest reliability of the RS-14 were both 0.82 ($P<0.001$), and the internal consistency Cronbach's α was 0.93. The cutoff score of 64 was obtained for screening cancer patients with low resilience (sensitivity and specificity were 0.74 and 0.71, respectively).
Conclusion The Chinese version of the RS-14 has good validity and reliability, and it can measure the resilience of Chinese people. The cutoff score of 64 for the RS-14 is appropriate for detecting cancer patients with low resilience in order to decrease psychological stress and improving quality of life. Health care nurses can screen and detect cancer patients with low resilience based on the said cutoff score to timely provide psychological care and interventions for the patients.

Keywords Resilience · Scale · Reliability · Validity · Diagnosis · Cutoff score · Cancer

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Introduction

Cancer is a disease that seriously damages human physical and mental health. The diagnosis of cancer has a serious impact on a patient's emotional and psychological status [1]. A patient's quality of life (QOL) is often affected considerably after surgery and chemotherapy/radiotherapy [2]. However, many studies have found that cancer patients with similar diseases and treatment status have significantly different QOLs [3]. Psychologists believe that resilience is the main factor that makes the patients with similar situations have different perceptions toward their QOLs [4].

Resilience is an individual's capacity to maintain psychological and physical well-being in the face of adversity [4]. Many researchers have suggested that an individual's resilience is not entirely innate and that an individual can develop resilience under certain circumstances [5]. People can exert effort to promote resilience and avoid the negative influence of adversity or unfavorable factors on psychological development [6]. Therefore, resilience has been a hot topic in the field of positive psychology.

In recent years, some researchers have applied the theory of resilience to studies on cancer treatments and prognosis [7]. The results show that patients with good resilience were able to correctly treat their disease and maintain relatively

good mental and psychological states, resulting in better QOL [8, 9].

To introduce the concept of resilience to cancer nursing in China, we study the application of the Resilience Scale (RS) developed by foreign researchers. The current research consists of the following: (1) translation of the English version of RS into Chinese and assessment of the reliability and validity of the Chinese version of RS using a large sample of community residents and (2) determination of the cutoff score of the Chinese version of RS for screening cancer patients to identify low resilience using a large sample of hospitalized cancer patients. The results can help clinic nurses detect patients who need more psychological care and supportive interventions.

Methods

Design

Our research work is divided into two separate studies. In the first study, we investigated the validity and reliability of the Chinese version of RS. In the second study, we determined the cutoff score of the Chinese version of RS used for detecting low resilience.

Participants

In the first study, we selected two communities in Fuzhou City using a two-stage cluster sampling method. The sample consisted of the residents selected randomly in these two communities. The inclusion criteria were as follows: (1) 18 to 70 years of age, (2) literate, and (3) without mental or psychological disease.

In the second study, our sample consisted of newly diagnosed cancer patients in five province-level hospitals from 2010 to 2011. The participants were limited to those whose tumor sites include nasopharynx, lung, esophagus, stomach, colorectal, breast, uterine, and cervix. The inclusion criteria were as follows: (1) 18 to 70 years of age, (2) literate, (3) without mental or psychological disease, and (4) knowing the diagnosis of cancer.

There were 625 eligible residents for the first study and 970 eligible patients for the second study. All of them in the two studies agreed to participate in the study, and the response rates for the two stages were 100 %. All participants provided written informed consent. This study was approved by the relevant institutional review boards for human research in Fujian Medical University.

Measures

The RS of Wagnild and Young [10] is widely used in resilience research. The first version of RS is a 25-item questionnaire (RS-25) with highest total score of 175 and lowest total score of 25. A high total score expresses high resilience. RS-25 has been used for measuring the degree of resilience of an individual in a wide variety of age groups, and its reliability and validity have been repeatedly confirmed [11]. Wagnild [12] has recently developed a short version of RS-25 that consists of 14 items (RS-14) to reduce responder burden. The two RS scales showed good internal consistency and concurrent validity [11, 12]. The participants rate the items in the RS-14 using a scale from 1 (strongly disagree) to 7 (strongly agree). In the current study, two native Chinese English teachers at the Fujian Medical University translated the original English version of the RS-14. Two other native Chinese English teachers at the same university back-translated the Chinese version into English. The back-translated version was compared with the original English version of the RS-14. The researchers and four translators discussed the non-concurring factors between the translated and back-translated scales, and a final Chinese version of the RS-14 was generated.

The Short Form-36 Health Survey (SF-36) is a 36-item survey on health status and QOL [13]. SF-36 can be used to survey the psychological health of general populations, and the Chinese version of the scale has been widely used in China [13]. SF-36 includes the following eight domains: physical functioning, role functioning—physical, body pain, general health, vitality (VT), social functioning (SF), role functioning—emotional (RFE), and mental health (MH). VT (four items), SF (two items), RFE (three items), and MH (five items) are used to measure the mental health of a respondent. A high sum of the scores from these four domain scores indicates good mental health. In this study, the internal consistency estimates (Cronbach's α) were 0.82, 0.78, 0.89, and 0.91 for the VT, SF, RFE, and MH domains, respectively.

The European Organization for Research and Treatment of Cancer Core Questionnaire (EORTC QLQ-C30 version 3.0) determines the QOL of cancer patients [14]. The EORTC QLQ-C30 is a 30-item questionnaire, including 28 items scored from 1 to 4 and 2 items scored from 1 to 7. The score of each item is transformed into a value that ranges from 0 to 100. The sum of all transformed scores of the 30 items is again transformed into a value that ranges from 0 to 100, which is the total score of the EORTC QLQ-C30. A high total score indicates good QOL. The Chinese version of the EORTC QLQ-C30 has been confirmed to be suitable for Chinese cancer patients [14]. In the current study, the Chinese version of the EORTC QLQ-C30 had a reliability of 0.93.

The Hospital Anxiety and Depression Scale (HADS), which is a 14-item (seven for anxiety subscale and seven for depression subscale) questionnaire, was used to evaluate the anxiety and depression of patients [15]. The score of

each item ranges from 0 to 3. The patients score the items based on their current situation. Both the score of anxiety subscale and the score of depression subscale range from 0 to 21, and the scores of 0–7 indicate asymptomatic, 8–10 symptoms suspicious, and 11–21 symptoms certainly existing [15]. In this study, a patient is considered to have severe depression when his/her score in the depression subscale exceeds 11 and severe anxiety when his/her score in the anxiety subscale exceeds 11. The Chinese version of HADS has been confirmed to be suitable for Chinese patients [16]. In the current study, the Chinese version of HADS had reliabilities of 0.89 for anxiety and 0.92 for depression.

Procedure

In the first study, trained graduate students from the Fujian Medical University went into a participant's home and asked the participant to complete the SF-36 and the RS-14 according to their situation during the previous 4 weeks. In the second study, trained nurses measured the resilience of participants prior to the treatment. The anxiety, depression, and QOL of the participants were also measured at the end of the treatment.

Statistical analysis

In the first study, Cronbach's α was used to assess the internal consistency reliability of the Chinese version of the RS-14, where $\alpha<0.7$ indicated that the scale has an acceptable reliability coefficient. Spearman–Brown's formula [17] was used to calculate the split-half reliability of the scale, and the Pearson correlation coefficient r was used to explore the test–retest reliability ($r>0.8$ indicated a good test–retest reliability). Construct validity was assessed using inter-item and item–scale correlations and through an exploratory factor analysis (principal components with varimax rotation). The number of the factors to be extracted depended on the number of eigenvalues greater than 1.0. The items with factor loadings ≥0.5 were considered to be closely related with the factor. The sum of the scores of VT, SF, REF, and MH domains of the SF-36 served as the standard measurement of mental health, and concurrent validity was assessed by calculating the correlation coefficient between the RS-14 and standard measurement of mental health (minimum acceptable value for r was 0.8).

In the second study, the patients were divided into two groups according to their HADS score. Patients with severe anxiety or severe depression were classified as the positive group, and those with neither severe anxiety nor severe depression were classified as the negative group. The method used for determining the cutoff score of the RS-14 is as follows: We first calculated the score range of the RS-14 for all patients (score range is the difference between the maximum and minimum scores) and then determined the interval value (the score range is divided by 10). The first cutoff value is the sum of the minimum score of the RS-14 and the interval value, the second cutoff value is the sum of the first cutoff value and the interval value, and the third cutoff value is the sum of the second cutoff value and the interval value. We repeated the same steps above until we produced ten cutoff values of the RS-14 score. The sensitivity (true positive rate), specificity (true negative rate), and Youden Index (YI) of each cutoff value were calculated. The Youden Index is a frequently used method to measure the effectiveness of a diagnostic marker and enables the selection of an optimal threshold value (cutoff value) for the marker [18]. This index is defined as YI=sensitivity+specificity−1. In this study, the cutoff value corresponding to the largest YI was the best value that could be used as the cutoff score of the RS-14 for detecting low resilience.

Statistical analysis was performed using SAS (version 9.0) for Windows (SAS Institute, Inc., Cary, NC).

Results

A total of 625 participants, including 323 (51.68 %) males and 302 (48.32 %) females, with mean age of 41.00 years (SD=10.70) were included in the first study. The percentages of the participants with primary school, middle school, high school, and college educational level were 12.14, 34.32, 22.89, and 30.65 %, respectively.

A total of 970 participants, including 496 (51.13 %) males and 474 (48.86 %) females, with the mean age of 51.27 years (SD=12.77), were included in the second study. The percentages of the participants with primary school, middle school, high school, and college education level were 26.80, 31.44, 24.43, and 17.32 %, respectively. Among the 970 participants, 338 (34.84 %) had nasopharyngeal cancer, 160 (16.50 %) had lung cancer, 214 (22.06 %) had esophageal, gastric, or colon cancer, and 258 (26.60 %) had breast or cervical cancer. Among the cancer patients, 129 (13.30 %), 365 (37.63 %), 316 (32.58 %), and 160 (16.50 %) patients were in stages I–IV of their respective disease. Moreover, 426 (43.92 %) patients received surgery combined with chemotherapy, 215 (22.16 %) patients received surgery combined with radiotherapy, 265 (27.32 %) patients received surgery combined with chemotherapy and radiotherapy, and 64 (6.60 %) patients received radiotherapy combined with chemotherapy.

Validation of the Chinese version of the RS-14: first stage of the current study

The correlation analysis between every two items in the RS-14 showed that all of the inter-item correlation coefficients ranged from 0.23 to 0.68 ($P<0.001$). Each item score was

related with the total score of the RS-14, and the item–scale correlation coefficients ranged from 0.62 to 0.82 ($P<0.001$).

Exploratory factor analysis was conducted to explore dimensions in the Chinese version of the RS-14. Two eigenvalues were greater than 1 ($\lambda_1 = 7.37$ and $\lambda_2 = 1.14$), and thus, two factors were obtained (accounting for 61 % of the total variance). The factor loadings are shown in Table 1 (factor loadings less than 0.5 are not shown). Factor 1 was closely related to the ten items that reflect the personal and self-control abilities, and thus, it was defined as the "Personal Competence Factor." Factor 2 was closely related to the four items that reflect the acceptance of self and life, and thus, it was defined as the "Acceptance of Self and Life Factor." The factor structure of the Chinese version of the RS-14 was similar to that of the English version of the RS-25 [10], suggesting the good construct validity of the Chinese version of the RS-14.

The sum of the scores of VT, SF, REF, and MH domains of the SF-36 as a standard measurement of mental health and the correlation coefficient between this sum and the score of the RS-14 was obtained at 0.82 ($P<0.001$), suggesting the good concurrent validity of the Chinese version of the RS-14.

The RS-14 had a Cronbach's α coefficient of 0.93. The internal consistency for factor 1 and factor 2 was 0.92 and 0.82, respectively. These results suggest the good internal consistency of the Chinese version of the RS-14.

Table 1 Factor loadings of the two factors (only factor loadings greater than 0.5 are displayed)

Item	Item no.	Factor	
		1	2
I usually manage one way or another.	1	0.60	
I feel proud that I have accomplished things in life.	2	0.72	
I feel that I can handle many things at a time.	5	0.78	
I am determined.	6	0.70	
I can get through difficult times because I have experienced difficulty before.	7	0.78	
I have self-discipline.	8	0.51	
I keep interested in things.	9	0.78	
My belief in myself gets me through hard times.	11	0.69	
In an emergency, I am someone people can generally rely on.	12	0.62	
I can usually find my way out of a difficult situation.	14	0.59	
I usually take things in stride.	3		0.80
I am friends with myself.	4		0.67
I can usually find something to laugh about.	10		0.81
My life has meaning.	13		0.61

Extraction method: principal component analysis; rotation method: Varimax with Kaiser Normalization

The 14 items in the RS-14 were divided into two sets according to the parity of their number. The correlation coefficient was R_h=0.89 between the two sets, and the split-half reliability was $R = \frac{2R_h}{1+R_h} = 0.82$ ($P<0.001$). The items in the two sets were closely correlated, suggesting good split-half reliability of the Chinese version of the RS-14.

We randomly selected 30 residents from the 625 participants to calculate the test–retest reliability. We asked the participants to redo the RS-14 after a week. The measurements of the two periods were correlated (correlation coefficients ranged from 0.53 to 0.85, and all of P values for the correlation coefficient test were less than 0.001), and 86 % of the correlation coefficients were greater than 0.70. The results of the paired t tests for the measurements of the two periods suggest that the difference was not statistically significant (P values for the paired t test ranged from 0.10 to 0.90). These results show the good test–retest reliability of the Chinese version of the RS-14.

The cutoff score of the Chinese version of the RS-14: the second study of the current study

In the second study, the resilience of 970 cancer patients was measured using the Chinese version of the RS-14. The RS-14 had Cronbach's α of 0.92, and factor 1 and factor 2 had α values of 0.90 and 0.81, respectively. The RS-14 scores of the patients ranged from 14 to 98, and the mean and standard deviations of the scores were 60.71 and 19.15, respectively. Moreover, 120 (12.37 %) patients obtained scores of less than 40, 517 (53.30 %) obtained scores in the range of 40 to 69, and 333 (34.33 %) obtained scores higher than 70.

The 970 patients were divided into two groups according to their HADS score. Patients with severe anxiety or severe depression (score of anxiety subscale ≥11 or score of depression subscale ≥11) were classified as the positive group, and the patients with neither severe anxiety nor severe depression (score of anxiety subscale <11 and score of depression subscale <11) were classified as the negative group. The positive and negative groups included 594 and 376 patients, respectively.

The maximum and minimum scores of the RS-14 were 98 and 14, respectively. Therefore, the range of the RS-14 scores for all patients was 84, and the interval value was set to 8. Thus, the first cutoff value was 22 (sum of the minimum score of the RS-14 and the interval value), and the second cutoff value was 30 (sum of the first cutoff value and the interval value). This step was repeated until ten cutoff values of the RS-14 were obtained, as shown in the first column of Table 2. For each cutoff value shown in Table 2, the numbers of patients in the positive and negative groups with the RS-14 score greater than and less than this cutoff value were counted, and its corresponding sensitivity, specificity, and YI were calculated (Table 2). The cutoff value of

Table 2 The sensitivity, specificity, and YI for the cutoff values of the RS-14 score

Cutoff value	Sensitivity	Specificity	YI
22	0.02	1.00	0.02
30	0.06	1.00	0.06
38	0.14	0.97	0.11
46	0.35	0.91	0.26
54	0.54	0.84	0.38
62	**0.69**	**0.72**	**0.41**
70	0.81	0.58	0.39
78	0.89	0.41	0.30
86	0.95	0.21	0.16
94	0.99	0.10	0.09
63	0.72	0.72	0.44
64	**0.74**	**0.71**	**0.45**
65	0.75	0.68	0.43

Values in bold corresponds to the maximum YI

62 corresponded to the maximum value of YI (0.41). Thus, we further calculated the sensitivity, specificity, and YI for the cutoff values from 62 to 65 (Table 2). As can be seen in Table 2, the cutoff value of 64 (sensitivity=0.74 and specificity=0.71) corresponded to the maximum value of YI (0.45), suggesting that 64 could be considered the cutoff score for the Chinese version of the RS-14. Patients with the RS-14 score <64 can be diagnosed with low resilience, and thus, clinic nurses should provide more psychological care and intervention for such patients.

The 970 patients were grouped according to their RS-14 score (<64 or ≥64) to evaluate the rationality of the cutoff score of 64. A total of 396 patients obtained scores ≥64, and 574 patients obtained scores <64. We compared the QOL between the two groups and found that the patients with the RS-14 score <64 had significantly lower QOL than patients with the RS-14 score ≥64. This result suggests that the cutoff score of 64 is suitable for the Chinese version of the RS-14.

Discussion

Resilience is an individual characteristic that moderates the negative effects of stress and promotes positive adaptation [4]. Good resilience is beneficial to the cancer patients to adjust their response to disease and treatment with a positive attitude. Health care nurses can determine who among the cancer patients need more psychological care by measuring the resilience of the patients.

RS-25 is a valid scale for measuring resilience of an individual [10, 19]. Used in a random sample of 810 old adults, researchers found, through exploratory factor analysis, a two-factor solution as most reliable. The first factor was entitled "Personal Competence" (17 items), and the second factor was entitled "Acceptance of Self and Life" (8 items) [10]. The RS-14 is the short version of RS-25, and it was confirmed to have good internal consistency and concurrent validity with the RS-25 [19]. Some researchers suggested that the RS-14 was a single-factor structure (accounting for 39.4–53 % of the total variance) through exploratory factor analysis [20]. In the current study, the Chinese version of the RS-14 is a two-factor structure (accounting for 61 % of the total variance), and the two factors were entitled "Personal Competence" and "Acceptance of Self and Life," respectively, and were similar to the factors in RS-25. By comparing the two factors of the Chinese version of the RS-14 with those of RS-25, we think that the two-factor structure of the Chinese version of the RS-14 is reasonable because all of the ten items that constitute factor 1 are included in the 17 items that constitute the first factor of RS-25. In addition, all of the four items that constitute factor 2 are included in the eight items that constitute the second factor of RS-25.

In the first study, we computed the concurrent validity by using the four domains of the SF-36 as a standard measurement of mental health. Because resilience is an indicator reflecting psychological health, and VT, SF, REF, and MH domains of the SF-36 can be used to measure the psychological health of general populations, these four domains of the SF-36 as a standard measurement are rational.

In the second part of the current study, we considered the score of anxiety and depression measured at the end of the treatment as the gold standard to determine the cutoff score for detecting low resilience. This condition was based on such assumption that if a patient has good resilience, he/she can adjust better and cope with the disease and treatment in a positive manner, i.e., without severe anxiety or depression. Based on this assumption, and taking into account that anxiety and depression in psychological theory are considered to be indicators of adaptation to stress and negatively related to resilience [10], we determined the cutoff score of 64 for the Chinese version of the RS-14.

There was a limitation in our study. There may be the differences between the positive group and negative group with respect to age, sex, disease condition, and treatment program. Since these factors may affect anxiety and depression of the patients, the sensitivity and specificity may be overestimated. However, the results of the comparison between the QOL of the patients with RS-14 score <64 and the QOL of the patients with RS-14 score ≥64 have confirmed that 64 is a reasonable cutoff score for the Chinese version of RS-14. The follow-up studies are still needed to justify the rationality of 64 for the cancer patients with different demographic characteristics, disease conditions, and treatments.

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Conflict of interest The authors have no conflicts of interest to declare. This study has no financial relationship with any organization that sponsored the research and authorship. The corresponding author has full control of all primary data and will allow the journal to review our data if requested.

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