**ABSTRACT**

**Background:** The rate of cardiac rehabilitation attendance at the Sarawak Heart Centre was identified as very low, and the reason has not been investigated. A scale is needed to identify barriers to participation in cardiac rehabilitation among patients with heart disease in Sarawak, Malaysia.

**Purpose:** The purposes of this study were to translate, adapt, and evaluate the Malay-language version of the Cardiac Rehabilitation Barriers Scale (CRBS) and to measure the psychometric properties of the Malay-version CRBS to justify its use in Sarawak.

**Methods:** A forward and back-translation method was used. Content validity was assessed by three experts. Psychometric testing was conducted on a sample of 283 patients who were eligible to participate in cardiac rehabilitation. A construct validity test was performed using factor analysis. Cronbach’s alpha was used to examine the internal consistency. The test–retest reliability was calculated using the intraclass correlation coefficient on 22 participants. Independent-samples t test and analysis of variance were conducted to assess the criterion validity. Mean scores for total barriers of the scale and each individual factor were compared among the different patient characteristics.

**Results:** The Malay-version CRBS showed an item level of content validity index of 1.00 for all of the items after improvements were made based on the experts’ suggestions. The factor analysis, using principal component analysis with direct oblimin rotation, extracted four factors that differed from the original study. These four factors explained 52.50% of the cumulative percentage of variance. The Cronbach’s alphas ranged from .74 to .81 for the obtained factors. Test–retest reliability was established using the intraclass correlation coefficient value of .78. Criterion validity was supported using the significant differences in the mean score for total barriers among educational level, driving distance, travel time to the hospital, and cardiac rehabilitation attendance.

**Conclusions/Implications for Practice:** This study found the Malay-version CRBS to be a valid and reliable instrument. It may be used with inpatients to identify barriers to participation in cardiac rehabilitation to promote rehabilitation attendance and improve patient care.

**Key Words:** translation, adaptation, psychometric testing, Cardiac Rehabilitation Barrier Scale, Malay.

**Introduction**

After in-hospital treatment, survivors of coronary heart disease (CHD) face substantial risks of recurrent cardiac event and death (Thune et al., 2011). Cardiac rehabilitation (CR) is an integral component in the management of CHD. The benefits of CR have been shown in a number of studies. Participation in CR has been associated with a 58% reduction in mortality (Beauchamp et al., 2013) and a significant reduction in hospital readmissions (Dunlay, Pack, Thomas, Killian, & Roger, 2014; Martin et al., 2012), which in turn may lower the overall costs of healthcare (Dendale, Hansen, Berger, & Lamotte, 2008). Despite these benefits, attendance rates as low as 7% and relatively high discontinuation rates of 8%–23% in CR programs have been reported (De Vos et al., 2013; Poh et al., 2015).

In an effort to improve CR attendance in Sarawak, a scale is necessary to address relevant patient and healthcare factor-related barriers. Sarawak, the largest state in Malaysia with an area of 124,450 km² and a population of 2.14 million, is located on Borneo Island (Department of Statistics Malaysia, 2017). Sarawak Heart Centre is the only government heart center in the state. Sarawak has a low catheterization laboratory to population ratio of 0.019 per 10,000, and the Sarawak Heart Centre manages about 7.2% of the total number of patients with heart disease in Malaysia (Wan Azman & Sim, 2015). The center is also the only government hospital in Sarawak to provide structured outpatient CR care at no cost to patients. However, an unpublished rehabilitation staff record from 2015 indicates suboptimal attendance in the outpatient CR program, with an attendance rate of 37.4% for all patients who were eligible to participate.

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A review of the available scales was conducted that examined their constructs, dimensions, and appropriateness for use with patients with CHD who require CR. The Cardiac Rehabilitation Barriers Scale (CRBS) was chosen because it assesses patient, healthcare provider, and healthcare-system-related factors (Shanmugasegaram et al., 2012). The CRBS was developed in Canada based on literature review, feedback from cardiologists, and CR staffs. The first version of the CRBS has 19 items and was administered to two cardiac cohorts, including 272 inpatients, 1,497 outpatients, and 97 cardiologists. This version was subsequently revised into a 21-item scale and was psychometrically tested on 2,636 cardiac inpatients. Moreover, a Brazilian Portuguese version of the 21-item CRBS has been psychometrically validated (Ghisi et al., 2012), and the CRBS has been translated into the Colombian-Spanish, French, Punjabi, Korean, Indonesian, and Chinese languages. The CRBS may be administered to inpatients or outpatients to identify barriers to CR participation. The scale items are rated on a 5-point Likert-type scale that ranges from 1 (strongly disagree) to 5 (strongly agree). The four subscales in the CRBS are as follows: perceived needs and healthcare factors (nine items); logistical factors (five items) such as distance, cost, and transportation problems; work and time conflicts (three items); and comorbidities and functional status (four items). Higher scores indicate greater barriers to participation in a CR program.

It was necessary to translate the questionnaire into Malay, the official language of Sarawak State. Therefore, the purpose of this study was to translate, adapt, and evaluate the Malay-version CRBS. Furthermore, this study aimed to measure the psychometric properties of the translated CRBS to justify its use in Sarawak. The ultimate objective was to offer a translated instrument that may be used to provide information and facilitate research and that will improve patient care by improving CR attendance.

**Methods**

**Translation and Cultural Adaptation**

Before beginning the translation process, permission was obtained from the developer of the CRBS to adapt, translate, and use this scale. A forward translation method was used (Sousa & Rojjanasrirat, 2011), and the questionnaire was translated by two independent translators whose first language is Malay. One of the translators was a university nursing lecturer who had over 25 years of experience in lecturing in the English language and who had published books in both Malay and English. The other translator was a secondary school teacher who had taught subjects in both English and Malay for 18 years. The translated questionnaires from the two translators were compiled into a single translated questionnaire by the research team. During the compilation process, both translators were consulted using a group chat when two different words were chosen, with consultations continuing until consensus was reached on which word to use. During this process, the research team and the translators decided to delete the word “severe” in Item 8 (…severe weather), as the word “severe” is not applicable to weather in the context of the research.

The translated questionnaire then underwent blind back-translation by a separate set of two translators. Neither of these translators, whose first language was English, knew about the original questionnaire. The first back-translator worked as a clinical physician who has used Malay and English in his clinical work for more than 10 years. The second back-translator was a secondary school teacher who had taught in both English and Malay for about 7 years. Next, the research team compared the back-translated questionnaires to the original questionnaire. The purpose of this comparison was to ensure that there was no difference in wording between the original items and the back-translated version. The meaning of all the items was found to be equivalent, except for Items 10 and 11. The research team then worked on rephrasing the items based on the suggestions from all of the four translators. For example, in Item 11, “…of time constraints” was rephrased to “I don’t have enough time”, as in the Malay language, “time constraints” is not commonly used and patients may have difficulties understanding the phrase. The preliminary version of Malay-version CRBS was then developed.

Subsequently, the research team worked to adapt the instructions and a few items on the original questionnaire. Five clinical CR nurses were invited to join the team for this adaptation process. Each had 7–15 years of experience in coronary care nursing and had experience with data collection in at least one research study or clinical trial. A half-day meeting was held, and each item was reviewed carefully. They were asked to contribute their knowledge and suggestions based on local information and context. The original instructions identified the barriers of patients who did not attend or who discontinued CR. For the Malay version, these instructions were adapted to examine respondents’ view regarding their future attendance in CR programs, as the translated questionnaire was expected to be delivered before the respondents’ CR appointment date. Phrases including “I have a problem with,” “I must,” and “I have” were added to Items 1, 2, and 8; Item 10; and Items 3, 4, 12, and 14, respectively. These adaptations did not affect the meaning of the original items.

The instrument was then emailed to three experts for quantification of content validity. The purpose of this step was to evaluate each item for content appropriateness and relevance. The experts included one physician who had experience working in cardiac care and was an investigator in clinical trials, one nursing educator who had more than 10 years of experience in cardiac care and was currently teaching coronary care nursing in a postbasic program, and one nursing matron in the CR unit who had more than 30 years of clinical experience in cardiac care nursing and was previously involved in clinical trials. The content validity scale developed by Davis (1992) was used. The experts rated each item in terms of clarity, appropriateness, and relevance.
to assess the barriers to CR on a 4-point scale (1 = not relevant, 2 = somewhat relevant, 3 = quite relevant, and 4 = highly relevant).

The content validity index (CVI) score was calculated for both the item level (I-CVI) and the scale level (S-CVI; Polit & Beck, 2006). The I-CVI was computed for each item by dichotomizing the 4-point scale, with items scored either 1 or 2 categorized into the “not relevant” category with 0 points each and items scored either 3 or 4 categorized into the “relevant” category with 1 point each. The points were later divided by the number of experts (3) to obtain the I-CVI value for each item. The S-CVI is the average of the I-CVIs for all of the scale items. As fewer than five experts were invited to rate the items, the I-CVI should be 1.00 for all items (Lynn, 1986), indicating that the S-CVI should be 1.00 as well (Polit & Beck, 2006). All of the invited experts responded within a week, and the calculated I-CVI value was 1.00 for all of the items except for Item 8, which scored a low value of .33. The S-CVI value was .97, which did not achieve the required CVI value. Examples in brackets were added to Item 8 to clarify the meaning of the statement “I have problems with weather.” These examples were “too hot to be outside of the house or raining.” After the revision to Item 8, the scale was emailed to the three experts again to once more quantify the content validity. All of them rated all items as 1.00, and thus, the scores for the I-CVI for all of the items and for the S-CVI were 1.00.

**Psychometric Testing**

**Participants**

Participants for the psychometric tests were recruited from the Sarawak Heart Centre using convenience sampling. Inclusion criteria were requiring CR and being eligible for CR program participation. Patients who had residual coronary stenosis or were assessed by healthcare providers to have limited ability to participate in the CR program because of stroke, physical impairment, or other reason were excluded. Data were collected between January and August 2017. Two hundred eighty-four inpatients were recruited, among whom 100 were excluded. Data were collected from the 22 participants in the “attended” category using the same scale 6 weeks later.

**Ethical considerations**

Ethical approval was obtained from the Medical Research and Ethic Committee, National Institutes of Health, Malaysia (Approval no. 5KKM/NIHSEC/P17-19). Informed consent was obtained from every participant. The participants were given full knowledge of the research process and could withdraw from the study at any time. They were assured that their personal data would remain confidential and that only the researcher would have full access to this data.

**Psychometric validation**

Data entry and data analysis were performed using SPSS Version 22.0 (IBM, Armonk, NY, USA). Returned questionnaires were examined for missing values. Percentage, pattern, and distribution of the missing values were analyzed before deciding on an approach to deal with these missing values.

A construct validity test was performed using factor analysis. The factorability of the 21 items was first assessed to determine the suitability of the data for use in factor analysis. This assessment included examining the correlation matrix, Kaiser–Meyer–Olkin measure of sampling adequacy, Bartlett’s test of sphericity, diagonal of the anti-image correlation matrix, and communalities.

After confirming suitability, factor extraction was performed using principal component analysis (PCA), as the purpose was to identify the components underlying all of the 21 items. Number of components to retain was determined using the following tests: the rule of eigenvalue greater than 1, at least 50% of cumulative percentage of variance, scree test, and parallel analysis (Reise, Waller, & Comrey, 2000; Williams, Onsman, & Brown, 2010). The obtained factors were then rotated using varimax and direct oblimin rotations, with the factor loading significance set at .32 (Brown, 2009). Both rotations were examined before deciding on the final rotation method. Finally, the retained components were assessed to ensure that they had at least three items with loadings greater than .4 (Samuels, 2016).

Cronbach’s alpha was used to estimate the internal consistency of the scale and subscales. The accepted minimum alpha value was set at .70, which confirms that correlations among items on the same subscale are acceptable (Tavakol & Dennick, 2011). The intraclass correlation coefficient (ICC) was used to assess the test–retest reliability of the scale. ICC estimates and their 95% confident intervals were calculated based on a mean-rating ($k = 2$), absolute-agreement, two-way mixed-effects model, with alpha values of greater than .75 indicating good reliability (Koo & Li, 2016). The suggested sample size was a minimum of 15–20 to obtain an alpha value of .05 and a power of 80% and to detect a value of .70 for the ICC (Bujang & Baharum, 2017). Data were collected from the 22 participants in the “attended” category using the same scale 6 weeks later.

The Shapiro–Wilk test was performed, and the Q-Q plot was examined to confirm that data were normally distributed. Independent-samples $t$ test and one-way analysis of
variance (ANOVA) were then used to assess the criterion validity of the scale. The criteria that were chosen to test the criterion validity include gender, educational level, driving distance, travel time to the hospital, and CR attendance. These criteria were found to have barrier scores that differed significantly from previous CRBS studies (Ghisi et al., 2012; Shanmugasegaram, Oh, Reid, McCumber, & Grace, 2013). Mean scores for total barriers of the scale and of each individual factor were compared among these criteria.

Results

Data Screening

One questionnaire that was returned with 80.95% of the items unanswered was excluded from data analysis. The remaining 283 questionnaires contained an average of 0.54% missing values for all questionnaire items. Little’s missing completely at random test resulted in a chi-square of 341.66 ($df = 334, p = .38$), indicating that the missing data were random. The missing data were thus replaced with a single imputation using the expectation–maximization algorithm, as this method preserves the relationship with other variables (Dong & Peng, 2013), which is an important basis for subsequent factor analysis.

Characteristics of the Participants

Table 1 shows the characteristics of the 283 participants. Mean age was 54.66 ($SD = 10.48$, range: 23–86) years. Most participants were male (83.75%) and had a nonuniversity level of education (88.34%); slightly over half (55.48%) reported a driving distance of more than 30 km to their CR program hospital, and 50.88% traveled over 1 hour to reach that hospital. Overall, CR attendance data showed that 72.44% did not attend the CR program and 14.49% discontinued CR after attending at least one but fewer than all sessions. Participants took 10–15 minutes to complete the questionnaire.

Content Validity

The Malay-version CRBS had I-CVI and S-CVI of 1.00. All of the items were retained in the final version of the instrument.

Construct Validity

Before performing factor analysis, the factorability of the data was examined. All of the items had a correlation of at least .30 with at least one other item in the correlation matrix, suggesting reasonable factorability. The Kaiser–Meyer–Olkin measure of sampling adequacy value was .73, which is above the recommended value of .60 and meets the “middling” criterion (Kaiser, 1974). Bartlett’s test of sphericity was significant ($\chi^2[210] = 2072.62, p < .05$). The diagonals of the anti-image correlation matrix were all above .60, and the communalities were all greater than .30. These results emphasize the appropriateness of proceeding with factor extraction.

Factor analysis was performed using PCA with all 21 items. Factor loading was set at .32 to suppress all loadings less than .32. Five components were identified with eigenvalues greater than 1, which explained 58.45% of the cumulative percentage of variance. The first component explained 21.46% of the variance, the second component explained 12.09% of the variance, and the third component explained 10.31% of the variance. The fourth and fifth components explained 5.96–8.64% of the variance. After varimax rotation, all of the components had at least three items with loadings greater than .40. However, four items (8, 16, 17, and 21) loaded on two components. Furthermore, the pattern matrix after direct oblimin rotation (delta = 0) showed that all of the components had at least three items with loadings greater than .40. However, four items (8, 16, 17, and 21) loaded on two components. The number of components retained was further examined using scree plot and parallel analysis. The scree plot showed a relatively large break after the fourth component, with the breaks between the subsequent components being all relatively small. The eigenvalues leveled off after the fourth or fifth component, a result that was rather ambiguous. The result of parallel analysis indicated that only four components of the original data produced an eigenvalue greater than the 95th percentile from the random data of 21 items, with 283 respondents. Thus, four components were retained for further analysis.

PCA was performed again with all 21 items by adding the commands to extract only four components. Varimax and direct oblimin rotations were conducted. The four components that were extracted explained 52.50% of the cumulative percentage of variance. Both rotations yielded very similar results, but the direct oblimin rotation provided the best-defined factor structure. The direct oblimin rotation showed that all items had primary loadings over .32 and that

### TABLE 1.
**Participant Characteristics (N = 283)**

| Category               | n   | %    |
|------------------------|-----|------|
| Gender                 |     |      |
| Male                   | 237 | 83.75|
| Female                 | 46  | 16.25|
| Educational level      |     |      |
| Nonuniversity          | 250 | 88.34|
| University             | 33  | 11.66|
| Driving distance, km   |     |      |
| ≥ 30                   | 157 | 55.48|
| < 30                   | 126 | 44.52|
| Travel time, hour(s)   |     |      |
| ≥ 1                    | 144 | 50.88|
| < 1                    | 139 | 49.12|
| CR attendance          |     |      |
| Did not attend         | 205 | 72.44|
| Discontinued           | 41  | 14.49|
| Attended               | 37  | 13.07|

Note. CR = cardiac rehabilitation.
all components had at least three items with loadings greater than .40. The factors extracted were labeled as Factor 1, “perceived needs and functional status”; Factor 2, “personal and health problems”; Factor 3, “work and family commitments”; and Factor 4, “healthcare factors.” The factor loading matrix for this final solution is presented in Table 2.

Internal Consistency
Cronbach’s alpha was used to examine the internal consistency, and the overall value was calculated at .82. The alphas were moderate for each extracted factor: .79 for “perceived needs and functional status” (nine items), .74 for “personal and health problems” (five items), .75 for “work and family commitments” (four items), and .81 for “healthcare factors” (three items). Alpha did not increase substantially for the scale or for individual factors if any item was deleted.

Reliability
Test–retest reliability was calculated using ICC with a mean-rating (k = 2), absolute-agreement, two-way mixed-effects model on 22 participants at a 6-week interval. The ICC value was .78.

### TABLE 2.

**Factor Loadings and Communalities Based on a Principal Component Analysis With Oblimin Rotation for 21 Items From the Malay-Version CRBS (N = 283)**

| Item                                                                 | Factor Loading | Variance Explained (%) | Eigen Value |
|---------------------------------------------------------------------|----------------|------------------------|-------------|
| **Factor 1: perceived needs and functional status**                 |                |                        |             |
| 7. I already exercise at home or in my community.                   | .864           | 21.46                  | 4.51        |
| 6. I don’t need cardiac rehab (e.g., feel well, heart problem treated, not serious). | .813           |                        |             |
| 18. I can manage my heart problem on my own.                        | .681           |                        |             |
| 17. Many people with heart problems don’t go, and they are fine.    | .599           |                        |             |
| 16. My doctor did not feel that cardiac rehab is necessary.         | .554           |                        |             |
| 13. I don’t have the energy.                                       | .471           |                        |             |
| 21. I prefer to take care of my health alone, not in a group.       | .423           |                        |             |
| 15. I am too old.                                                   | .410           |                        |             |
| 9. I find exercise tiring or painful.                               | .377           |                        |             |
| **Factor 2: personal and health problems**                          | .842           | 12.09                  | 2.54        |
| 3. I have transportation problems (e.g., access to a car, public transportation). | .739           |                        |             |
| 2. I have problem with cost (e.g., parking, gas).                   | .711           |                        |             |
| 1. I have problem with distance (e.g., not located in your area, too far to travel). | .632           |                        |             |
| 8. I have problem with weather (e.g., too hot to be outside of the house, raining). | .460           |                        |             |
| 14. I have other health problems that prevent me from going (specify: ______). |             |                        |             |
| **Factor 3: work and family commitments**                           | .858           | 10.31                  | 2.17        |
| 4. I have family responsibilities (e.g., caregiving).               | .708           |                        |             |
| 11. I don’t have enough time (e.g., too busy, inconvenient class time). | .707           |                        |             |
| 12. I have work responsibilities.                                   | .700           |                        |             |
| 10. I have to travel to other places (e.g., holiday trip, business trip). |             |                        |             |
| **Factor 4: healthcare factors**                                    | −.930          | 8.64                   | 1.81        |
| 5. I don’t know about cardiac rehab (e.g., doctor didn’t tell me about it). |             |                        |             |
| 20. It took too long to get referred and into the program.          | −.797          |                        |             |
| 19. I think I was referred, but the rehab program didn’t contact me. | −.788          |                        |             |

Note. Factor loadings < .32 were suppressed. CRBS = Cardiac Rehabilitation Barriers Scale.
Criterion Validity

Independent-samples t test and ANOVA were conducted to assess the criterion validity. Table 3 shows the mean score for total barrier of the scale and each individual factor among the different patient characteristics. The total barrier score ranged from 21 to 105. The mean score for total barrier was 54.02 ($SD = 8.67$) and ranged from 30 to 75. There were significant differences between educational level ($p = .02$), driving distance to the hospital, CR program location ($p < .001$), and travel time to the hospital ($p < .001$). Participants with a nonuniversity level of education had significantly higher barriers than respondents with a university level of education. Participants who needed to travel more than 30 km and who required a travel time of over 1 hour from their house to the hospital also faced higher barriers to attending CR programs. The mean score for total barriers did not differ between genders, although male participants reported significantly higher barriers in Factor 3 (work and family commitments).

One-way ANOVA showed a significant effect of the barriers score on CR attendance, $F(2, 280) = 34.68, p < .001$. Post hoc analyses using Tukey’s honestly significant difference test indicated that the mean score for total barriers was significantly higher for participants who did not attend the CR program than for those who did attend ($p < .001$). In addition, the mean score for total barriers was higher for respondents who did not attend the CR program than for those who discontinued CR after attending one but less than all sessions ($p < .001$). However, those who attended CR did not differ significantly from those who discontinued CR ($p = .64$). Furthermore, the barriers score for each individual factor showed significant effects on CR attendance. Table 4 shows the Tukey’s honestly significant difference comparison between total barriers score and each individual factor.

| Characteristic        | Factor 1 | Factor 2 | Factor 3 | Factor 4 | Total Score |
|-----------------------|----------|----------|----------|----------|-------------|
| Gender                |          |          |          |          |             |
| Male                  | .52      | .05      | .02a     | .42      | .15         |
| Female                | 237      | 15.26 (4.14) | 11.33 (3.30) | 6.97 (1.87) | 53.69 (8.73) |
|                       | 46       | 16.75 (4.11) | 10.26 (2.57) | 7.22 (1.86) | 55.71 (8.19) |
| Educational level     | .02      | .01a     | .99      | .35      | .02a        |
| Nonuniversity         | 250      | 15.71 (4.10) | 11.16 (3.24) | 7.05 (1.91) | 54.46 (8.70) |
| University            | 33       | 13.67 (4.23) | 11.15 (2.96) | 6.72 (1.42) | 50.67 (7.73) |
| Driving distance, km  | .63      | < .01a   | .27      | < .01a   | < .01a      |
| ≥ 30                  | 157      | 16.98 (3.90) | 11.35 (3.29) | 7.37 (2.02) | 56.49 (8.53) |
| < 30                  | 126      | 13.59 (3.70) | 10.92 (3.10) | 6.57 (1.55) | 50.94 (7.83) |
| Travel time, hour(s)  | < .01a   | < .01a   | .13      | < .01a   | < .01a      |
| ≥ 1                   | 144      | 17.35 (3.69) | 11.44 (3.27) | 7.42 (2.01) | 57.33 (8.16) |
| < 1                   | 139      | 13.53 (3.71) | 10.86 (3.11) | 6.59 (1.61) | 50.59 (7.82) |

Note. Item range: Factor 1 = 9–45; Factor 2 = 5–25; Factor 3 = 4–20; Factor 4 = 3–15; total score = 21–105.

*Total mean scores differ between groups.

Discussion

This study implemented the measures that were suggested in the literature in an attempt to develop a valid and reliable Malay-version CRBS. The questionnaire developed in Malay will be used to assess the barriers perceived by inpatients to CR program participation.

The translation and adaptation process followed the guidelines suggested by Sousa and Rojjanasrirat (2011). In comparing the back-translated questionnaires with the forward-translated questionnaires and the original version, Sousa and Rojjanasrirat suggested using a multidisciplinary committee composed of one methodologist, one healthcare professional, all four translators, and, if possible, the developer of the original instrument. The committee that was gathered for this study included a methodologist and healthcare professionals. Although the developer of the original scale was not invited, all of the identified discrepancies were resolved via discussion without affecting the meaning of the original items. The revised items achieved I-CVI and S-CVI scores of 1.00 after two rounds of expert reviews and item improvements based on the experts’ suggestions.

Factor analyses using PCA with both varimax and direct oblimin rotations were conducted to extract the factors. This technique was used to assess the construct validity by examining the interrelationships among the variables in the Malay-version CRBS to identify the underlying structure of the variables. Rotated structure solutions are easier to interpret than the original extracted factors, and direct oblimin rotation may produce more accurate results for studies of human behavior (William et al., 2010). Direct oblimin rotation was chosen as the final rotation method in this study, as it provided the best-defined factor structure after the rotations.

No item was deleted during the process of translation and psychometric validation. The number of items is consistent with...
the validation studies in the original version (Shanmugasegaram et al., 2012) and the Brazilian Portuguese version (Ghisi et al., 2012). Four factors were extracted from the PCA in this study, including perceived needs and functional status (nine items), personal and health problems (five items), work and family commitments (four items), and healthcare factors (three items). All of these factors were considered internally consistent, as each earned a Cronbach’s alpha value greater than .70 (Tavakol & Dennick, 2011). The reliability of the scale was also established with an ICC of .78.

Perceived needs and functional status were grouped together as the first factor in this study. This is different from the original structure, which grouped perceived needs and healthcare factors as the first factor. One plausible explanation is that patients in Sarawak interpret the barriers of perceived needs and of functional status as a single issue.

### TABLE 4.

**Tukey’s HSD Comparison of Total Barrier Score and Each Individual Factor**

| Barriers Score (I) | Barriers Score (J) | Mean Difference (I–J) | SE  | p       | 95% CI        |
|--------------------|--------------------|-----------------------|-----|---------|---------------|
| Total barriers     |                    |                       |     |         |               |
| Attended           | Did not attend     | −9.41*                | 1.39| < .001  | [−12.69, −6.14]|
| Discontinued       |                    | −1.59                 | 1.77| .639    | [−5.75, 2.57]  |
| Did not attend     | Attended           | 9.41*                 | 1.39| < .001  | [6.14, 12.69]  |
| Discontinued       | Attended           | 7.82*                 | 1.33| < .001  | [4.68, 10.96]  |
| Discontinued       | Did not attend     | 1.59                  | 1.77| .639    | [−2.57, 5.75]  |
| Did not attend     | −7.82*             | 1.33                  | < .001|        | [−10.96, −4.68]|
| Factor 1: perceived needs and functional status | | | | | |
| Attended           | Did not attend     | −2.20*                | 0.75| .010    | [−3.96, −0.43] |
| Discontinued       |                    | 0.10                  | 0.95| .993    | [−2.14, 2.34]  |
| Did not attend     | Attended           | 2.20*                 | 0.75| .010    | [0.43, 3.96]   |
| Discontinued       | Attended           | 2.30*                 | 0.72| .004    | [0.61, 3.99]   |
| Discontinued       | Did not attend     | −0.10                 | 0.95| .993    | [−2.34, 2.14]  |
| Did not attend     | −2.30*             | 0.72                  | .004|         | [−3.99, −0.61] |
| Factor 2: personal and health problems | | | | | |
| Attended           | Did not attend     | −5.13*                | 0.66| < .001  | [−6.69, −3.58] |
| Discontinued       |                    | −1.79                 | 0.84| .085    | [−3.76, 0.19]  |
| Did not attend     | Attended           | 5.13*                 | 0.66| < .001  | [3.58, 6.69]   |
| Discontinued       | Attended           | 3.34*                 | 0.63| < .001  | [1.85, 4.83]   |
| Discontinued       | Did not attend     | 1.79                  | 0.84| .085    | [−0.19, 3.76]  |
| Did not attend     | −3.34*             | 0.63                  | < .001|        | [−4.83, −1.85] |
| Factor 3: work and family commitments | | | | | |
| Attended           | Did not attend     | −1.60*                | 0.56| .014    | [−2.93, −0.27] |
| Discontinued       |                    | −0.54                 | 0.72| .728    | [−2.23, 1.14]  |
| Did not attend     | Attended           | 1.60*                 | 0.56| .014    | [0.27, 2.93]   |
| Discontinued       | Attended           | 1.06                  | 0.54| .126    | [−0.22, 2.33]  |
| Discontinued       | Did not attend     | 0.54                  | 0.72| .728    | [−1.14, 2.23]  |
| Did not attend     | −1.06              | 0.54                  | .126|         | [−2.33, 0.22]  |
| Factor 4: healthcare factors | | | | | |
| Attended           | Did not attend     | −0.48                 | 0.33| .304    | [−1.25, 0.29]  |
| Discontinued       |                    | 0.63                  | 0.41| .278    | [−0.34, 1.61]  |
| Did not attend     | Attended           | 0.48                  | 0.33| .304    | [−0.29, 1.25]  |
| Discontinued       | Attended           | 1.12*                 | 0.31| .001    | [0.38, 1.85]   |
| Discontinued       | Did not attend     | −0.63                 | 0.41| .278    | [−1.61, 0.34]  |
| Did not attend     | −1.12*             | 0.31                  | .001|         | [−1.85, −0.38] |

Note. CI = confidence interval; HSD = honestly significant difference.

* p < .05.
functional status items appear to relate to patients’ perceived needs for CR. Moreover, the items related to perceived needs relate to the health status perception of patients—for example, “I don’t need CR” and “I can manage my heart problem on my own.” These perceptions on health status tend to affect the functional status of patients (Allahverdipour, AgharriJafarabadi, Heshmati, & Hashemiparast, 2013). Therefore, perceived needs and functional status were identified as two interconnected subscales and were combined into a single factor in this study.

Two items, Items 14 and 4, loaded on different factors in this study, which suggest different interpretations of these items in the Malaysian setting. Item 14 in the comorbidities subscale in the original CRBS loaded on four logistical factor items. A new factor, called “personal and health problems,” was created for these items. One possible explanation for this difference from the original scale is that patients in Sarawak interpret the phrase “other health problems” in this item as personal problems that prevent them from participating in a CR program. Similarly, Item 4 in the logistical factors in the original CRBS loaded on all of the items in the work/time conflicts subscale. These items were combined in a new factor called “work and family commitments” in the Malay version. “Family responsibilities” in Item 4 may be interpreted by the patients as a commitment that acts as a barrier to CR participation.

In assessing criterion validity, the mean scores for total barriers and each individual factor were found to differ significantly among the groups of patients who attended CR, did not attend CR, and discontinued CR after attending at least one but fewer than all of the sessions. In addition, the scores were found to relate negatively to CR program attendance, with higher barrier scores associated with a higher likelihood of discontinuance or nonattendance. These findings are consistent with the findings of the original validation study (Shanmugasegaram et al., 2012).

The differences in the mean score for total barriers were also observed for educational level, driving distance, and time travel to the hospital. This is consistent with the barriers found in other studies to attending and utilizing CR programs. Higher educational level was shown to increase the likelihood of attending a CR program (Dunlay et al., 2009), whereas longer distance to the nearest CR provider was associated with lower CR uptake and attendance (van Engen-Verheul et al., 2012). It was also found that patients were significantly less likely to enroll in CR when travel time to attend a CR program was 60 minutes or more (Brual et al., 2010).

This study was affected by several limitations. First, there was high number of male patients, patients who did not attend the CR program, and patients with a relatively low level of education, which may reflect a selection bias. However, selection bias is unlikely, as a previous study also found the same differences in CRBS scores between the groups (Ghisi et al., 2012). Second, the Malay-version CRBS was administered to inpatients before hospital discharge. Patients may develop barriers to CR after hospital discharge. Finally, as the study was conducted in Sarawak, the findings may only be generalizable to patients with a background similar to the participants in this study, especially in terms of similar healthcare system utilization patterns. Further studies on Malay-speaking patients are necessary to validate the findings in this study.

**Implications**

The Malay-version CRBS may be used with inpatients to identify barriers to CR program participation. The identified barriers should be modified to increase CR attendance and to further improve patient care.

**Conclusions**

The results of this study suggest that the Malay-version CRBS is a valid and reliable instrument. It may be used to identify the barriers to CR program participation and to suggest interventions to effectively increase CR program attendance.

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