Development and Validation of the Chinese Health Literacy Scale for Chronic Care

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This study aims to develop and test the psychometric properties of the Chinese Health Literacy Scale for Chronic Care (CHLCC). This is a methodological study with a sample of 262 patients 65 years of age and older who had chronic illnesses. Pearson’s correlation, independent sample t tests, and analyses of variance were used. The CHLCC showed a significant positive correlation with Chinese literacy levels ($r = 0.80; p < .001$) but was negatively correlated with age ($r = -0.31; p < .001$). Respondents who were male ($t = 4.34; p < .001$) and who had reached Grade 12 or higher in school ($F = 51.80; p < .001$) had higher CHLCC scores than did their counterparts. Individuals with high levels of health literacy had fewer hospitalizations than did their counterparts ($\beta = -0.31; \text{incidence rate ratio} = 0.73; p < .05$). The CHLCC also displayed good internal reliability (Cronbach’s $\alpha = 0.91$) and good test–retest reliability (intraclass correlation coefficient = 0.77; $p < .01$). The CHLCC is a valid and reliable measure for assessing health literacy among Chinese patients with chronic illness. The scale could be used by practitioners before implementing health promotion and education.

Patients with chronic illnesses encounter challenges in their day-to-day self-management activities. They struggle to manage their symptoms, comply with treatment regimes, minimize the negative consequences of physical deterioration, and change their lifestyles to cope with the limitations created by their chronic diseases (Barlow, Wright, Sheasby, Turner, & Hainsworth, 2002). Patients with poor health literacy are less likely than are patients with better health literacy to successfully manage their chronic illnesses because those with poor health literacy have difficulty exhibiting adequate self-management and eventually experience poor health outcomes (DeWalt et al., 2006; Gazmararian, Williams, Peel, & Baker, 2003; Rothman, DeWalt, et al., 2004; Rothman, Malone, et al., 2004b).

Health literacy is defined as an individual’s capacity to obtain, process, and understand basic health information and the services needed to make appropriate health decisions (Nielsen-Bohlman, Panzer, & Kindig, 2004). Health literacy has a significant direct association and an indirect association with self-management activities among patients with chronic illnesses (Baker, 2006; Cavanaugh et al., 2008; Fransen, von Wagner, Essink-Bot, 2012; Karter et al., 2010; Mbaezeu et al., 2010; Paasche-Orlow & Wolf, 2007).

The health literacy of patients cannot be judged on the basis of appearances or first impressions. Patients with health literacy problems frequently feel embarrassed.
and attempt to hide this issue from health care providers, friends, and even close relatives (Nath, Sylvester, Yasek, & Gunel, 2001). When individuals with inadequate health literacy enter the health care system, they are more likely to experience difficulty reading prescription bottles and appointment slips, following self-care instructions (e.g., for blood glucose monitoring), and understanding advice from health education brochures. Knowledge of health literacy levels in the Chinese population is limited. The most commonly used instruments, the Rapid Estimate of Adult Literacy in Medicine (REALM), Test of Functional Health Literacy Assessment (TOFHLA), and Newest Vital Sign (NVS), are available only in English and Spanish, and they are not culturally sensitive; in particular, they do not take into account that the sentence structure of Chinese characters is markedly different from that of English. The REALM, TOFHLA, NVS, and their derivatives place a strong emphasis on pronunciation and comprehension in English, and this approach might have limited applicability in other languages, including Chinese (Tsai, Lee, Tsai, & Kuo, 2011).

Three additional health literacy measurements have been developed for Chinese adults: the Taiwan Health Literacy Scale (Pan, Su, & Chen, 2010), the short form of the Taiwan Health Literacy Scale (Pan, 2010), and the Mandarin Health Literacy Scale (Tsai et al., 2011). The Taiwan Health Literacy Scale and its short form are word-recognition tests and were developed with reference to the REALM (Pan, 2010; Pan et al., 2010). They only measure individuals’ ability to read the word aloud and do not acknowledge the importance of understanding and applying these words in health decisions. The Mandarin Health Literacy Scale is lengthy (it takes approximately 25 minutes to complete) and may not be patient friendly or health professional friendly, particularly in busy clinical settings.

The Chinese population, which is the largest in the world, is becoming aware of the concept of health literacy (Wang, 2000). Several studies on this topic have been conducted in Hong Kong, China, and Taiwan, and efforts have been made to investigate the association between health literacy and health outcomes, such as self-reported health status, health-promoting behaviors (Chang, 2011), glycemic controls (Tang, Pang, Chan, Yeung, & Yeung, 2008), national health status, and health care utilization (Lee, Tsai, Tsai, & Kuo, 2010). Two additional studies assessed the health literacy of secondary school and college students and found that many of them did not have adequate health literacy skills (Yu, Yang, Wang, & Zhang, 2012; Zhang & Cui, 2011). These previous studies noted two key issues: (a) practitioners and researchers had significant concerns about health literacy and intended to address health literacy issues in Chinese society; and (b) health literacy is a timely topic in the Chinese population, but no measurement instrument has been consistently used. Moreover, no study has been geared toward patients with chronic illnesses.

During the Annual Ministerial Meeting of the Asia-Pacific Region, Zhu (2009), the Minister of Health in China, reiterated that the measures of health literacy should be well defined to help formulate evidence-based approaches to improving health at the regional and national levels. Hence, developing a validated instrument that can be used to measure the health literacy of Chinese individuals is clearly warranted (Kim, 2009). The prevalence of chronic illness in the Chinese population has escalated during the last decade, and good management of chronic illness can reduce the cost of medical services.

Method

This study aimed to develop the Chinese Health Literacy Scale for Chronic Care (CHLCC) and to evaluate its psychometric properties (including internal consistency,
test–retest reliability, and discriminant validity) among older Chinese adults with chronic illnesses.

**Conceptual Framework**

The CHLCC was developed with reference to the revised Bloom’s Taxonomy (Anderson & Krathwohl, 2001). Bloom’s Taxonomy was recently adopted as the framework in the research team’s development of another health literacy scale that measured the ability of Chinese patients with Type II diabetes mellitus to understand and interpret health information (Leung, Lou, Cheung, Chan, & Chi, 2012). The present study continues this effort to isolate an appropriate framework for developing a health literacy scale for patients with chronic illnesses.

Health literacy represents the ability to access, understand, evaluate, and communicate health information (Rootman & Gordon-El-Bihbety, 2008); it measures more than the ability to read (Schonlau, Martin, Haas, Derose, and Rudd, 2011). There is no doubt that these abilities are related to cognitive processes in which individuals receive or seek health information, try to understand that information, apply the information to day-to-day communication with health care professionals or peers, and analyze the information in context when making health decisions. Thus, using Bloom’s Taxonomy recognizes the likely role of cognition in processing health information.

**Design and Participants**

We used a convenience sample for this study. The sample size was based on (a) the recommended subject-to-item ratio of 5:1 (Terwee et al., 2007) and (b) a minimum sample size for conducting an analysis with item response theory (IRT; Hambleton & Cook, 1983). Given an attrition rate of 5%, a total of 263 participants were required for the present study. In addition, another 30 participants and 11 participants were recruited for test–retest reliability and face validity assessments, respectively. Participants were recruited from a community health center and from five elderly community centers in the Southern District of the Hong Kong Special Administrative Region in China.

The inclusion criteria for the participants were 65 years of age or older, having at least one of four types of chronic illness (hypertension, diabetes mellitus, chronic obstructive pulmonary disease, or arthritis), cognitive capabilities (as demonstrated by a score on the Chinese version of the Short Portable Mental Status Questionnaire equal to or greater than 8), and the ability to communicate in Cantonese. Participants who had acute illnesses, such as fever or infection, were excluded from the study.

Between August 2010 and January 2011, a trained research assistant approached the potential participants, providing the specific objectives of the study, a detailed explanation of the study procedures, and written information sheets. The research assistant checked participants’ eligibility for the study after obtaining their written consent. The research assistant administered two tests (the CHLCC and the PPCLS) to those who were eligible in a face-to-face interview format. To avoid influencing the participants, the research assistant read the instructions and questions without offering any additional interpretation or explanation.

This study adhered to ethical research standards and regulations. Ethical approval was obtained from the Ethical Review Board of the University of Hong Kong/Hospital Authority Hong Kong West Cluster.
Process of Developing the CHLCC

Four levels of cognition (remembering, understanding, applying, and analyzing) were considered relevant to health literacy. Individuals are usually trained to retain knowledge (remember), understand instructional messages (understand), and execute procedures in a given situation (apply). Some individuals are able to transition to higher levels of cognition, such as analyzing, evaluating, and creating. The analysis process includes breaking materials into parts and determining how those parts are related to one another and to the overall structure or purpose. The evaluation process involves making judgments on the basis of criteria and standards, and the creation process involves combining essential elements to form a new pattern or structure (Anderson & Krathwohl, 2001). We created four corresponding subscales for the CHLCC.

The remembering subscale measured an individual’s ability to memorize and read aloud terms that are often used in chronic illness management. A total of 30 terms were identified from health education leaflets or information sheets that were given to patients with chronic illnesses at general outpatient clinics or specialty clinics. In Hong Kong, many chronically ill patients (e.g., more than 160,000 diabetic patients) receive medical consultations and follow-up care in these clinics every year (Wong, Ho, & Chao, 2012). Therefore, the materials from these clinics likely reflect common practices in chronic illness management in Hong Kong. As suggested in other scale development literature (Oberle, Singhal, Huber, & Burgess, 2000; Baron-Epel, Balin, Daniely, & Eidelman, 2007), at least two experts should be included in the face validity testing of a scale. In this study, a panel of four experts was formed: two nurses and one doctor, whose main duties were health education and medical consultation for patients with chronic illnesses; and the principal investigator, who is an experienced researcher who works on health promotion among Chinese adults.

After review, another eight terms were added to the list. These 38 terms were subsequently ranked by the three experts using a 5-point Likert scale ranging from 5 (most relevant to chronic illness care) to 1 (least relevant). Twenty-two terms were selected and included in the final version of the scale; these terms were ranked as the most relevant to chronic illness care. The selected terms were arranged according to length (from one-word terms to five-word terms). The other three subscales (understanding, applying, and analyzing) were developed on the basis of situations in day-to-day chronic illness care in which patients are required to make decisions.

The three subscales comprised 20 questions: 7 for understanding, 7 for applying, and 6 for analyzing. Some questions were created on the basis of the TOFHLA (Parker, Baker, Williams, & Nurss, 1995) but emphasized the usual practices in Chinese communication. The draft questions were reviewed and rated by four chronic health care experts. They were asked to consider whether the chosen labels and questions represented actual situations encountered by chronically ill patients in Chinese society and whether they were clearly stated.

Other Variables

In addition to the CHLCC, each participant also completed the Preschool and Primary Chinese Literacy Scale (PPCLS; Li, 2005) and provided demographic information (including information regarding his or her age, sex, and education level). The PPCLS had good internal consistency (Cronbach’s $\alpha = .85$) and good test–retest reliability ($r = 0.82; p < .001$) over a period of 2 weeks (Li, 2005).
We also retrieved the participants’ medical records and identified their frequency of hospitalization during the previous 12 months. On the basis of the accessibility of data in medical records and the cost of collecting prospective data, the research team decided to use retrospective data in this study. This retrospective approach has been used in other scale validation studies, such as Thomas and Lane (2005). Previous studies showed that individuals with poor health literacy were more likely to be hospitalized (Berkman, Sheridan, Donahue, Halpern, & Crotty, 2011; DeWalt, Berkman, Sheridan, Lohr, & Pignone, 2004).

**Statistical Analysis**

We calculated descriptive statistics for the respondents’ demographics, including frequencies and proportions, to provide preliminary statistical information. To validate the CHLCC, we assessed its face validity by inviting 11 patients with chronic illnesses to comment on the draft scale and note whether the health information provided was an accurate representation of the situations that they encountered in day-to-day chronic illness care. Then, we calibrated the scale (i.e., we removed redundant items so that the scale could be shortened to a reasonable length but all the essential domains of the constructs could be measured using the minimum number of items) with IRT (Edelen & Reeve, 2007).

A one-parameter logistic (1PL) IRT model, which consists of a global discrimination parameter for all items and a difficulty parameter for each item (a person with greater ability would be more likely to answer difficult items correctly), was used to check the measurement properties of each item on the scale. The model was considered acceptable if each item showed the unidimensionality of the underlying construct and local independency. The item was selected on the basis of the following two criteria:

1. **Item fit**: Item (chi-square) goodness-of-fit statistics were used to guide the item selection process. High significant chi-square values indicated that the item fit the 1PL IRT model poorly within each domain, and these items were eliminated from the corresponding construct.

2. **Item information curves**: Items with identical item information curves patterns represented similar information and overlap.

We examined the unidimensionality assumption of each 1PL IRT model and report the eigenvalue for each domain. The unidimensionality assumption was considered to be satisfied if it met one of these criteria: (a) only one eigenvalue was greater than 1 or (b) the first eigenvalue ratio (i.e., the first eigenvalue divided by the second eigenvalue) was greater than 3. We also examined the goodness-of-fit of each 1PL IRT model before and after the item selection to determine whether such action would enhance the fit of the 1PL IRT model. The model is considered to have good fit if the $p$ value of the chi-square is greater than .05.

We then used a bifactor confirmatory factor analysis to examine whether or not the remaining items fit the proposed model (i.e., whether the items belonged to their corresponding domains; all of them belonged to the overall domain of health literacy). We used Bayesian estimation to analyze the bifactor confirmatory factor analysis model because Bayesian estimation yields a more accurate and sufficient parameter estimation for a small sample size (Muthén & Asparouhov, 2012). We evaluated the goodness-of-fit of the bifactor confirmatory factor analysis model using posterior
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predictive checking. A model with a nonsignificant posterior predictive $p$ value has good fit (Muthén & Asparouhov, 2012). We used the “ltm” package of R to perform the IRT analysis (Rizopoulos, 2006).

After the scale calibration, we tested the discriminant validity of the CHLCC by reviewing its correlations with five constructs: age, sex, education level, Chinese literacy, and frequency of hospitalization. Previous research reported that adults with lower education levels and older adults had lower levels of health literacy (Ko, Lee, Toh, Tang, & Tan, 2012; Rudd, 2007); in addition, men were found to have higher levels of health literacy (Baron-Epel, Balin, Daniely, & Eidelman, 2007; Wu et al., 2010) than women. Reading ability, or literacy skills, was also found to be related to health status and health literacy (Gazmararian et al., 2003). We used Pearson’s correlation to test the relationship between the CHLCC and age and that between the CHLCC and the PPCLS. We also used an independent sample $t$ test to test the relationship between the CHLCC and sex. To test the relationship between the CHLCC and education level, we performed an analysis of variance.

We assessed the relationship between the CHLCC and the frequency of hospitalization using Poisson regressions and controlled for age and sex in the regression models because advanced age and male sex were good predictors of hospitalization (Inouye et al., 2008). Last, we calculated Cronbach’s alphas to assess the internal consistency of each subscale and the CHLCC and examined intraclass correlations to assess the test–retest reliability of the scale over a period of 3 weeks.

We conducted receiver operating characteristic analysis to determine the possible cutoff of the CHLCC. Using one single item (e.g., education) to determine the cutoff of a health literacy scale is not recommended (Hanchate et al., 2008); therefore, we used a multiple factor approach. Wolf, Feinglas, Thompson, and Baker (2010) recommended using health outcomes, such as hospitalization, to determine the cutoffs for health literacy scales. In this study, we used education level (Grade 7 or higher) and hospitalization (no hospitalizations in the previous 12 months) to identify participants who had adequate health literacy. We assessed the performance of the CHLCC in classifying subjects as having adequate health literacy using the receiver operating characteristic curve. The cutoff point was identified, and its sensitivity and specificity were evaluated.

We used SPSS version 20.0 (IBM Corporation, 2011) and R version 2.15.2 (Institute for Statistics and Mathematics, 2012) to perform the aforementioned analyses.

Results

Demographics of the Respondents

Participants were 262 individuals who completed the CHLCC and other measures. After 21 days, we received all information again (except for the demographic information) from 31 respondents. The majority of participants were women (72.5%). One third were 65 to 74 years old. Approximately 40% of respondents had no formal education, and 45% had only finished primary school (Grade 6). Participants’ education levels were similar to those of elderly individuals (no formal education: 36%; primary school: 39%; secondary school: 25%) in Hong Kong (Census and Statistics Department, 2006). The present sample was fairly representative of the older population in Hong Kong in terms of education level. A majority of the respondents had hypertension (80.2%), 46.6% had arthritis, and 34.4% had diabetes mellitus. A smaller proportion (5.7%) reported having chronic obstructive pulmonary disease (Table 1).
Table 1. Demographics of study participants ($N = 262$)

| Variable                        | n   | %    |
|---------------------------------|-----|------|
| Sex                             |     |      |
| Female                          | 190 | 72.5 |
| Age (years)                     |     |      |
| 65–69                           | 35  | 13.4 |
| 70–74                           | 58  | 22.1 |
| 75–79                           | 83  | 31.7 |
| 80–84                           | 59  | 22.5 |
| 85–89                           | 23  | 8.8  |
| 90 or older                     | 4   | 1.5  |
| Education level                 |     |      |
| No formal education             | 104 | 39.7 |
| Grade 1–6                       | 117 | 44.7 |
| Grade 7–11                      | 39  | 14.9 |
| Grade 12 or higher              | 2   | 0.8  |
| Chronic illness                 |     |      |
| Hypertension                    | 210 | 80.2 |
| Arthritis                       | 122 | 46.6 |
| Diabetes mellitus               | 90  | 34.4 |
| Chronic obstructive pulmonary disease | 15 | 5.7  |

**Face Validity**

Both patients and the expert panel confirmed the face validity of the CHLCC.

**Item Selection**

The redundant items within each subscale were identified by observing the IICs. Items with identical or similar item information curves patterns were considered to be redundant. Figure 1 shows the item information curves of the items in each subscale. The dotted lines represent the redundant items that were removed from the corresponding subscale. One item in the applying subscale was identified as violating the local independent assumption and was removed from the scale. Using 1PL IRT models, 12 words were selected to form the remembering subscale, and four items each were selected to form the understanding, applying, and analyzing subscales. Thus, a total of 24 items were selected to form the CHLCC.

Table 2 shows the results of the goodness-of-fit analysis of the CHLCC. Before item elimination (with 42 items), the model did not fit well because the subscales for understanding and applying did not meet the criteria (i.e., only one eigenvalue was greater than 1, or the first eigenvalue ratio was greater than 3). The criteria were met after 10 items had been eliminated from the remembering subscale along with four items from the understanding subscale, three items from the applying subscale, and one item from the analyzing subscale. The insignificant chi-square values of all of the selected items indicated the good fit of the item with the 1PL IRT model. Each item in the remembering subscale was assigned a value of 1 point, whereas each item in the other three subscales was given a value of 3 points. Thus, the maximum number of points for each subscale was 12, and the maximum total number of points for the CHLCC was 48.
Figure 2 shows the results of the bifactor confirmatory factor analysis of the CHLCC. The posterior predictive checking result showed that the 95% confidence intervals of the chi-square ranged from –21.55 to 128.55 and that the posterior predictive \( p \) was equal to .08. This indicated a good fit with the proposed model (Muthén & Asparouhov, 2012).

**Discriminant Validity of the CHLCC**

The CHLCC showed significant correlations with age, sex, and education level. The average CHLCC score for men (\( M = 33.8, SD = 8.9 \)) was significantly higher than that of women (\( M = 28.1, SD = 10.9, t = 4.34, p < .001 \)). Participants who had attended Grade 12 or higher (\( M = 40.0, SD = 2.8 \)) had significantly higher CHLCC scores than did those who had not (Grades 7–11: \( M = 39.4, SD = 6.9 \); Grades 1–6: \( M = 33.5, SD = 8.3 \); no formal education: \( M = 21.9, SD = 9.2, F = 51.80, p < .001 \)). The CHLCC also showed a strong positive correlation with the PPCLS (\( r = .80; p < .001 \); Table 3).

The mean frequency of hospitalization during the previous 12 months was 1.3 (\( SD = 2.2 \)). To assess the relationship between the CHLCC score and hospitalization, the participants were divided into three subgroups according to the percentile of their CHLCC scores. These subgroups were low (0–23; \( n = 78; 29.8\% \)), moderate (24–35; \( n = 89; 34.8\% \)), and high (36–48; \( n = 95; 36.3\% \)) health literacy. The results of the Poisson regression models showed that the high health literacy group was less likely to have been hospitalized than was the low (\( \beta = -.31; \text{incidence rate ratio} = 0.73; p < .05 \)) or moderate (\( \beta = -.43; \text{incidence rate ratio} = 0.65; p < .01 \)) group.

**Internal Consistency, Reliability, and Cutoff of the CHLCC**

The CHLCC had high internal consistency (Cronbach’s alpha = 0.91), and its test–retest reliability during a 3-week period was good (intraclass correlation = 0.77; \( p < .01 \); Table 3). The area under the receiver operating characteristic curve for predicting adequate health literacy was 0.77 (95% CI, 0.67–0.86, \( p < .001 \)). The curve for
Table 2. Results of the goodness-of-fit statistics of the Chinese Health Literacy Scale for Chronic Care

| Remembering | Overall goodness-of-fit | Item goodness-of-fit |
|-------------|-------------------------|----------------------|
|             | No. of items | Chi-square | $p$ | First eigenvalue | Discrimination | Difficulty | Chi-square | $p$ | Percentage of correct |
| Before elimination | 22 | 3314286 | .08 | $16.27 \div 1.65 = 9.86$ | Item 1 | -0.75 | 35.75 | .437 | 82.1 |
| | | | | | Item 2 | -0.66 | 45.22 | .351 | 80.5 |
| | | | | | Item 3 | -0.21 | 8.35 | .682 | 72.5 |
| | | | | | Item 4 | -0.34 | 9.52 | .649 | 74.8 |
| | | | | | Item 5 | -0.01 | 6.00 | .782 | 67.9 |
| | | | | | Item 6 | 0.22 | 9.01 | .384 | 61.8 |
| | | | | | Item 7 | 0.15 | 8.17 | .450 | 63.7 |
| | | | | | Item 8 | -0.16 | 7.29 | .682 | 71.4 |
| | | | | | Item 9 | 0.36 | 11.84 | .265 | 57.6 |
| | | | | | Item 10 | 0.12 | 25.89 | .139 | 64.5 |
| | | | | | Item 11 | -0.21 | 4.61 | .868 | 72.5 |
| After elimination | 12 | 1625.78 | .71 | $9.18 \div 0.97 = 9.46$ | | | | | |
| | | | | | Item 12 | 0.48 | 11.02 | .305 | 53.4 |
| Understanding | Before elimination | After elimination | 1.47 |
|---------------|--------------------|-------------------|------|
| 8             | 138.34             | .12               | 2.29 |
| 4             | 14.04              | .18               | 2.17 |
|               | 2.29 ÷ 1.00 =      |                   |      |
| Item 1        | -0.46              | 27.28             | .776 |
|               | 61.8               |                   |      |
| Item 2        | 0.34               | 40.54             | .090 |
|               | 41.2               |                   |      |
| Item 3        | -0.16              | 22.23             | .876 |
|               | 54.2               |                   |      |
| Item 4        | 0.65               | 27.14             | .667 |
|               | 33.6               |                   |      |

| Applying      | Before elimination | After elimination | 1.23 |
|---------------|--------------------|-------------------|------|
| 7             | 273.84             | .20               | 1.78 |
| 4             | 10.34              | .34               | 1.69 |
|               | 1.98 ÷ 1.11 =      |                   |      |
| Item 1        | -1.73              | 23.17             | .574 |
|               | 84.4               |                   |      |
| Item 2        | -1.08              | 26.18             | .733 |
|               | 73.7               |                   |      |
| Item 3        | -0.60              | 33.9              | .743 |
|               | 63.7               |                   |      |
| Item 4        | 0.05               | 50.84             | .535 |
|               | 48.9               |                   |      |

| Analyzing     | Before elimination | After elimination | 1.09 |
|---------------|--------------------|-------------------|------|
| 5             | 29.34              | .22               | 1.73 |
| 4             | 14.48              | .13               | 1.63 |
|               | 1.66 ÷ 0.96 =      |                   |      |
| Item 1        | -1.72              | 29.06             | .446 |
|               | 82.4               |                   |      |
| Item 2        | -0.87              | 39.31             | .287 |
|               | 68.3               |                   |      |
| Item 3        | 0.35               | 43.52             | .842 |
|               | 42.4               |                   |      |
| Item 4        | -0.42              | 45.15             | .228 |
|               | 59.2               |                   |      |
the CHLCC showed that scores ≥ 35.5 on the CHLCC had a sensitivity of 84% and a specificity of 66% for predicting adequate health literacy. Of the participants, 36% were considered to have adequate health literacy.
The findings of this study showed that the CHLCC meets or exceeds psychometric standards. The panel of experts and the patients with chronic illnesses agreed that the CHLCC exhibited high face and content validity. The first eigenvalue ratio of the remembering subscale was greater than 3, and only one eigenvalue was greater than 1 in the other three subscales. This finding supports the unidimensionality of each subscale, and the results of the bifactor confirmatory factor analysis indicated that there were four subscales (remembering, understanding, applying, and analyzing) within the CHLCC. Taken together, the items reflect the overall construct of health literacy related to chronic care in the Chinese population. This result implies that the four subscales measure the 4-level cognitive actions taken when the participants use health information and make decisions in the health context.

### Table 3. Results of validity and reliability of the CHLCC

| Discriminant validity                  | $M (SD)$ | Coefficient |
|---------------------------------------|----------|-------------|
| **Demographic**                       |          |             |
| Age                                   | $r = -0.31^{***}$ |             |
| Chinese literacy                      | 119.5 (71.8) | $r = 0.80^{***}$ |
| Sex                                   |          | $df = 156, t = 4.34^{***}$ |
| Male                                  | 33.8 (8.9) |             |
| Female                                | 28.1 (10.9) |             |
| **Education**                         |          |             |
| Grade 12 or higher                    | 40.0 (2.8) |             |
| Grade 7–11                            | 39.4 (6.9) |             |
| Grade 1–6                             | 33.5 (8.3) |             |
| No formal education                   | 21.9 (9.2) |             |
| **Reliability**                       |          |             |
| Overall scale                         | Cronbach’s $\alpha$ | 0.91 |
| **Subscale**                          |          |             |
| Remembering                           | 0.97     |             |
| Understanding                         | 0.60     |             |
| Applying                              | 0.49     |             |
| Analyzing                             | 0.45     |             |
| **Test–retest reliability**           | Intraclass correlation | 0.77** |
| Overall scale                         |          |             |
| Remembering                           | 0.90^{***} |             |
| Understanding                         | 0.66^{**} |             |
| Applying                              | 0.38     |             |
| Analyzing                             | 0.51*    |             |

*Note: Chinese literacy was measured by the PPCLS. Pearson’s correlation was used to assess the relationship between CHLCC and age, as well as CHLCC and PPCLS; Independent-samples $t$ test was used to assess the relationship between CHLCC and sex; analysis of variance was used to assess the relationship between CHLCC and education level. CHLCC = Chinese Health Literacy Scale for Chronic Care; PPCLS = Preschool and Primary Chinese Literacy Scale. $^{*}p < .05. ^{**}p < .01. ^{***}p < .001.$

### Discussion

The findings of this study showed that the CHLCC meets or exceeds psychometric standards. The panel of experts and the patients with chronic illnesses agreed that the CHLCC exhibited high face and content validity. The first eigenvalue ratio of the remembering subscale was greater than 3, and only one eigenvalue was greater than 1 in the other three subscales. This finding supports the unidimensionality of each subscale, and the results of the bifactor confirmatory factor analysis indicated that there were four subscales (remembering, understanding, applying, and analyzing) within the CHLCC. Taken together, the items reflect the overall construct of health literacy related to chronic care in the Chinese population. This result implies that the four subscales measure the 4-level cognitive actions taken when the participants use health information and make decisions in the health context.
The internal consistency coefficient and test–retest reliability coefficient indicated the good reliability and stability of the CHLCC. The correlations showed that the CHLCC had good discriminant validity. Respondents who were men, those who were younger, and those who had higher education levels also had significantly higher CHLCC scores than did their counterparts. The current findings were consistent with those of the previous literature (Baron-Epel et al., 2007; Ko et al., 2012; Rudd, 2007; Wu et al., 2010). The CHLCC was also significantly correlated with Chinese literacy. This finding is consistent with the results of studies conducted in the United States that examined the association between health literacy and general literacy (Baker, 2006; Nielsen-Bohlman et al., 2004). Such studies indicated that people with poor overall literacy had lower levels of health literacy.

The CHLCC was also associated with frequency of hospitalization. Patients with higher health literacy had less frequent occurrences of hospitalization. This finding echoes the findings presented in previous studies of the Caucasian population (Berkman, Sheridan, Donahue, Halpern, & Crotty, 2011; DeWalt, Berkman, Sheridan, Lohr, & Pignone, 2004). Thus, using this CHLCC, health care providers may be able to identify those who are more likely to require acute health services such as hospitalization. The cutoff point for the CHLCC was set at 35.5. Thus, those with scores equal to or lower than 35 may require help with chronic illness management. Our findings regarding the CHLCC have several implications for future research and practice related to health literacy. This instrument can be used to assess the health literacy of Chinese individuals in public health and clinical settings. Because most participants were able to complete the CHLCC within 7 minutes, it can serve as a quick assessment tool that will identify individuals with inadequate health literacy, thus alerting health care providers to the possibility that these patients may have difficulty with printed educational materials or information sheets.

As the prevalence of chronic illness in Chinese society has escalated, the time needed to care for these patients has become more demanding. Short scales such as the CHLCC will encourage the measurement of health literacy prior to any health educational intervention. The CHLCC could be used to assess levels of health literacy in population surveys. The information collected could be used to guide policy development and health promotion in the region. People from different ethnic groups interpret the variables included in health literacy instruments according to their social and cultural background (Shaw, Armin, Torres, Orzech, & James, 2012). It is worthwhile to study the use of health literacy scales across different ethnic groups.

The process of developing this health literacy scale, which involved the analysis of cognitive processes (remembering, understanding, applying and analyzing), provides insight for future research on health literacy. Further studies should explore the relationship between cognition and health literacy. Research questions might include how health information is processed; how long it takes us to understand and apply such information when we make health decisions; what factors can facilitate the processes of understanding, applying, and analyzing health information; and how we reach the stage in which we apply or analyze health information. The present research has not considered different domains within cognitive psychology (i.e., memory, attention, language use, perception) in addressing health information processing and health decision making (Schwab, 2008). To date, only a few studies (e.g., Freedman, Echt, Cooper, Miner, & Parker, 2012) have addressed this area of research.
This study has limitations, however. First, this study employed convenience sampling, which may have generated selection bias. Second, some of the health information used in the scale is context specific. To use the CHLCC in other regions of China, researchers may need to reexamine some items to ensure that they are suitable for these contexts. Third, the CHLCC did not take into account the evaluating and creating processes, which are the highest two cognitive levels noted in Bloom’s Taxonomy. However, although the present study is limited by the use of retrospective medical records on hospitalization, it provides a foundation on which further prospective work on the predictive validity of the CHLCC can be based. Prospective data on health outcomes in relation to health literacy should be used in future research.

In conclusion, the present study outlined the development and validation of the 24-item CHLCC. This newly developed instrument provides a user-friendly measure of health literacy in the Chinese population focusing on chronic illness management needs. This instrument has been developed in a timely manner to promote the link between health literacy and chronic illness management.

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