Abstract

Aims and Objectives: The aim of this study is to develop and test the psychometric properties of the Chinese Health Literacy Scale for Diabetes (CHLSD).

Background: Diabetic patients encounter many challenges when making health decisions in their daily lives, as they have access to many different kinds of health information. Health literacy issues are new topics in Chinese society. Without a valid and reliable instrument in Chinese, it is difficult to measure the level of health literacy and promote the concept of health literacy in Chinese societies.

Design: A methodological study with a sample of 137 type 2 diabetes patients aged 65 years or older.

Method: CHLSD was developed with reference to the revised Bloom's Taxonomy model. Psychometric tests (content validity, item analysis, construct validity, discriminative ability, and test-retest reliability) were conducted. Correlations between CHLSD and four relevant measures were tested. Cronbach's alpha and alpha if item deleted were calculated to assess internal consistency.

Results. Cronbach's α for CHLSD and its four subscales (remembering, understanding, applying, and analyzing) were 0.884, 0.885, 0.667, 0.654, and 0.717, respectively. The CHLSD was significantly correlated with the Diabetic Knowledge Scale ($r = 0.398$, $p < 0.001$), the Diabetic Management Self-Efficacy Scale ($r = 0.257$, $p < 0.001$), the Preschool and Primary Chinese Literacy Scale ($r = 0.822$, $p < 0.001$), and the Chinese Value of Learning Scale ($r = 0.303$, $p < 0.001$). It took an average of 7 minutes to complete this 34-item instrument.

Conclusion: The findings of this study support the CHLSD as a reliable and valid instrument for measuring the health literacy of Chinese diabetic patients.

Relevance to Clinical Practice: We recommend that clinicians use this tool to assess patients' health literacy before conducting any kind of health promotion.

Keywords: type 2 diabetes, scale development, health promotion, validity, psychometric properties

Introduction

In the field of nursing and health care, there is an increasing emphasis on health literacy, which is defined as an individual's ability "to access, understand, evaluate and communicate information as a way to promote, maintain and improve health in a variety of settings across the life-course" (Rootman & Gordon-El-Bihbety 2008, p. 11). Health literacy is different from general literacy, which is usually developed through formal education and describes how individuals communicate through particular language and mathematic calculation. Individuals with adequate literacy or those who are highly educated may not necessarily be able to interpret health information and make appropriate health-related decisions with the available health information (Nielsen-Bohlman *et al.* 2004, Paton & Newcastle-under-Lyme 2009). Navigating in health care system demands other skills beyond simple communication and mathematic calculation (McCray 2005).

Adults with inadequate or marginal health literacy have difficulty understanding the health care information they receive and eventually may have difficulty following physician prescriptions and implementing self-care (McMurray *et al.* 2007, Cho *et al.* 2008, Cutilli & Schaefer 2011). Evidence has shown that inadequate health literacy is associated with negative health outcomes such as poor physical and mental health (Wolf *et al.* 2005), higher hospitalization rates (Baker *et al.* 2002), less use of flu vaccination (Scott *et al.* 2002, Miller 2004), physical inactivity, lower subjective health, higher levels of pain (Kim 2009), and even higher mortality (Sudore *et al.* 2006, Baker *et al.* 2007).

Among diabetic patients, there is a significant negative correlation between health literacy and the glycemic control (HbA1c) ($r = -.32$, $p < .001$) (Tang *et al.* 2008). Health literacy

is one of the significant predictors of HbA1c reduction: If a patient's health literacy score increases by one unit, a 0.12 unit reduction in the patient's HbA1c level is expected (Tang *et al.* 2008). A similar pattern was observed by Schillinger *et al.* (2002); patients with inadequate health literacy were more likely than their counterparts to report retinopathy. When individuals with inadequate health literacy receive health care, they are more likely to have difficulty reading prescription bottles and appointment slips, following self-care instructions such as blood glucose monitoring, and understanding the information in health education brochures. Therefore, it is important for health professionals to identify individuals with inadequate health literacy and provide special instructions to help them better manage their chronic diabetes (Tang *et al.* 2008).

Patients' health literacy cannot be judged from appearance or impression (Nath *et al.* 2001). On many occasions, patients with health literacy problems feel embarrassed and do not express their confusion to health care providers, friends, or even close relatives. Little is known about the prevalence of health literacy inadequacy in the Chinese population or any relevant actions taken to assist Chinese individuals with inadequate health literacy in chronic care.

Overview of Existing Health Literacy Measurement Instruments

A recent critical appraisal of health literacy instruments (Jordan *et al.* 2011) evaluated 19 instruments and determined that none appeared to fully measure the ability of an individual to seek, understand, and use health information. Additionally, the content of these instruments mostly focused on reading comprehension and numeracy. The most commonly used instruments for assessing health literacy among adults in English-speaking populations are the Test of Functional Health Literary in Adults (TOFHLA) and the Rapid Estimate of Adult Literacy in Medicine. Unfortunately, they are not designed specifically for diabetic patients, who frequently need to understand diabetes-related concepts (such as hypoglycemia) or indicators (such as blood

glucose levels). A Chinese version of TOFHLA was developed, but this scale does not reflect the essential communication and health decision-making skills required by diabetic patients.

Currently, the only available instrument that is specifically designed for diabetes is the 60-item Literacy Assessment for Diabetes (Nath *et al.* 2001). Patients are asked to read words related to diabetes care, allowing the assessor to check their ability to read the words correctly. This instrument is limited to measuring the respondents' word recognition, as does not determine whether they understand the meaning of these diabetes-related words and can apply the relevant concepts in daily self-care.

Therefore, there is no specific instrument that measures an individual's ability to recognize diabetes-related words, understand the relevant concepts, and apply these concepts in health decision making. There is also no instrument that can be used in Chinese society for this patient group.

The aim of this study was to develop a diabetes-specific health literacy scale, the Chinese Health Literacy Scale for Diabetes (CHLSD), and test its psychometric properties.

Framework for the Development of CHLSD

The CHLSD was developed with reference to the revised Bloom's Taxonomy model (Anderson & Krathwohl 2001). Bloom and colleagues (1956) originally created this taxonomy to explain the classification of different levels of learning that commonly occur in educational settings and the changes in cognitive processes during the learning process. Anderson and Krathwohl (2001) made some minor but significant modifications and developed six categories of cognitive processes: remembering, understanding, applying, analyzing, evaluating and creating. Individuals are usually trained in knowledge input (remembering), understanding the meaning of the instructional messages (understanding), and executing the procedure in a given

situation (applying) (Anderson & Krathwohl 2001). Cognitive processes are needed when making health-related decisions (Feldman-Stewart *et al.* 2004). Therefore, this framework was adopted to guide the development of the CHLSD.

Methods

Instrument Development

The CHLSD was designed to measure the health literacy of diabetic patients in terms of decision making on four cognitive levels: remembering, understanding, applying, and analyzing. In the initial stage, the research team met with one diabetes nurse and one doctor whose main duties were health education and medical consultation for diabetic patients in an attempt to identify some frequent issues in diabetes care. The research team gathered commonly used drug labels, appointment sheets, information sheets, and health educational leaflets from two public primary care clinics for diabetes. More than 160,000 patients received treatment in these public clinics in 2009 (Wong *et al.* 2012).

The "remembering" subscale measures an individual's ability to read aloud commonly used terms frequently seen in printed educational leaflets or information sheets in diabetic management. A total of 120 terms were chosen from health educational leaflets and information sheets given to diabetic patients. Five experts (a nurse consultant in diabetes, a health educator, two family physicians, and a social worker) were invited to screen out the most commonly used terms using the Delphi technique (Sinha *et al.* 2011). The experts were asked to rate all 120 terms, with 5 being the most relevant to diabetes care and 1 being the least relevant. Terms rated 4 or 5 were included in the second round of rating. The experts then rated the terms again and decided which were used more frequently in their daily practice. They were asked to use the same scale to rate the terms. Following the second round, 84 terms had a score of 4 or 5. In the

final round of rating, the experts were encouraged to rate the terms again and were reminded to identify terms that best represent their usual practice in communication with patients. Scores given to each term were summed. The 60 terms with the highest scores were selected for use in the remembering subscale. The elected terms were arranged according to length, with 1-word terms placed first, followed by 2-word, 3-word, 4-word, and 5-word terms. In Chinese, terms with more words are more complex. Complex terms are not usually interpreted by splitting the term into different parts, such as the prefix or suffix in English. In fact, Chinese terms are interpreted by their visual design or the sound produced when reading the words. Participants were asked to read each word aloud to the trained research assistant. Two points were given for each term that was read correctly, one point was given for each term that was read correctly with hesitation, and zero points were given for terms that were not read correctly. Higher scores represented higher cognitive remembering skills.

The other three subscales (understanding, applying, and analyzing) were developed based on situations in day-to-day diabetes care in which patients need to make decisions. These situations included administration of oral drugs (diabetes drugs and antibiotics), insulin injection, blood glucose monitoring, instructions about medical follow-up or preparation for X-ray with contrast, and Social Security regulations. A total of 20 questions were included in these three subscales: 7 questions for understanding, 7 questions for applying, and 6 questions for analyzing. Some questions were composed based on TOFHLA (Parker *et al.* 1995) but with an emphasis on usual practices in communication in Chinese populations. The draft questions were reviewed and rated by the five experts. They were asked to consider whether the chosen labels and questions represented actual situations encountered by diabetic patients in Hong Kong and whether they

were clearly stated (content validity). These labels and questions were subsequently refined and became the subscales of understanding, applying, and "analyzing.

Design and Participants

The study utilized a methodological design with convenience sampling. A total of 137 subjects were recruited from five elderly community centers in Hong Kong from April 2009 to March 2010. Included were Chinese persons with type 2 diabetes mellitus who were aged 65 or older, cognitively intact (scoring 8 or above on the Short Portable Mental Screening Questionnaire), and able to communicate in Cantonese.

Power Calculation

Generally speaking, a Cronbach's alpha of 0.70 or higher indicates a reliable scale. Assuming the Cronbach's alpha of the proposed scale (CHLSD) was 0.80, the effect size was estimated to be 0.26 (van Zyl *et al.* 2000). With this effect size, the alpha level at 0.05, and power at 0.8, the calculated sample size was 109 (Lenth 2006). An additional 28 participants were added for an assumed attrition rate of 26%, creating a minimal number of 137 participants. **The above sample size calculation was consistent with the recommendation for validating a 34-item instrument, that is, at least 4 participants per item (Hinkin, 1995). Thus a minimum of 136 (= 4 x 34) participants were needed in the current study.**

A total of 194 older adults were approached. After screening tests, 165 were eligible and 152 agreed to participate in the study. The first 15 participants were invited to join the pilot study, which aimed to refine the questionnaire, assess the time needed to complete the CHLSD, and assess the clarity of the draft questionnaire. A total of 137 participants were included in the main study. Using convenience sampling, 30 subjects were invited to complete the questionnaire a second time, 21 days later; only 26 participants agreed to do so (Figure 1).

[Please insert Figure 1 about here]

Other Measures

We also tested the correlations between CHLSD and four other measures: the 15-item Diabetes Knowledge Scale (DKS) (Chan & Molassiotis 1999), the 20-item Diabetes Management Self-Efficacy Scale (DMSES-20) (Wu *et al.* 2008), the Preschool and Primary Chinese Literacy Scale (PPCLS) (Li 1999), and the 5-item Chinese Value of Learning Scale (CVLS) (Leung *et al.* 2006). The first two measures are validated scales that assess knowledge of diabetes and ability and self-confidence in diabetes management. The latter two measures are related to Chinese cultural characteristics, with PPCLS measuring ability to read and understand Chinese characters up to the junior level in primary school (i.e., grade 4 in the U.S. education system) and CVLS measuring how Chinese adults value learning (i.e., whether they are willing to continue learning as they age).

The DKS was translated into Chinese with good internal consistency (Cronbach's alpha = 0.83) and good test-retest reliability ($r = 0.64$, $p < 0.001$) during a period of 3 months in the Chinese population (Lee & Shiu 2004).

The DMSES-20 had good internal consistency (Cronbach's alpha = .77-.93) and good test-retest reliability ($r = 0.86$, $p < 0.01$) during a period of 2 weeks in the Chinese population (Wu *et al.* 2008).

PPCLS had good internal consistency (Cronbach's alpha = 0.85) and good test-retest reliability ($r = 0.82$, $p < 0.001$) during a period of 2 weeks in the Chinese population (Li 2006).

The CVLS was developed and validated among Chinese adults aged 45-64 years in Hong Kong (Leung *et al.* 2006). It has excellent internal consistency (Cronbach's alpha = 0.94) and

reasonable test-retest reliability (Intraclass correlation = 0.51, $p = 0.03$) during 1 week (Leung *et al.* 2006).

Ethical Considerations

Ethical approval was obtained from the Institutional Review Board (IRB) of the University/Hospital Authority of Hong Kong.

Data Analysis

Several psychometric properties of CHLSD were assessed, including item analysis, construct validity, discriminative ability, test-retest reliability, and correlation with four other relevant measures. Item analysis was performed to screen out items that had low corrected-item-total correlation coefficients. Cronbach's alpha was used to assess the internal consistency of each subscale and CHLSD. Items that all subjects answered correctly were dropped. The Cronbach's alpha of each subscale was subsequently recalculated. We observed the alpha if item deleted (AIID) of each item and compared it with the Cronbach's alpha of the subscale. This AIID represented the overall reliability coefficient for internal consistency of the subscale if an individual item was removed from the subscale. If the AIID was greater than the overall alpha of the corresponding subscale, we dropped the item and recalculated the Cronbach's alpha. The procedure was repeated until no item could be dropped (i.e., all AIID values were smaller than the overall alpha of the subscale). Confirmatory factor analysis was conducted to assess the number of subscales in the CHLSD. Pearson correlations were calculated to test the relationships between CHLSD and PCLLS, DKS, DMSS, and CVLS. Pearson correlation was calculated to test the reliability of the scale during a period of 2 weeks (that is, test-retest reliability).

Procedures

Social workers who worked in elderly community centers assisted with subject recruitment by identifying potential participants who were willing to participate in the study. Potential participants were invited to meet the trained research assistant in at the centers, at which point the assistant explained the purpose and procedures and screened for eligibility. Those who met all the inclusion criteria were recruited. All participants provided written informed consent.

Pilot study. Before the implementation of the main study, the draft CHLSD was pilot-tested with three older adults with the same eligibility criteria as those participated in the main study. In the cognitive interviews, these participants were asked to indicate their understanding of the wording of the draft scale. The trained assistant recorded their responses and clarified issues with the participants when necessary. Comments or queries about the wording of the scale were incorporated in the final draft of the scale. Four questions were refined and the labels were enlarged after the pilot test. The main study was carried out from April 2009 to March 2010. Each participant was requested to read the terms in the remembering subscale and answer the questions in the three other subscales. Upon completion of the interview, each participant received a cash coupon of HK$10 (US$1.3) **as an incentive. Monetary incentive could improve the rate of response to a research study (Malin, Rideout, & Ganz, 2000).**

Results

A total of 137 older adults participated in the main study; half were male. The mean age of the participants was 72.3 years (*SD* = 5.4). About 40% completed primary school (grade 6) and one third of the participants completed secondary school (grade 11). The majority (77%) were living with their family (Table 1).

[Please insert Table 1 about here]

Construct Validity

There were 80 items total (60 items in the remembering subscale, 7 in the understanding subscale, 7 in the applying subscale, and 6 in the analyzing subscale) in the originally designed CHLSD (Model 1). After eliminating the 12 items that were answered correctly by all subjects in the remembering subscale, the Cronbach's alpha was 0.852 (Model 2). Another 30 items were eliminated and the alpha increased to 0.885; therefore, the final remembering subscale consisted of 18 items (Model 3). In the understanding subscale, no item was dropped and its Cronbach's alpha was 0.667. In the applying and analyzing subscales, two items were eliminated. The Cronbach's alpha of the applying subscale increased from 0.569 to 0.654 and the alpha of the analyzing subscale increased from 0.640 to 0.717 following these eliminations. The Cronbach's alpha of the final CHLSD scale with 34 items was 0.884 (Table 2). Confirmatory factor analysis, which was carried out after item elimination, yielded a model with RMSEA = 0.008 and CFI = 0.997, indicating the presence of the four subscales in the CHLSD. Table 3 shows the factor loading of the four subscales of CHLSD.

[Please insert Table 2 and Table 3 about here]

We assessed the discriminative ability of CHLSD by reviewing its relationship with age and educational level. CHLSD scores were compared among subjects with different educational levels: no education (M = 35.5, SD = 10.8), primary school (M = 42.9, SD = 6.7), secondary school (M = 47.5, SD = 3.8), and graduation from secondary school or above (M = 48.5, SD = 2.8) (F = 18.796, $p < 0.001$). We also calculated the correlation between CHLSD and age (r = -0.261, p = 0.002).

The remembering subscale was significantly correlated with understanding (r = 0.811, $p < 0.001$), applying (r = -0.459, $p < 0.001$), and analyzing (r = 0.320, $p < 0.05$). Understanding

was significantly correlated with applying ($r = 0.778$, $p < 0.001$) and analyzing ($r = 0.553$, $p < 0.001$), whereas applying was significantly correlated with analyzing ($r = 0.387$, $p < 0.001$).

Correlation with Four Relevant Measures

The CHLSD showed significant positive correlation with the DKS ($r = 0.398$, $p < 0.001$) and the DMSS ($r = 0.257$, $p < 0.001$). It also showed strong correlation with the PPCLS ($r = 0.822$, $p < 0.001$) and mild correlation with the CVLS ($r = 0.303$, $p < 0.001$) (Table 4).

The remembering subscale showed strong correlation with PPCLS ($r = 0.877$, $p < 0.001$) and mild correlation with DKS, DMSS, and CVLS ($r = 0.265$, 0.250, and 0.213, respectively; $p < 0.05$). The understanding subscale showed moderate correlation with PPCLS ($r = 0.502$, $p < 0.001$) and mild correlation with DKS ($r = 0.393$, $p < 0.001$), DMSS ($r = 0.260$, $p < 0.01$), and CVLS ($r = 0.270$, $p < 0.01$). The applying subscale showed mild correlation with DKS ($r = 0.381$, $p < 0.001$), PPCLS ($r = 0.263$, $p < 0.05$), and CVLS ($r = 0.237$, $p < 0.05$). The analyzing subscale also showed mild correlation with DKS, PPCLS, and CVLS ($r = 0.199$, 0.255, and 0.206, respectively; $p < 0.05$) (Table 4).

[Please insert Table 4 about here]

Test-Retest Reliability

The test-retest reliability of CHLSD during a 2-week period was good ($r = 0.898$, $p < 0.001$). Because only one trained research assistant was involved in data collection, inter-rater reliability was not a concern and not measured.

Discussion and Conclusion

CHLSD is the first health literacy scale developed according to the revised Bloom's Taxonomy model (Anderson & Krathwohl 2001), a theoretical framework outlining the cognitive process in learning. This model has been adapted and applied to some health literacy

studies (e.g., Garde *et al.* 2007, Chan & Kaufman 2011). This taxonomy model represents not only the complexity of health-related Internet navigation but also day-to-day health communication during medical consultations and self-care. Health literacy is defined as one's ability to access, understand, evaluate, and communicate health information (Rootman & Gordon-El-Bihbety 2008), and this undoubtedly relates to the cognitive process in which an individual continues to seek health information, tries to understand the information, and eventually applies such information in communication or analyzes the information when making health decisions. Using Bloom's taxonomy to guide the development of health literacy scale provided a deeper understanding of different domains in health literacy. As Jordan *et al.* (2011) noted, the existing health literacy instruments did not measure and reflect broader constructs such as the capacity to process and retain information and the application of such information to an individual's lifestyle. This newly developed instrument, the CHLSD, fills this gap and provides a reliable measure for health literacy in the Chinese context.

The development of the CHLSD addressed the first four levels of cognition as described in Bloom's taxonomy. Not all individuals are able to move on to higher level of cognition, i.e., evaluating and creating. The evaluating process refers to making judgments based on criteria and standards, whereas creating refers to putting all essential elements together to form a new pattern or structure (Anderson & Krathwohl 2001, Chan & Kaufman 2011). It was believed that trained professionals were more capable of evaluating and creating than laymen because professionals had a stronger understanding of standards and were in a better position to create new structures or patterns.

The findings of this study provided support for the reliability and validity of the CHLSD. The test-retest reliability coefficient of the CHLSD supported its good reliability. Content

validity was established by the expert panel, whose members agreed that the CHLSD reflected the usual phenomenon in clinical practices and commonly used terms in diabetes care. All participants noted the understandability of the scale and agreed the CHLSD was of acceptable face validity. Item analyses and confirmatory factor analysis showed that CHLSD is a multidimensional, four-factor scale with 34 items. The internal consistency of the CHLSD and its subscales was good, as their coefficient alphas were all in the recommended acceptable range (Hays & Revicki 2005, Jordan *et al.* 2011).

On the other hand, CHLSD and its subscales had positive correlations with the PCLLS, indicating the latter scale is an acceptable measure for assessing the ability of adults to read and use Chinese words at the primary 3 level in the Hong Kong education system (i.e, grade 4 in the U.S. system). The words included in the CHLSD are commonly used terms in diabetes care or clinical communications. Thus, having the basic literacy in the Chinese language is essential. The CHLSD and its subscales were also found to be positively correlated with the Chinese Value of Learning Scale, demonstrating that cultural norm within Chinese society (that is, the philosophy of continuous learning throughout the lifespan) is considered. The concept of lifelong learning is important in chronic illness care management, as diabetic patients continue to encounter challenges in lifestyle modification and drug modification (Williams & Lopez 2005).

The CHLSD and its subscales were positively correlated with patients' self-efficacy in diabetes management and knowledge of diabetes. Recent studies showed that diabetes knowledge and self-efficacy are related to health literacy (Cavanaugh 2011, Fransen *et al.* 2011). This demonstrates that the CHLSD has good correlations with these four diabetes-related and Chinese culture-oriented measures.

Limitations

The current study has five limitations. First, the sample used in the current study was from one region (Hong Kong Special Administrative Region) in China, in which most residents speak Cantonese as their native language. It is important to investigate the psychometric properties of this scale in other Chinese cities and among Putonghua-speaking populations. Second, some labels and questions used in the subscales are specific to situations in Hong Kong. Caution should be used when utilizing this scale in other regions. Third, results of confirmatory analysis should be interpreted with caution due to small sample size. Larger samples in future studies are recommended. Fourth, convenience sampling was used in the current study and the results cannot be generalized to the entire Chinese population. Lastly, advanced levels of cognition (that is, evaluating and creating) were not included in this health literacy scale. These two levels of cognition may demand more information, better understanding of the health care context, and detailed observation of the performance of the subjects. Other studies in health literacy scale development may consider the inclusion of these measures.

Relevance to Clinical Practice

Our data provide evidence for the validity and reliability of the CHLSD as a useful and practical tool in diabetes care. Health professionals could use this scale to assess patients' ability to adopt diabetes-related health information in their self-care in a reasonable timeframe (about 17 minutes) prior to health education and/or medical consultation. With a better understanding of their patients' health literacy, health professionals could tailor appropriate interventions to facilitate self–care among diabetic patients.

References

Anderson LW & Krathwohl DR (eds.) (2001) *A taxonomy for learning, teaching, and assessing: A revision of Bloom's Taxonomy of Educational Objectives*. Longman, New York.

Baker DW, Gazmararian JA, Williams MV, Scott T, Parker RM, Green D, Ren J & Peel J (2002) Functional health literacy and the risk of hospital admission among Medicare managed care enrollees. *American Journal of Public Health* **92**, 1278-1283. doi:10.2105/AJPH.92.8.1278

Baker DW, Wolf MS, Feinglass J, Thompson JA, Gazmararian JA & Huang J (2007) Health literacy and mortality among elderly persons. *Archives of Internal Medicine* **167**, 1503-1509.

Bloom BS, Engelhart MD, Furst EJ, Hill WH & Krathwohl DR (1956) *Taxonomy of educational objectives: the classification of educational goals; Handbook I: Cognitive Domain*. Longmans, New York.

Cavanaugh KL (2011) Health literacy in diabetes care: explanation, evidence and equipment. *Diabetes Management* **1**, 191-199. doi:10.2217/dmt.11.5

Chan CV & Kaufman DR (2011) A framework for characterizing eHealth literacy demands and barriers. *Journal of Medical Internet Research* **13**, e94. doi:10.2196/jmir.1750

Chan Y & Molassiotis A (1999) The relationship between diabetes knowledge and compliance among Chinese with non-insulin dependent diabetes mellitus in Hong Kong. *Journal of Advanced Nursing* **30**, 431-438.

Cho YI, Lee SYD, Arozullah AM & Crittenden KS (2008) Effects of health literacy on health status and health service utilization amongst the elderly. *Social Science & Medicine* **66**, 1809-1816. doi:10.1016/j.socscimed.2008.01.003

Cutilli CC & Schaefer CT (2011) Case studies in geriatric health literacy. *Orthopaedic Nursing* **30**, 281-285. doi:10.1097/NOR.0b013e318227e24d

Feldman-Stewart D, Brundage MD, Van Manen L & Svenson O (2004) Patient-focussed decision-making in early-stage prostate cancer: insights from a cognitively based decision aid. *Health Expectations* **7**, 126-141. doi:10.1111/j.1369-7625.2004.00271.x

Fransen MP, von Wagner C & Essink-Bot ML (2011) Diabetes self-management in patients with low health literacy: ordering findings from literature in a health literacy framework. *Patient Education and Counseling*. Advance online publication. doi:10.1016/j.pec.2011.11.015

Garde S, Heid J, Haag M, Bauch M, Weires T & Leven FJ (2007) Can design principles of traditional learning theories be fulfilled by computer-based training systems in medicine: the example of CAMPUS. *International Journal of Medical Informatics* **76**, 124-129. doi:10.1016/j.ijmedinf.2006.07.009

Hays R & Revicki D (2005) Reliability and validity (including responsiveness). In *Assessing Quality of Life in Clinical Trials* (2nd edn., Fayers P & Hays RD eds.), Oxford University Press, Oxford, pp. 25-39.

Hinkin TR (1995) A review of scale development practices in the study of organizations. *Journal of Management* 21, 967-988.

Jordan JE, Osborne RH & Buchbinder R (2011) Critical appraisal of health literacy indices revealed variable underlying constructs, narrow content and psychometric weaknesses. *Journal of Clinical Epidemiology* ***64***, 366-379. doi: S0895-4356(10)00143-5 [pii] 10.1016/j.jclinepi.2010.04.005

Kim SH (2009) Health literacy and functional health status in Korean older adults. *Journal of Clinical Nursing* **18**, 2337-2343. doi:10.1111/j.1365-2702.2008.02739.x

Lee CSL & Shiu ATY (2004) Perceived health care climate, diabetes knowledge and self-care practice of Hong Kong Chinese older patients: a pilot study. *Journal of Clinical Nursing* **13**, 534-535. doi:10.1046/j.1365-2702.2003.00892.x

Leung A, Chi I, Chow N, Chan KS & Chou KL (2006) Construction and validation of Chinese Value of Learning Scale (CVLS). *Educational Gerontology* **32**, 907-920. doi:10.1080/03601270600846675

Lenth RV (2011) Java applets for power and sample size. Available at: http://www.stat.uiowa.edu/~rlenth/Power/ (accessed 1 July 2012).

Li H (1999) Development and validation of the preschool and primary Chinese literacy scale. Poster presented at the Society for Research in Child Development Conference, Albuquerque, NM, USA.

Li H (2006) Development and validation of the preschool and primary Chinese literacy scale. In *Measurement and Assessment in Educational and Social Research* (Kozuh B ed.), pp. 18-24.

McCray AT (2005) Promoting health literacy. *Journal of the American Medical Informatics Association* **12**, 152-163. doi:10.1197/jamia.M1687

McMurray A, Johnson P, Wallis M, Patterson E & Griffiths S (2007) General surgical patients' perspectives of the adequacy and appropriateness of discharge planning to facilitate health decision-making at home. *Journal of Clinical Nursing* **16**, 1602-1609. doi:10.1111/j.1365-2702.2006.01725.x

Miller MJ (2004) The relationship between a synthetic estimate of functional health literacy and preventive health care use in a national sample of elderly (Doctoral dissertation, University of Pittsburgh, 2004). Available at: http://etd.library.pitt.edu/ETD/available/etd-12022004-001521/ (accessed 6 July 2006).

Malin JL, Rideout J, Ganz PA (2000) Tracking managed care: the importance of a cash incentive for medical director response to a survey. *The American Journal of Managed Care* 6, 1209-14.

Nath CR, Sylvester ST, Yasek V & Gunel E (2001) Development and validation of a literacy assessment tool for persons with diabetes. *Diabetes Educator* **27**, 857-864. doi:10.1177/014572170102700611

Nielsen-Bohlman L, Panzer AM & Kindig DA (eds.) (2004) *Health Literacy: A Prescription to End the Confusion*. National Academies Press, Washington, DC.

Parker RM, Baker DW, Williams MV & Nurss JR (1995) The test of functional health literacy in adults: a new instrument for measuring patients' literacy skills. *Journal of General Internal Medicine* **10**, 537-541. doi:10.1007/BF02640361

Paton C & Newcastle-under-Lyme U (2009) Health policy: overview. In *Health Systems Policy, Finance and Organization* (Carrin G ed.), Academic Press, Oxford, pp. 3-16.

Rootman I & Gordon-El-Bihbety D (2008) *A Vision for a Health Literate Canada: Report of the Expert Panel on Health Literacy*. Canadian Public Health Association, Ottawa.

Schillinger D, Grumbach K, Piette J, Wang F, Osmond D, Daher C, Palacios J, Sullivan GD & Bindman AB (2002) Association of health literacy with diabetes outcomes. *Journal of American Medical Association* **288**, 475-482. doi:10.1001/jama.288.4.475

Scott TL, Gazmararian JA, Williams MV & Baker DW (2002) Health literacy and preventive health care use among Medicare enrollees in a managed care organization. *Medical Care* **40**, 395-404.

Sinha IP, Smyth RL & Williamson PR (2011) Using the Delphi technique to determine which outcomes to measure in clinical trials: recommendations for the future based on a systematic review of existing studies. *PLoS Medicine* **8**, e1000393. doi:10.1371/journal.pmed.1000393

Sudore RL, Mehta KM, Simonsick EM, Harris TB, Newman AB, Satterfield S, Rosano C, Rooks RN, Rubin SM, Ayonayon HN & Yaffe K (2006). Limited literacy in older people and disparities in health and healthcare access. *Journal of American Geriatrics Society* **54**, 770-776. doi:10.1111/j.1532-5415.2006.00691.x

Tang YH, Pang SMC, Chan MF, Yeung GSP & Yeung VTF (2008) Health literacy, complication awareness, and diabetic control in patients with type 2 diabetes mellitus. *Journal of Advanced Nursing* **62**, 74-83. doi:10.1111/j.1365-2648.2007.04526.x

van Zyl JM, Neudecker H & Nel DG. (2000) On the distribution of the maximum likelihood estimator of Cronbach's alpha. *Psychometrika* **65**, 271-280. doi:10.1007/BF02296146

Williams BR & Lopez S (2005) Reaching the homebound elderly: the Prescription Intervention and Lifelong Learning (PILL) program. *Home Health Care Services Quarterly* **24**, 61-72. doi:10.1300/J027v24n01_05

Wolf MS, Gazmararian JA & Baker DW (2005) Health literacy and functional health status among older adults. *Archives of Internal Medicine* **165**, 1946-1952.

Wong KW, Ho SY & Chao DVK (2012) Quality of diabetes care in public primary care clinics in Hong Kong. *Family Practice* **29**, 196-202. doi:10.1093/fampra/cmr060

Wu SFV, Courtney M, Edwards H, McDowell J, Shortridge-Baggett LM & Chang PJ (2008) Development and validation of the Chinese version of the Diabetes Management Self-efficacy Scale. *International Journal of Nursing Studies* **45**, 534-542. doi: S0020-7489(06)00262-8 [pii] 10.1016/j.ijnurstu.2006.08.020

Figure 1. Participant recruitment of the CHLSD study

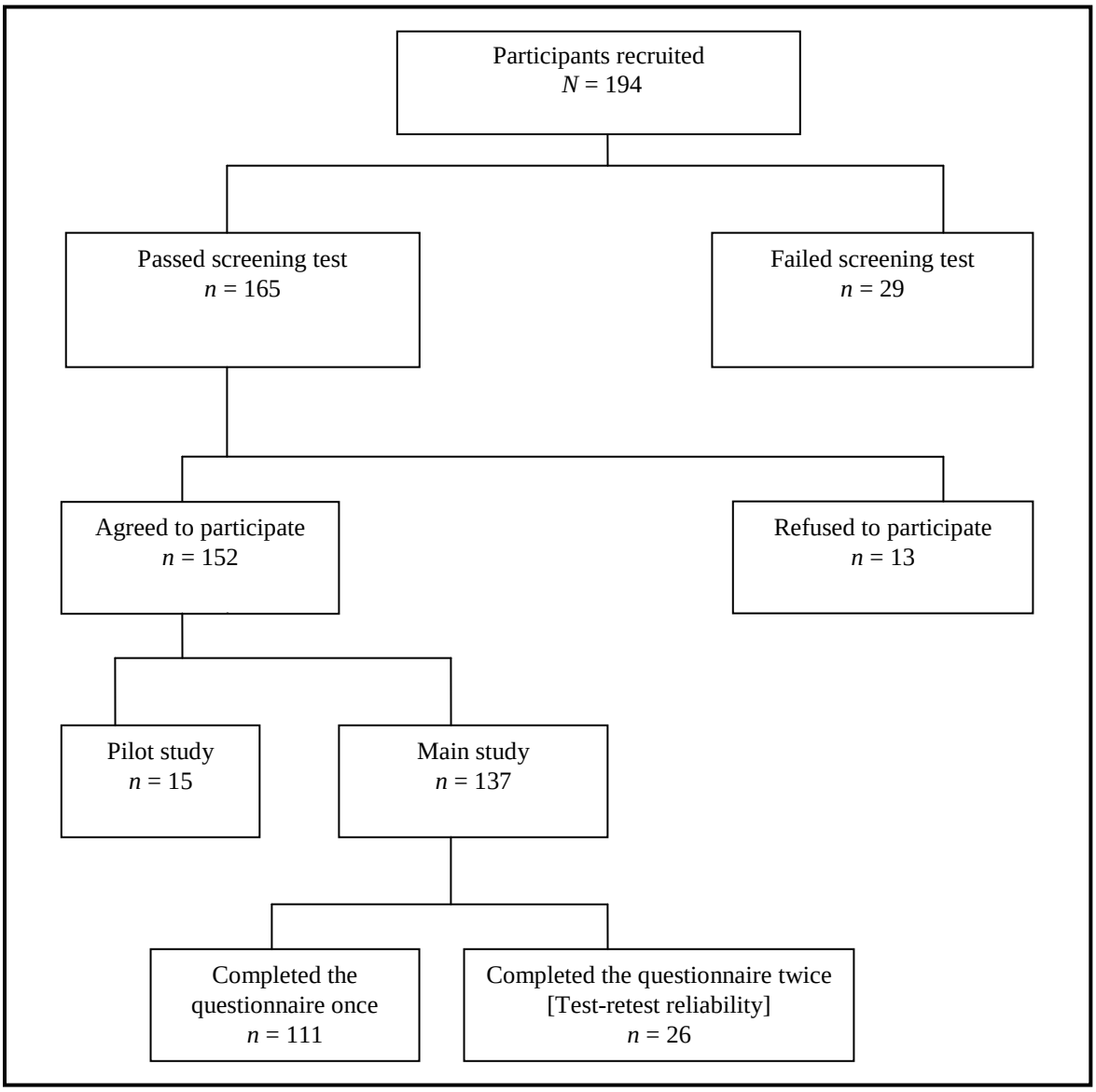

Table 1. Demographics of participants

Variable	***N* (%)**
Gender	
Male	69 (50.4)
Female	68 (49.6)
Age	
65-69	49 (35.8)
70-74	37 (27.0)
75-79	23 (16.8)
80-84	15 (10.9)
>85	13 (9.5)
Education	
None	11 (8.0)
Grade 1-6	54 (39.4)
Grade 7-11	46 (33.6)
Grade 12+	26 (19.0)
Living Status	
Living with family	106 (77.4)
Living alone	31 (22.6)

Table 2. Item analysis of the CHLSD and its subscales

Scale	Model 1		Model 2		Model 3	
	Items (*n*)	**α**	**Items (*n*)**	**α**	**Items (*n*)**	**α**
CHLSD	80		64		34	0.884
Remembering	60	0.849	48	0.852	18	0.885
Understanding	7	0.667	7	0.667	7	0.667
Applying	7	0.569	5	0.654	5	0.654
Analyzing	6	0.640	4	0.717	4	0.717

Table 3. Factor loading of the CHLSD subscales

Item	Remembering	Understanding	Applying	Analyzing
1	0.911			
2	0.993			
3	0.925			
4	0.883			
5	0.822			
6	0.934			
7	0.871			
8	0.823			
9	0.903			
10	0.850			
11	0.906			
12	0.828			
13	0.828			
14	0.952			
15	0.762			
16	0.710			
17	0.930			
18	0.898			
19		0.560		
20		0.535		
21		0.550		
22		0.713		
23		0.740		
24		0.822		
25		0.678		
26			0.519	
27			0.574	
28			1.023	
29			0.853	
30			0.730	
31				0.761
32				0.753
33				1.046
34				0.922

Table 4. Pearson correlations of the CHLSD and its subscales with other measures

	DKS	DMSS	PPCLS	CVLS
CHLSD	0.398***	0.257***	0.822***	0.303***
Remembering	0.265**	0.250**	0.877***	0.213*
Understanding	0.393***	0.260**	0.502***	0.270**
Applying	0.381***	0.041	0.263**	0.237**
Analyzing	0.199*	0.077	0.255**	0.206*

Note. DKS = Diabetes Knowledge Scale, DMSS = Diabetes Management Self-Efficacy Scale, PPCLS = Preschool and Primary Chinese Literacy Scale, CLVS = Chinese Value of Learning Scale.

*$p < .05$

**$p < .01$

***$p < .001$