Development and validation of a general health literacy test in Singapore

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SUMMARY

Due to the concern of equating correct pronunciation with comprehension and the differences in health care systems, existing health literacy (HL) instruments may not be appropriate for or applicable to English-speaking countries other than the USA. The purpose of this study was to develop and validate the Health Literacy Test for Singapore (HLTS), which is an adapted version of the Short-Test of Functional Health Literacy in Adults. Three hundred and two patients were interviewed and administered the HLTS, the Newest Vital Sign (NVS), a demographic questionnaire, and a knowledge test of chronic diseases. The convergent validity of HLTS was determined by examining the association between HLTS and NVS HL levels, whereas predictive validity was tested by examining the difference in knowledge of chronic conditions between the two HLTS HL (i.e. adequate and inadequate HL) groups. Bivariate correlation of HLTS HL levels with age and education was assessed to test a priori hypotheses that patients with inadequate HL were older and less educated. The results showed that HLTS displayed good internal reliability (Cronbach’s alpha = 0.87). The correlation between HLTS and NVS was moderate (γ = 0.55; P = 0.005) and individuals with inadequate HL were older (P = 0.002) and less educated (P = 0.007). In addition, patients with adequate HL had a higher mean score on the chronic disease knowledge test (P = 0.036). In conclusion, the HLTS is a valid and reliable measure for assessing Singaporeans ability to read and comprehend health-related materials written in English.

Key words: health literacy; instrument validation; STOFLHA; Singapore

INTRODUCTION

The concept of health literacy (HL) has emerged from two different sources: clinical care as a clinical risk and public health as a personal asset (Nutbeam, 2008). The asset model covers broad notions of HL that include the necessary skills and capacities to make critical decisions about health, and the model is applicable to everyday life (Nutbeam, 2008; Peerson and Saunders, 2009). In contrast, the risk model, which is more established and studied, focuses on the knowledge and skills relating primarily to health care settings (Nutbeam, 2008; Peerson and Saunders, 2009). The latter model begins with assessment of HL using a screening tool, and the ultimate goal is to improve clinical outcomes (Nutbeam, 2008).

In the context of clinical care, HL can be defined as a constellation of skills that constitute the ability to perform basic reading and numerical tasks for functioning in the health care...
environment and acting on health care information (American Medical Association, 1999). In the past few decades, the prevalence of low HL and its adverse influence on health outcomes have become an important public health concern. Previous research has indicated that inadequate HL is associated with poorer knowledge about diseases and health services, increased risk of hospital admission and poorer health status (Dewalt et al., 2004). In Singapore, English is the working language and one of the four official languages, and health-related materials are primarily written in English, though communication in other languages is occasionally provided. Until now, little is known if patients in Singapore have sufficient English proficiency to comprehend and act on the written information provided in the health care environment.

Before assessing the HL of the general population, a validated and reliable screening tool is needed. Two widely used instruments for HL assessment are the Rapid Estimate of Adult Literacy in Medicine (REALM) and the Test of Functional Health Literacy in Adults (TOFHLA; Davis et al., 1991; Parker et al., 1995). The REALM is a word-recognition test that assesses the subject’s ability to correctly pronounce a list of health-related words, whereas the TOFHLA measures the subject’s ability to read and comprehend health-related materials. The validity and reliability of both the original and short version of the TOFHLA (STOFHLA) were constructed using ambulatory care patients in the USA (Parker et al., 1995; Baker et al., 1999). The instruments were originally developed in English and Spanish; the Hebrew version of STOFHLA was recently developed and validated (Baron-Epel et al., 2007).

The STOFHLA consists of a 4-item numeracy section that tests subjects’ numerical skills and understanding of the information presented in prompts, such as prescription labels and appointment cards, and a 36-item reading comprehension section with two prose passages: instructions for preparation for an upper gastrointestinal series and the patient rights and responsibilities section of a Medicaid application (Baker et al., 1999). The STOFHLA showed good internal consistency; Cronbach’s alpha was 0.68 for the four numeracy items and 0.97 for the 36 items in the two prose passages. The correlation between the STOFHLA and the REALM was high ($\rho = 0.80; P < 0.001$; Baker et al., 1999).

As some instruments equate correct pronunciation with comprehension, and as there are differences in health care systems between the USA and Singapore, none of the available HL instruments seems to be appropriate and applicable when studying HL in the Singapore population. As such, to further HL research in Singapore and potentially in other English-speaking countries, we have developed an adapted version of the STOFHLA, which did not involve pronunciation assessment and knowledge about the Medicaid.

METHODS

Study population

Three polyclinics which were representative of the public primary care clinics in Singapore were selected to participate in the study. Four hundred and sixty-six patients in the waiting areas of the three participating primary care clinics were approached by two trained interviewers, and 302 (64.8%) agreed to participate. Inclusion criteria were: (i) age $\geq 21$ years, (ii) self-reported English proficiency (i.e. able to speak and read English) and (iii) visual acuity necessary to read the instruments used in the interview. Patients were excluded if they had speaking, hearing or cognitive impairment that precluded them from adequately interacting with the interviewers. The interviewers were reminded to approach patients based on their availability rather than age or other characteristics. Non-Chinese patients were oversampled, with a target of 50%, to ensure adequate representation and to broaden the diversity of the sample. Participants were given a S$10 supermarket voucher upon completion of the interview.

Interview instruments

A general HL test, the Health Literacy Test for Singapore (HLTS), was developed by modifying the STOFHLA. Similar to STOFHLA, HLTS contains a 4-item numeracy test and a 36-item reading comprehension test that consists of two prose passages. The numeracy test consists of the original STOFHLA numeracy items (Baker et al., 1999) with the format of the prompts changed to resemble the style of corresponding materials used in the clinics where the patients were recruited. The first passage in the reading comprehension section of HLTS comes directly from the STOFHLA (i.e. instructions for
preparation for an upper gastrointestinal series) with a few Singaporean-friendly terms replacing those used in the original test: ‘dinner’ for ‘supper’, ‘porridge’ for ‘broth’, ‘jam’ for ‘jelly’ and ‘bread’ for ‘toast’. Because the local population was unfamiliar with the health insurance systems in the USA, the other passage in STOFHLA from the Medicaid application was replaced with a locally produced patient health education text on diabetes treatment (see Appendix). The replacement passage had a readability level similar to that of the original STOFHLA passage (Flesch Kincaid Grade Level 9.1 and 9.7, respectively). The two passages also had similar word counts (136 and 128 words, respectively).

For validation purposes, also included in the interview were the Newest Vital Sign (NVS) and a test of patients’ knowledge of three chronic conditions namely, asthma, diabetes and hypertension. The NVS is a validated and reliable HL test that assesses patients’ understanding of an ice cream nutrition label with six questions (Weiss et al., 2005; Osborn et al., 2007). Three HL levels can be defined by the total NVS scores: 0–1 correct answers indicate that limited literacy is likely, 2–3 indicate that limited literacy is possible and 4 or more correct responses indicate adequate literacy (Weiss et al., 2005; Osborn et al., 2007). The chronic condition knowledge test included 15 yes/no questions, five for each condition; the questions were selected from a published study (Gazmararian et al., 2003). Sociodemographic data were also collected from the respondents.

Data collection
Patients were interviewed in October and November 2008. The HLTS was administered using the instructions provided by the STOFHLA. For the reading comprehension section, participants were asked to use a list of four words to fill in spaces where words had been selectively deleted from reading passages (modified cloze procedure; Taylor, 1953); participants were given 7 min to complete this section. The research protocol was approved by the institutional review board of the participating clinics.

Statistical analysis
The cut-off between ‘inadequate HL’ and ‘adequate HL’ was set at 75% correct responses in both HLTS sections (i.e. ≥3 numeracy items and ≥27 reading comprehension items). Convergent validity was determined by examining the association between HLTS and NVS HL levels using the Goodman–Kruskal gamma correlation, which is a non-parametric rank correlation test that investigates agreement in ordinal data. Multiple linear regression analysis was conducted to test the predictive validity of HLTS by examining the difference in knowledge of chronic conditions between the two HLTS HL groups after adjusting for the presence of each chronic condition tested. The number of knowledge test questions answered correctly was used as the dependent variable in the regression model. Bivariate correlation of HLTS HL levels with age and education was assessed by the independent sample t-test and the Goodman–Kruskal gamma correlation, respectively, to test a priori hypotheses that patients with inadequate HL were older and had lower education levels. Due to the small sample size and to facilitate interpretation, adjacent response categories were combined for the analysis when necessary. Internal consistency of the HLTS items was determined by Cronbach’s alpha. All analyses were performed with the PASW, formerly SPSS, version 17.0, and statistical significance was set at \( P < 0.05 \).

RESULTS
The sociodemographic characteristics of the respondents are summarized in Table 1. About half of the respondents were female (57.3%), Chinese (52.0%) and had attended a primary or secondary school (46.6%). The mean age of the respondents was 42.7 (SD = 13.0) years.

In the HLTS numeracy test, 0.7, 3.0, 12.6 and 83.8% of the respondents correctly answered 1, 2, 3 and 4 questions, respectively. The number of reading comprehension items answered correctly ranged from 15 to 36, with a mean ± SD of 32.5 ± 4.4. Based on the predetermined criteria, 88.4% of the respondents had adequate HL. The proportion of respondents with adequate HL in each sub-sociodemographic group is reported in Table 1. The internal consistency of the HLTS was satisfactory; the Cronbach’s alpha for the 36 reading comprehension items was 0.87, with or without adding the four numeracy items.
In the NVS test, almost half of the respondents correctly answered all six questions. Based on the categorization scheme, the respondents can be divided into three HL level groups: limited literacy is likely (5.7%), limited literacy is possible (17.9%) and adequate literacy (76.4%). The correlation between HLTS and NVS HL levels was moderate, with a gamma coefficient of 0.55 (\( P = 0.005 \)). Bivariate analysis indicated that individuals with inadequate HL were older (mean age difference = 7.5 years, \( P = 0.002 \)) and less educated (\( \gamma = 0.41, P = 0.007 \)). In addition, patients with adequate HL had a higher mean score on the knowledge test than those with inadequate HL (mean knowledge score is 10.4 and 9.7 points, respectively). After adjusting for the presence of the three chronic diseases tested, the difference in knowledge test score is significant between the two groups (mean difference in scores = 0.90 points; \( P = 0.036 \)).

### DISCUSSION

In this study, a general HL test, the HLTS was developed based on the STOFHLA. The study results suggest that HLTS appears to have good reliability (internal consistency), convergent validity and predictive validity for English-speaking Singaporean population. Like the STOFHLA, HLTS possesses face validity because the testing materials were drawn from texts that patients were likely to encounter in health care settings. The internal consistency of the reading comprehension items in this adapted test is slightly lower than that of the original STOFHLA (Cronbach’s alpha = 0.87 and 0.97 in the HLTS and STOFHLA, respectively; Baker et al., 1999).

There has been limited HL research done in Singapore. To the best of our knowledge, currently in Singapore, there is no HL or general literacy measure that can serve as the gold standard with which we can compare our results. Little research, if any, has been done to validate any of the existing HL measures in the Singapore population, let alone using these measures to investigate the extent of the general population’s understanding of written medical information. The HLTS developed in the present study has a fundamentally different design and content from those word-recognition tests such as the REALM. Not only is equating correct pronunciation of a list of words with comprehension of the whole text questionable, in a multilingual country like Singapore where it is common for people of different language backgrounds to speak with different accents, it is even more challenging to determine the ‘correct’ pronunciations. As for the other commonly used HL test, the STOFHLA, the local population’s unfamiliarity with Medicaid is likely to hinder their understanding of the application form and it is also difficult to find analogous words to replace some of the terms used in that passage due to differences in health care systems. As such, this passage was replaced by a locally produced text that patients may encounter in a clinical setting. After re-formatting the prompts of the numeracy section and replacing a few words in the other passage, the rest of the STOFHLA items were deemed appropriate and applicable by the study investigators and were included in the HLTS.

The development of the HLTS is an essential first step for HL research and investigation in clinical settings in Singapore and, potentially,

### Table 1: Characteristics of the respondents (\( N = 302 \))

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Count (n)</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>129</td>
<td>(42.7)</td>
</tr>
<tr>
<td>Female</td>
<td>173</td>
<td>(57.3)</td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>21–40</td>
<td>133</td>
<td>(44.0)</td>
</tr>
<tr>
<td>41–60</td>
<td>131</td>
<td>(43.4)</td>
</tr>
<tr>
<td>61 and above</td>
<td>26</td>
<td>(8.6)</td>
</tr>
<tr>
<td><strong>Ethnicity</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chinese</td>
<td>157</td>
<td>(52.0)</td>
</tr>
<tr>
<td>Malay</td>
<td>64</td>
<td>(21.2)</td>
</tr>
<tr>
<td>Indian</td>
<td>71</td>
<td>(23.5)</td>
</tr>
<tr>
<td>Others</td>
<td>10</td>
<td>(3.3)</td>
</tr>
<tr>
<td><strong>Highest level of education completed</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No school/primary school</td>
<td>8</td>
<td>(2.6)</td>
</tr>
<tr>
<td>Secondary</td>
<td>133</td>
<td>(44.0)</td>
</tr>
<tr>
<td>Post-secondary(^a)</td>
<td>96</td>
<td>(31.8)</td>
</tr>
<tr>
<td>University</td>
<td>65</td>
<td>(21.5)</td>
</tr>
<tr>
<td><strong>Housing type</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;4 room HDB flat</td>
<td>62</td>
<td>(20.5)</td>
</tr>
<tr>
<td>4-room HDB flat</td>
<td>103</td>
<td>(34.1)</td>
</tr>
<tr>
<td>5-room HDB flat/executive</td>
<td>89</td>
<td>(29.5)</td>
</tr>
<tr>
<td>Private housing</td>
<td>45</td>
<td>(14.9)</td>
</tr>
<tr>
<td><strong>Personal gross monthly income(^b)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;$1000</td>
<td>112</td>
<td>(37.1)</td>
</tr>
<tr>
<td>$1000–1999</td>
<td>66</td>
<td>(21.9)</td>
</tr>
<tr>
<td>$2000–2999</td>
<td>52</td>
<td>(17.2)</td>
</tr>
<tr>
<td>≥$3000</td>
<td>71</td>
<td>(23.5)</td>
</tr>
</tbody>
</table>

HL, health literacy; HDB, housing development board.
\(^a\)Post-secondary includes polytechnic, junior college and institute of technical education.
\(^b\)In Singapore dollar.
other countries where health care materials are provided primarily in English. With this newly developed instrument, we hope to encourage the initiation of research that examines the magnitude of the HL problem and to enhance educational or communication strategies to reduce the adverse effects of inadequate HL on health outcomes. Nevertheless, further refinement of HLTS may be needed before its application in population-based studies or other health care settings, such as the inpatient setting or long-term care facilities. If better discrimination among HL levels is desired, particularly for individuals with a higher HL level, more difficult items need to be added to the test. Moreover, in order to account for regional differences in word use and in the format or context of health-related materials, the wording and context of HLTS items may need to be re-examined before it can be administered to English-speaking patients in other countries. As most study participants were able to complete the HLTS within 10 min, it can serve as a quick screening tool to identify patients who may have difficulty understanding written health information and who may not be reliably identified otherwise, for example, by their education levels. Further efforts, such as providing simplified versions of or substitutes for written materials, need to be made in order to improve the communication with these patients. In addition, the effect of translation (i.e. providing the text written in patients’ primary language) on improving patients’ comprehension warrants future investigation.

There are a few limitations to this study. The cut-off point of 75% correct responses for adequate and inadequate HL is somewhat arbitrary; its sensitivity and specificity for detecting patients with trouble reading and comprehending medical information and its association with adverse health-related outcomes need further investigation. Another limitation is the possibility of selection bias. The respondents seemed to be younger and better educated than the general population and there was less diversity in the respondents’ HL levels than desired, i.e. the number of patients with low HL is limited. Despite the lack of information about the characteristics and English proficiency of those who declined to participate, a random sampling design may have helped us obtain a patient sample with more diversified HL levels. Lastly, considering the distinction of the two HL models and corresponding measures, the HLTS developed may be more suited to clinical settings than public health programmes.

**FUNDING**

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**REFERENCES**


If meal planning does not __________ your diabetes, your doctor may have
   a. afford
   b. destroy
   c. control
   d. sweeten

to __________ some tablets for you. There are ______ different types of
   a. prescribe            a. anything
   b. preserve            b. single
   c. describe            c. disease
   d. consult             d. many

tables available to ______ type 2 diabetes. These tablets are a ______ to
   a. store                a. machine
   b. treat                b. book
   c. keep                 c. furniture
   d. affect               d. tool

help you manage your blood ______ level in addition to the
   a. diet
   b. hemorrhage
   c. glucose
   d. osteoporosis

meal ______ and exercise that you need to ________. If both diet and
   a. plan            a. advise
   b. content          b. reduce
   c. method            c. swallow
   d. table             d. follow

tables ______ to control your blood glucose to the ________ level,
   a. win            a. daily
   b. fail            b. direct
   c. lose            c. desired
   d. rise            d. dangerous
insulin injections ______ be needed.
   a. are
   b. sure
   c. to
   d. may

_______ taking your medication, ______ your doctor if:
   a. Because
   b. However
   c. Although
   d. Before
   a. inform
   b. contain
   c. select
   d. delay

• you are ________ to this medicine or any other medicines
   a. symptomatic
   b. attracted
   c. allergic
   d. registered

• you are ________ any prescription or ________ medicines
   a. talking
   b. taking
   c. making
   d. learning
   a. non-prescription
   b. lifestyle
   c. effective
   d. carbohydrates

• you have a heart, kidney or liver ________
   a. flavour
   b. pressure
   c. study
   d. problem

• you are ________ for any surgery
   a. stopping
   b. missing
   c. going
   d. directing

• you are pregnant or ________ to get pregnant or if you are ________.
   a. visiting
   b. planning
   c. pleasing
   d. planting
   a. roasting
   b. breastfeeding
   c. living
   d. coordinating