Psychometric Evaluation of a Chinese Version of the eHealth Literacy Scale (eHEALS) in School Age Children

Koo, Malcolm, PhD[1]; Norman, Cameron D., PhD[2]; Chang, Hsiao-Mei, MSc[3]

Authors[1, 3] were formerly affiliated with the Graduate Institute of Natural Healing Sciences, Nanhua University. Author[2] is affiliated with the Dalla Lana School of Public Health, University of Toronto and CENSE Research + Design. **Contact author**: Malcolm Koo, PhD; Graduate Institute of Natural Healing Sciences, Nanhua University, Dalin, Chiayi 62249, Taiwan; Phone: +886-5-2721001 ext. 2641; Fax: +886-5-2427195; Email: m.koo@utoronto.ca

Abstract

The eight-item eHealth Literacy Scale (eHEALS) is a previously validated scale developed to assess consumers' combined knowledge, comfort, and perceived skills at finding, evaluating, and applying electronic health information to health problems. In the present study, a Chinese version of the eHEALS was developed and its psychometric properties assessed. A single group, cross-sectional study design was used to evaluate the Chinese version of the eHEALS (C-eHEALS) on 216 six-grade school children in two elementary schools located in south Taiwan. Results indicated that the C-eHEALS had good internal consistency reliability (Cronbach's alpha = 0.92) and produced a single factor that accounted for 63.5% of the total variance using principal components analysis. Furthermore, the total C-eHEALS score was significantly associated with computer skills including the ability to use a word processor, the use of the Web to search for information, the ability to find the file on the computer after downloading, and the ability to use computer to do school assignment. In conclusion, the C-eHEALS is a promising tool for evaluating eHealth literacy in Mandarin-speaking school children.

Key Words: information literacy, information skills, health behavior, elementary school students, eHealth literacy.

Introduction

With the widespread use of the Internet as a medium for health information, it is imperative to understand the impact that such technology has on decision-making among non-health professionals is high. The interactive nature of the technology, including ease of access and potential anonymity, make it an attractive source of information for the young health consumer.[1] However, the substantial variations in the quality of the health information available on the Internet have raised concerns about the potential negative health effects related to eHealth use.[2] For example, inaccurate and incomplete health information on the Internet may lead to false reassurance or needless distress arise from incorrect self-diagnosis.[3] Biased information and misleading promotional material can also lure patients to try unproven treatments and potentially deflect them from making optimal treatment decisions for their health conditions.[4] The potential for risk is exacerbated in young people who may not have the experience or skill to properly evaluate its quality or potential consequences of use.[5] Skinner and colleagues found that adolescents who use the Internet for health information felt that high-quality information did exist, but that they were insufficiently skilled to find it.[6] For public health, the challenge is assessing the level of skills that consumers have and finding the means to improve them if necessary.

To assess consumers' perceived skills at finding, evaluating and applying electronic health information to health problems, Norman and Skinner developed the eHealth Literacy Scale (eHEALS).[7] The scale was based on a theoretical model comprised of six key eHealth core skills including (1) traditional literacy, (2) health literacy, (3) information literacy, (4) scientific literacy, (5) media literacy, and (6) computer literacy.[8] The eHEALS is a simple eight-item self-reported scale with five-point Likert response format and has been successfully applied to different contexts.[9-11]

The need for skills in seeking and appraising eHealth resources is common across ages, sex, and cultural groups, even if the specific health conditions may vary between them. We sought to translate and apply the eHEALS to Chinese school children to assess the applicability of the instrument and eHealth literacy model in a different cultural context. The present study was designed to assess the psychometric properties of the Chinese version of eHEALS (C-eHEALS) for use in Mandarin-speaking school children.

Methods

Design, Participants and Setting

A single group, cross-sectional study design was used. Data for the present study were collected as part of a larger study examining the association between health literacy and computer competencies in school children. Participants in the study were sixth-grade school children in two elementary schools located in Minhsiung and Meishan townships of Chiayi county in south Taiwan. The written form of Chinese language in Taiwan is in Traditional Chinese characters. The two schools were established within ten years and both had a classroom with computers for every student in the class. In addition, both schools provided no formal classes on Internet use. Informed consent was obtained from the parents of the participating students. The sample size of the study was based on the recommendation by Gorsuch that a sample of 200 is preferred in factor analysis.[12]

Instruments

The original English version of the eHEALS was developed as a scale to quantify the levels of consumers' perceived skills at using information technology for health. The eHEALS is an eight-item measure of eHealth literacy developed to measure consumers' combined knowledge, comfort, and perceived skills at finding, evaluating, and applying electronic health information to health problems. A psychometric evaluation of the eHEALS on 664 adolescents revealed a Cronbach's alpha of 0.88 and a single factor solution with an eigenvalue of 4.48 (56% of the variance explained) was obtained by principal components analysis. Test-retest reliability showed modest stability over time from baseline to 3-month follow-up with a Pearson correlation coefficient of 0.46.[7]

The English version was translated into Chinese by a bilingual Chinese-native speaker (MK) who had lived in an English-speaking country for over twenty years. The original denotation and connotation of items was discussed with the original scale developer (CN) during the translation process.

The response format for each of the eight items was a five-point Likert scale ranging from "strongly disagree" to "strongly agree", yielding a score for each item from 1 to 5, respectively. The total score for the C-eHEALS was calculated by totaling the

scores for each item, with equal weights. Thus, scores on the scale could range from a minimum of 8 to a maximum of 40, with higher scores representing higher levels of eHealth literacy.

A pilot version of the C-eHEALS was reviewed by four elementary school teachers who native language is Mandarin to explore the readability and age-appropriateness of the language in the instrument. All of them have at least eight years of teaching experience in elementary schools. They were asked to provide feedback on the appropriateness of the wordings of the questionnaire. The questionnaire was then administered to 30 school children in six-graders in an elementary school in Meishan of Chiayi county. The respondents were asked to indicate whether they understood each question or found it difficult to answer after they had completed the questionnaire. A copy of the final version of C-eHEALS in Chinese is included in Appendix 1.

Data Collection Procedure

Surveys were conducted at the two schools on two occasions: October 9 and 14, 2008. On the day of survey administration, students were gathered in a classroom. The questionnaire printed on paper was distributed to each student. Each question was explained to the students while the question was projected on a large screen in front of the classroom.

Data Analysis

The study followed the same statistical analysis procedures used in the original development of the eHEALS to ensure appropriate comparison with some additional statistical tests done to further understand the scale's properties.[7] Data were analyzed using SPSS for Windows version 13. Descriptive statistics including mean, standard deviation, median, minimum, and maximum were calculated. Floor effects and ceiling effects were assessed by calculating the percentage of participants scoring 8 or 40, respectively, on the C-eHEALS. Cronbach's alpha was used to estimate the internal consistency of the C-eHEALS and it is considered as good if the coefficient is greater than 0.70.[13] For further assessment of internal consistency, item-to-total score correlations were calculated for each item using the Reliability Analysis function in SPSS. The obtained value for each item represents the correlation between the score of that item and the rest of the C-eHEALS score. A minimum value of item-

to-total correlation values of 0.2 has been suggested.[13]

Construct validity of the C-eHEALS was analyzed using factor analysis with factors extracted as valid based on the scree test.[14] The suitability of the data for factor analysis was assessed using the Kaiser–Meyer–Olkin (KMO) method and Bartlett's test of sphericity.[15] The concurrent validity was assessed by simple linear regression analyses, with C-eHEALS score as the dependent variable and each of the ten computer skills as independent variables (Table 2).

Results

The total number of six-graders in the two schools was 219. The response rate for the questionnaire survey was 100 per cent. Of them, 109 were male students (49.8%). Three completed questionnaires had missing values on the items of C-eHEALS and therefore 216 students were included in the analysis. We did not collect information the education and income levels of students' parents. The majority of the students had access to a computer at home. Of the 219 students, 102 students (46.6%) had access to one computer and 109 (49.8%) had access to two or more computers. Only 8 students (3.6%) had no access to a computer at home.

Examination of the C-eHEALS scale scores showed that students scored throughout the full range with a mean score of 28.4 and a standard deviation of 7.6. The median, minimum, and maximum scores were 29, 8, and 40, respectively. Score 'ceiling' effects (highest ehealth literacy) were 3.2% and 'floor' effects (lowest ehealth literacy) were 6.5%. The internal consistency reliability (Cronbach's alpha) was 0.92.

Item-total scale correlations and factor loadings for the C-eHEALS are shown in Table 1. The item-total scale correlations for the eight items ranged from 0.71 to 0.87. The KMO value was 0.888, exceeding the recommended value of 0.60[15] and the Bartlett's test of sphericity was statistical significant ($p < .001$). These results indicated that the data were appropriate for exploratory factor analysis. Using principal components analysis, a single solution with an eigenvalue of 5.08 was obtained and the single factor accounted for 63.5% of the total variance.

To assess the concurrent validity of the C-eHEALS, simple linear regression analyses were conducted

between C-eHEALS and ten different computer skills. Results indicated that the total scores of C-eHEALS was significantly associated with the following four skill items: I know how to use a word processor ($p = .002$), I often use the Web to search for information ($p = .030$), I know how to find the files on my computer after downloading from the Web ($p = .007$), and I know how to use a computer to do school assignments ($p = .010$). Two skill items were also marginally significant and they included: I know how to use keywords to find information on the Web ($p = .058$) and my computer skills are better than my classmates ($p = .054$) (Table 2).

Discussion

This study was designed to evaluate the psychometric properties of a translated version of eHEALS in Chinese (C-eHEALS). Although the original version of eHEALS was developed and validated in adolescents, the performance of the Chinese version in elementary school children was satisfactory.

The findings in the present study provide support for both construct and concurrent validity in Mandarin-speaking Chinese school children. The results of the factor analysis found that all eight C-eHEALS items loading were on one factor. This is consistent with the original version of the scale and lends further support for this scale to measure a single construct of eHealth literacy. The concurrent validity of C-eHEALS was also satisfactorily established as it converged well with other measures of computer skills. In addition, the C-eHEALS also demonstrated good internal consistency.

This study also shows that the concept of eHealth literacy as measured by the eHEALS is not only translated appropriately across cultures, but with other age groups, suggesting that the skill set might be consistent across the developmental spectrum. This finding complements unpublished[16] work elsewhere that showed the original eHEALS constructs were consistent with different adult age groups.

Several limitations in this study should be noted. First, participants were sixth-grade students from two elementary schools in south Taiwan. Additional studies will be required to provide evidence of the generalizability of the scale to other Chinese population samples. Second, with the lack of a gold standard for ehealth literacy, we could only assess the

concurrent validity of C-eHEALS using a list of ten computer skills that we had developed for this study. Third, a forward-translation and back-translation protocol was not used in this study. Therefore, we do not have formal verification of the semantic equivalence of the C-eHEALS to eHEALS. Nevertheless, with the active involvement of the original scale developer (CN) during the translation process, we believe the impact on the utility of the C-eHEALS is minimal.

In conclusion, the C-eHEALS is a promising tool for evaluating ehealth literacy in Mandarin-speaking school children. Considering its brevity, ease of administration, and good psychometric properties, it is hoped results of this study will encourage further investigations of the C-eHEALS for use across different age groups and sex in the Chinese population. Information including health information is readily accessible on the Internet by school children. Therefore, C-eHEALS can be used as a simple tool to measure eHealth literacy levels in school children. Such tool is essential to facilitate further research on developing and testing interventions that could raise eHealth literacy and ultimately promote self-empowerment in students.

References

1. Gray NJ, Klein JD, Noyce PR, Sesselberg TS, Cantrill JA. Health information-seeking behaviour in adolescence: The place of the Internet. *Soc Sci Med.* 2005;60(7):1467-1478.

2. Eysenbach G, Powell J, Kuss O, Sa ER. Empirical studies assessing the quality of health information for consumers on the world wide web: a systematic review. *JAMA.* 2002;287(20):2691-2700.

3. Ryan A, Wilson S. Internet healthcare: do self-diagnosis sites do more harm than good? *Expert Opin Drug Saf.* 2008;7(3):227-229.

4. Schmidt K, Ernst E. Assessing websites on complementary and alternative medicine for cancer. *Ann Oncol.* 2004;15(5):733-742.

5. Norman CD, Jackson S, Larkin J, Lombardo C, Meyer T, Skinner H. *The five E's for health: Understanding eLiteracies for eLearning in*

electronic educational environments. [book online]. The Canadian Council on Learning, Ottawa; 2008. http://www.ccl-cca.ca/pdfs/FundedResearch/Norman-FinalReport-HL2006.pdf. Accessed June 30, 2011.

6. Skinner H, Biscope S, Poland B, Goldberg E. How adolescents use technology for health information: implications for health professionals from focus group studies. *J Med Internet Res*. 2003;5(4):e32.

7. Norman CD, Skinner HA. eHEALS: The eHealth Literacy Scale. *J Med Internet Res.* 2006;8(4):e27.

8. Norman CD, Skinner HA. eHealth Literacy: Essential skills for consumer health in a networked world. *J Med Internet Res.* 2006;8(2):e9.

9. Bodie GD, Dutta MJ. Understanding health literacy for strategic health marketing: eHealth literacy, health disparities, and the digital divide. *Health Mark Q.* 2008;25(1-2):175-203.

10. Miller VM. Poor eHealth literacy and consumer-directed health plans: a recipe for market failure. *Am J Bioeth.* 2007;7(11):20-22.

11. Wu AD, Begoray DL, Macdonald M, et al. Developing and evaluating a relevant and feasible instrument for measuring health literacy of Canadian high school students. *Health Promot Int.* 2010;25(4):444-452.

12. Gorsuch RL. *Factor Analysis*. 2nd ed. Lawrence Erlbaum, Hillsdale, NJ; 1983.

13. Streiner DL, Norman GR. *Health Measurement Scales. A Practical Guide to Their Development and Use.* 4th ed. Oxford University Press, NY; 2008.

14. Cattell RB. The Scree test for the number of factors. *Multivariate Behavioral Res* 1966;1(2):245-276.

15. Kaiser HF. An index of factorial simplicity. *Psychometrika.* 1974;39(1):31–36.

16. Norman CD, Legare J, Rootman I. Measuring eHealth literacy in a population sample of 1008 British Columbia residents. Centre for Clinical Epidemiology and Evaluation, Vancouver Coastal Health Authority. Vancouver, BC; 2007.

Table 1. Item-to-total correlations and factor loadings for the Chinese version of the eHealth Literacy Scale (C-eHEALS) (N=216)

C-eHEALS items	Item-to-total correlation	Factor loading
1. I know what health resources are available on the Internet	0.757	0.751
2. I know where to find helpful health resources on the Internet	0.870	0.876
3. I know how to find helpful health resources on the Internet	0.869	0.876
4. I know how to use the Internet to answer my questions about health	0.828	0.834
5. I know how to use the health information I find on the Internet to help me	0.845	0.852
6. I have the skills I need to evaluate the health resources I find on the Internet	0.719	0.712
7. I can tell high quality health resources from low quality health resources on the Internet	0.712	0.703
8. I feel confident in using information from the Internet to make health decisions	0.753	0.748

Table 2. Simple linear regression analysis of the Chinese version of the eHealth Literacy Scale (C-eHEALS) and computer skills (N=216)

Computer skills	Standardized beta	*P*
1. I know how to use a word processor (Word)	0.21	.002
2. I know how to use keywords to find information on the Web	0.13	.058
3. I often use the Web to search for information	0.15	.030
4. I know how to find the file on my computer after downloading from the Web	0.19	.007
5. Send and receive email is easy for me	0.12	.101
6. I often unable to attach files in email	0.01	.923
7. I know how to use a computer to do school assignments	0.19	.010
8. I worry about computer virus when I use USB keys	-0.04	.600
9. I know what intellectual property is about	0.09	.227
10. My computer skills are better than my classmates	0.13	.054

Appendix 1: Chinese version of the eHealth Literacy Scale (C-eHEALS)

	非常不同意	不同意	不確定	同意	非常同意
1. 我知道網際網路上有什麼樣的健康資源	□	□	□	□	□
2. 我知道在網際網路上去那裡找有用的健康資源	□	□	□	□	□
3. 我知道如何在網際網路上找到有用的健康資源	□	□	□	□	□
4. 我知道怎樣使用網際網路來解答我有的健康問題	□	□	□	□	□
5. 我知道怎樣使用從網際網路上的健康資訊來幫助自己	□	□	□	□	□
6. 我擁有評估網際網路上健康資源的能力	□	□	□	□	□
7. 我能夠分辨出高品質與低品質的網際網路健康資源	□	□	□	□	□
8. 我有自信使用網際網路的資訊作出健康決策	□	□	□	□	□