eHealth literacy and Cancer Screening: A Structural Equation Modeling

Jung Hoon Baeg, Florida State University
Hye-Jin Park, Florida State University

Abstract
Many people use the Internet for their health information needs. Individuals searching for health information can bombarded with resources. Some of these resources can me poor or give misinformation. It is important for individuals to be able to understand what resources are reputable and give the most accurate information. eHealth Literacy Scales (eHEALS) were developed to address some of these challenges. This study examined how eHealth literacy (direct and indirect) and affected the eHealth literacy on colon cancer screening test using Structure Equation Modeling (SEM). This study also analyzed what other factors, such as socioeconomic characteristics (SES) and Internet usage, influenced eHealth literacy and the colon cancer screening. The study examined the data of 108 adult participants. Among SES, race has a direct affect on the Internet usage and also a direct affect on the eHealth literacy. However, eHealth literacy does not directly affect on colon cancer screening.
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Contact: jhb6536@my.fsu.edu, hpark5@nursing.fsu.edu

1   Introduction

Access to health information through the Internet has opened up many new information resources to people; health information is the most frequently searched topic on the Internet. Over 80% of U.S. adults (93 million Over 80% of U.S. adults (93 million people) search online for health information for themselves or for someone else (Fox, 2006). There are some challenges regarding health information on the Internet. In order to retrieve quality health information, individuals need to have access to the Internet, retrieval skills, and the ability to evaluate and determine relevant searches. eHealth Literacy Scales (eHEALS) were developed to address some of these challenges. eHealth literacy is defined as "the ability to seek, find, understand, and appraise health information from electronic sources and apply the knowledge gained to addressing or solving a health problem" (Norman & Skinner, 2006a, p. 1). eHealth literacy includes the computer, media, numeracy skill, health, traditional and scientific literacy.

Regarding eHealth literacy, many studies have tried to verify the eHEALS scales either in English or other foreign languages (Koo, Norman, & Chang, 2012; Mitsutake, Shibata, Ishii, & Oka, 2012; Norman & Skinner, 2006b; Van Der Vaart et al., 2011), with respect to populations deal with HIV positive individuals (Robin & Graham, 2010), older people (Xie, 2011), and parents whose children have special healthcare needs (Knapp, Madden, Wang, Sloyer, & Shenkman, 2011). There has been no study on how ehealth literacy may or may not influence health outcome and help disease prevention behavior.

According to the American Cancer Society (2011), over 1.5 million new cancer cases occurred in the U.S and over 500,000 deaths are projected from these new cases (Siegel, Ward, Brawley, & Jemal, 2011). Cancer has one of the highest mortality rates and it is estimated that one of five individuals in the U.S may develop cancer by 2030. The projected overall cancer cost will increase from $124.6 billion (2010) to approximately $158 billion by 2020 (Siegel et al., 2011). The high clinical and financial burden with cancer has led to great interest in prevention of cancer. As a result, many researches have been conducted on cancer prevention and showed how cancer screening can help to detect cancer earlier. Early detection can increases treatment success for many types of cancer (Kalager, Selen, Langmark, & Adami, 2010). However, has been little research conducted on the relationship between the new concept of ehealth literacy and cancer screening behavior.

2   Research model and Hypotheses

The research model used in the study is shown in Figure 1. Based on the literature reviews, eight hypotheses were examined in this study.
H1-H3 SES (education (1), income (2), and race (3)) should positively influence Internet usage
H4. Health status should positively influence Internet usage
H5. Health status should positively influence the cancer screening experience.

H6. Internet usage should positively influence eHealth literacy.
H7. eHealth literacy should positively influence the cancer screening experience.
H8. eHealth literacy should positive influence on eCancer literacy.
H9. eCancer literacy should positively influence the cancer screening experience.
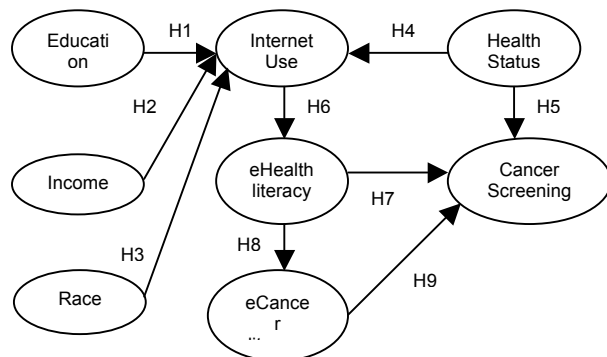

Figure 1. Research Model

3   Method

3.1   Design and Sample

Structural Equation Modeling (SEM) was used to identify the direct or indirect relationship between variables, such as SES, eHealth literacy, cancer literacy, and cancer screening. A convenient sampling method was used to recruit participants. A total of 108 adults participated in this study between March and May 2013. The inclusion criteria for sampling are both genders, over 18 years old and all ethnic groups.

3.2   Questionnaire

The questionnaire consisted of 38 questions with 3 parts, including general characteristics questions (18 items), cancer screening/cancer information seeking questions (11 items), and eHealth literacy scales (8 items) with two supplemental items. In the general characteristics questions, participants were asked about their socio-demographic information, cancer history, and current health status.

In the cancer screening/cancer information seeking section, participants answered cancer screening tests for breast, cervical, colon, and prostate cancer and 5 items of perception of cancer information seeking on the Internet, such as 'Too hard to understand cancer information found on the internet' with 5-point Likert scales (1-strongly disagree and 5-strongly agree).

In order to measure the eHealth literacy, 8 items of eHEALS was measured (Norman & Skinner, 2006a). Each item is rated on five point Likert scales of 1 to 5. (1-strongly disagree and 5-strongly agree). The items are: "(1) I know what kind of health resources are available on the Internet; (2) I know where to find helpful health resources on the Internet; (3) I know how to find helpful health resources on the Internet; (4) I know how to use the Internet to answer my questions about health; (5) I know how to use the health information I find on the Internet to help me; (6) I have the skills I need to evaluate the health resources I find on the Internet; (7) I can tell the difference between high quality health resources and low quality health resources on the Internet; and (8) I feel confident in using information from the Internet to make decisions about by health." eHEALS has identified the excellent internal consistency reliability, alpha = .89-.97 with good test-retest reliability (Koo, Norman, & Chang, 2012; Mitsutake, Shibata, Ishii, & Oka, 2012; Norman & Skinner, 2006a; Van Der Vaart et al., 2011).

3.3   Data Analysis

SPSS v.18 was used for descriptive analysis and eHEALS factor analysis. Mplus v.5 was used to identify the relationship between general characteristics variable and eHelath literacy and cancer prevention experiences with full Structural Equation Modeling (SEM).

## 4	Results and Discussions

### 4.1	General characteristics

A total of 108 participants answered survey questions. Fifty-two percent were female and 49% were male. The highest participation came from age range 50-59 (32%) followed by 60-69 age range (23%). Fifty-six White/Caucasian (52%) participated and approximately 79% of the participants (n=84) graduated from either a two-year or four-year college or graduate school and 22% were educated to a level of high school. Thirty two percents (32%) of the respondents (n=34) had household incomes under $25,000 and 20% (n=21) of the respondents earned over $75,000 per year. Over 60% of the respondents (n=68) indicated that their health status was excellent or very good and just 9% (n=10) said fair or poor. In eHealth literacy, overall 46% (n=50) had high eHealth literacy and 54% (n=58) had a low eHealth literacy. The mean eHealth literacy score was 29.7 (Sd=5.88) and the mean score is the cut off point for high or low eHealth literacy levels.

### 4.2	SES and Internet usage

We examined the direct relationship between SES, health status, and Internet usage. Among those variables, only race (H3) had the statistically significant direct effect on the Internet usage with a good model fit (p<.001, CFI = .855, RMSEA =.076). Many studies showed that race/ethnicity, education, income are influence factors to use the Internet. Knapp et al (2010) found Hispanic parents were not likely to use the Internet for health information compared to parents of other races/ethnicities. This study also found similar results that only race significantly influenced Internet usage.

### 4.3	Internet usage and eHealth literacy scale

Internet usage and eHealth literacy results showed that Internet usage had a direct influence on eHealth literacy (p<.001, β = .222). Some studies argue the validity of eHEALS because of the weak correlation between eHealth literacy and Internet usage (Van der Varrt et al., 2011). However, this study's results support that eHEALS is a valid scale for eHealth literacy.

### 4.4	eHealth literacy and cancer screening

eHealth literacy did not directly influence the cancer screening experience (H7). Results showed a coefficient value that is negative and p-value is not statistically significant (β = -.16, p=.37). However, eHealth literacy indirectly influenced the cancer screening experience via eCancer literacy (H8). eHealth literacy positively influenced eCancer literacy (p<.005, β = .293). This result indicates that characteristics of eHealth literacy scales measure only eHealth literacy instead of actual behavior, such as preventable disease or cancer screening. Norman (2011) also suggested that variables might need to be added, such as a social media interaction, to significantly determine the consequence for the psychometric integrity of the instrument. Based on the developer of eHEALS, we included additional subscales, eCancer literacy, that provides for a robust eHEALS identification.

### 4.5	eCancer literacy and cancer screening

eCancer literacy (H9) showed a statistically significantly influence on the cancer screening experience directly (p<.05, β =.862). eCancer literacy consists of 5 questionnaires that all asked the perception of cancer information searching on the Internet. This result may suggest that eHEALS can measure the general eHealth literacy but is not sufficient to measure the specific disease prevention behavior. In order to measure the specific health behavior, a mediator might be needed to connect eHealth literacy and specific health performance.

### 4.6	Full structure equation model

This study used full SEM with the Weighted Least Square Mean and Variance (WLSMV) in Mplus. WLSMV is used when the number of categories is less than 4, and a specialized estimation method for non-normal data. When using the WLSMV, a new fit index is used for verification. Weighted Root Mean Square Residua (WRMR) is computed and less than 1.0 suggests a good fit (Yu & Muthen, 2002).

In this full SEM, model fit showed the good fit (CFI = .855, TLI = .946, RMSEA = .076, WRMR = .630). Among variables these variables are statistically significant on the direct influence from race (H3) to Internet usage (β = -.257, p=.00), from Internet usage (H5) to eHeath literacy (β = .222, p=.00), from eHealth literacy to eCancer literacy (β =293, p=. 00), from eCancer literacy to cancer prevention (β =.862, p=.05). The final model is listed in the Figure 2.
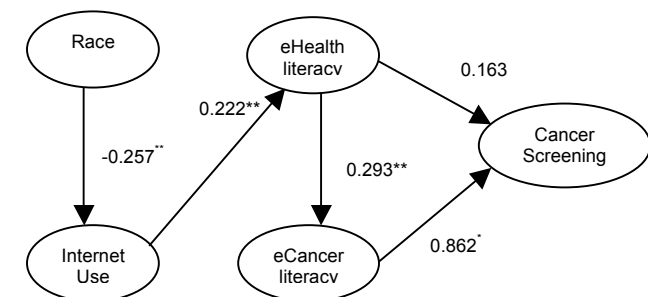
*P<.05 **P<.01

Figure 2. Final Model

5   Limitation and future study

This study had some limitations. Small sample size and sampling method also indicated that this study's result could not be generalized. Based on a power value of .80 and each parameter at the .05 levels, the total sample size should be over 140 (Muthen & Buthen, 2002). In this study, the sample size was low compared to the suggested sample number. However all model fit indices was validated even though the sample of this study was slightly low. In order to further evaluate this study's variables and relationship between eHealth literacy and disease prevention, a larger sampling size is recommended and random sampling method is needed.

6   Conclusion

This is the very first study to use eHEALS to measure either the direct or indirect relationship between eHealth literacy and the cancer screening whether the person received cancer screening for early prevention. Most previous studies only focused on either the correlation between socioeconomic characteristics (SES) and eHealth literacy, or compared eHealth literacy groups' different disease knowledge. We also examined the relationship between SES and Internet usage and indicated how these relationship influence eHealth literacy. In addition, we also analyzed the relationship between eHealth literacy and actual cancer screening behavior. More importantly this study also suggested that a mediator variable (eCancer literacy) might be needed between eHealth literacy and the health outcome or disease prevention.

7   References

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7.1   Table of Figures