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Characteristics of the Elderly that Influence the Efficient Provision of Healthcare Web Services

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ABSTRACT

This study surveyed the variables associated with tailored user interfaces (UIs) to identify and apply to. healthcare web services. A total of 308 elderly people of age 50 and above), living in Incheon, South Korea, were surveyed through one-on-one interviews. The survey results of these 300 subjects were analyzed and used to demonstrate that younger subjects higher EQ-5D and TAM indices. The technology acceptance model showed the greatest effect on the perceived need for web services.

Key words*: User Interface, Active Aging, Healthcare, Web Service, Senior.*

1. INTRODUCTION

In South Korea, It is accounted 12.7% population over 65-year-old compared to total population in 2014, and expected to increase to 19.0% in 2024 and to 27.6% in 2034. In 2013, the treatment cost for the aforementioned category of elderly people under the health insurance program stood at KRW17.5283 trillion, which accounted for 34.5% of the total treatment cost of KRW50.7426 trillion. In 2013, the treatment cost per elderly person in the aforementioned category was KRW3.05 million, up 4.1% from the previous year [1]. A look at the chronic disease patterns of the people over 65 years old in South Korea will reveal that as the age increases, the incidence of chronic diseases and complex chronic diseases likewise increases, indicating that 88.5% of the elderly people in South Korea have at least one chronic disease [2], meaning that most of the elderly people in the country have chronic diseases. As the improvement of elderly people's health will not only help improve their life quality but will also boost their social welfare benefits in the medical and long-term treatment category, there is a need to develop elderly healthcare services designed to prevent elderly health loss and to improve the elderly's health.

A look at South Korea's elderly healthcare services will reveal that the initial stage focused on disease management and emergency disease management targeting marginalized people, including the elderly living alone and the people in remote areas, including islands, while the latest health support system is currently expanding into the healthcare area. Healthcare support services can now be aided by various smart devices, increasing the people's interest in the provision of support for the usability of smart devices.

Aldo, elders themselves are trying to decrease dependence on others. To develop elderly friendly services, the services or products should be easy to use without additional tool [3].

In 2014, South Korea's Internet penetration rate reached 83.6%, but the rate for the 60-year-old and older people reached only 32.8%. Also, according to ITU's 2013 Internet use data, South Korea's Internet use rate was 84.8%, which was lower than Norway's rate (95.1%) but was far higher than India's and Mexico's rates (15.1 and 43.5%, respectively) and was similar to Germany's, USA's, and Canada's rates. The total smartphone use rate reached 95.5%, and the rate for the 60-year-old and older people reached 78.3% [4]. Although they increased their Internet and smartphone subscription and use

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rates significantly, the elderly were still far behind in information utilization capacity.

Moreover, pre-elderly in the 50-59 age range, are a group that is experiencing passion and desire about current life and anxiety about retirement at the same time [5].

With the population aging and with the rapid further development and spread of the Internet and smartphones, the online healthcare area is expanding. Also, with the increasing interest in the use of smart devices, many studies have been conducted to develop user interface (UI) guidelines for mobile devices and TVs, and for many other devices. Research has yet to be conducted, however, on the development of a UI that would enhance the elderly's use thereof. This study thus sought to identify the current UI overview for elderly healthcare web services, and to survey the demand for such services so as to derive the factors that should be considered for the development of healthcare web services for the active aging.

2. THEORETICAL DISCUSSION

2.1 UI

UI design (e.g., human-computer interaction [HCI], ergonomics and usability) is the common key factor in the user experience design category [6]. Interface refers to the contact surface between humans and things (referring to all products, information, and spaces), or the communication space. Jef Raskin defined interface as "the way of doing the intended act with a product." Joann T. Hackos defined interface in a broad sense, as "the bridge that connects the world of the product or the system with the world of the user," and explained it as a method for the user to interact with the product to obtain his or her goal, and as the way that the system, in connection with the user's needs, shows the user and acts [7]. Good interface design conditions involve an interface that can clearly express the system value, functional, and structural models to the user, as well as the system information and functions, so that the user can use the system accurately and speedily. Also, a good interface should faithfully express the developer-intended aesthetic impression or individuality to the user [8]. Specifically, the basic UI evaluation items include usability, accessibility, and convenience, and UI is the medium for converting the product's functional and technical characteristics into human user values.

In 2001, the U.S. NIA (National Institute on Aging) developed web access guidelines for enhancing the elderly's webpage usability. The guidelines defined the consideration and acceptance of the font size, color, and style, along with the NIA-proposed background image and color, vertical scroll, document format, and other design requirements to provide effective webpages for the elderly. The U.S. state government websites comply with the recommended 10 second download time for the facilitation of web use, and have adopted UE, the program for converting general sites into elderly-friendly sites in a bid to achieve digital evolution for the elderly [9]. Moreover, despite the existence of Nokia 7710 Usability Guidelines v1.0, SKT Standard UI Guide 2.0, Microsoft Windows XP Visual Guideline [10], and iOS Human Interface Guidelines, research has yet to be conducted on the UI for elderly healthcare web services. In this study, as shown in Table 1, with regard to the four principles under the Korean-version Web Contents Access Guideline 2.0, the items needed for healthcare web services were extracted from the feasibility-of-implementation, feasibility-of-operation, and feasibility-of-recognition items to confirm what could be derived according to the user groups.

Table 1. Derivation of UI survey items

Web interface evaluation criteria for the elderly	Principles of the Korean-version Web Contents Access Guideline 2.0	UI survey items
Layout Typographic	Feasibility of understanding	Data amount/type
Navigation	Feasibility of operation	Existence or non-existence of fixed menus
Color Graphic Icon	Feasibility of recognition	Main menu type Recognizing icons
	Robustness	

2.2 EuroQol-5 dimensions (EQ-5D)

Increase in the number of patients with chronic diseases is a health level indicator of a population, requiring an indicator that can encompass not only diseases and deaths but also comorbid conditions or patients' subjective evaluation of their health state. Such indicator is a particularly useful tool for measuring health life quality as it can express the relative good or bad health state through a single number on a scale of 0 to 1 (0 = death; 1 = complete health state). EQ-5D is an instrument for measuring health life quality and is one of the world's most widely used measurement instruments for such purpose [9]. EQ-5D, as a health-measuring instrument, consists of EQ-5D utility values (EQ-5D profile) and the EQ-5D visual analogue scale (EQ-5DVAS) asking five questions about a person's current health state. The said five questions pertain to mobility, self-care, usual activity, pain/disability, and anxiety/depression, each of which evaluates the person's functions in three stages (stage 1: no problem; stage 2: some/moderate problem; and stage 3: extreme problem). The answers to the five questions are classified into 243 health states, which are compared with the British people's representative samples to obtain utility values. The score theoretically represents an indicator weight between 0 (death) and 1 (complete health state), but minus values may actually be obtained, given the nature of the tariff score system [12]. This study used only the EQ-5D utility value (EQ-5D profile) scale of the Korean-version KEQ-5D, which is based on the cross-culture adaptation process and the confirmation thereof [13]. The quality weights predicted by Jo Min-u (2007) were used to come up with a Korean quality weight prediction formula, as follows:

$$Y = 1 - (0.050 + 0.096\times M2 + 0.418\times M3 + 0.046\times SC2 + 0.136\times SC3 + 0.051\times UA2 + 0.208\times UA3 + 0.037\times PD2 + 0.151\times PD3 + 0.043\times AD2 + 0.158\times AD3 + 0.050\times N3)$$

For instance, the predicted quality weight for EQ-5D health state "32322" is as follows: [14]

Predicted quality weight = complete health state - disutility

Complete health state = 1.000

Disutility for the 32322 state = 0.050 + 0.418 (M3) + 0.046 (SC2) + 0.208 (UA3)

+ 0.037 (PD2) + 0.043 (AD2) + 0.050 (N3)

Predicted quality weight for the 32322 state = 1- (0.050 + 0.418 + 0.046 + 0.208 + 0.037

+ 0.043 + 0.050) = 0.148

Besides the single indicator EQ-5D, the health-adjusted life years can be calculated to measure the health state of a population and to compare the state between nations. The health-adjusted life years is an indicator that comprehensively measures the disease state and death, and is useful for evaluating disease burdens, the influence of a certain disease on communities, and the economy. The "health-adjusted life years" indicator consists of the quality-adjusted life years and the disability-adjusted life years. The former, compared with the latter, is easy to interpret, reflects the diverse aspects of health, and is obtained from direct surveys of a population, giving it the advantage of making the data more realistic. To calculate the quality-adjusted life years, health life quality weights for the respective heath states are needed, and EQ-5D is a representative health-quality-measuring tool for obtaining such weights.

2.3 Technology acceptance model (TAM)

The technology acceptance model (TAM) proposed by Davis (1989) is the most widely used model for offering an answer to whether or not the users positively accept and use the newly emerging information and device technology. TAM, which was designed based on the theory of reasoned action (TRA) in the social psychology domain, is founded on the framework whereby the user's attitude towards the use of information technology determines his or her intention in performing an action, which in turn determines the actual action of using that information technology. TAM was first developed by Davis to explain the users' behaviors with regard to the acceptance of computer information systems, which are innovative technologies, and it was developed as a theoretical framework for identifying the factors that impact the organization members' acceptance of information technology, which is adopted to improve the organization's work performance. It was assumed that the user's attitude towards the use of information technology can be explained by two leading variables (i.e., perceived usefulness and perceived ease of use). The perceived usefulness directly impacts the intention of using information technology, and is influenced by the combination of the ease of use and external variables. Also, usefulness and ease of use were found to be influenced by external variables [15]. The research on the home use of online diagnosis systems by patients with congestive heart failure (CHF) and chronic obstructive pulmonary disease (COPD) (Rahimpour et al., 2008) also found that the perceived usefulness influenced the intention of use. Lin and Yang (2009) reported in their study on the use of ACMS (Asthma Care Mobile Service) designed for the real-time monitoring of asthma patients that the perceived ease of use affirmatively influenced the perceived usefulness and attitude. Also, Song (2005) [16] reported in his analysis of the acceptance factors for health information websites reported that the perceived ease of use and the perceived usefulness affirmatively influenced the intention of use. An (2005) expanded and revised TAM2 and consequently presented ICTAM (Information and Communication Technology Acceptance Model). In particular, to explain and predict the consumers' e-health website acceptance patterns, An verified if the website's compatibility and perceived playfulness, and website loyalty, are important factors [17]. The past studies on the manipulative definition of TAM variables are presented in Table 2, and the present study also sought to identify the effects of TAM on the elderly's intention in using exclusive Web services, and on their UI requirements.

Table 2. Manipulative definitions of the TAM variables

Variable	Manipulative definition	Relevant studies
Service quality	Direction and degree of difference between the consumer and his expectation	Parasuraman et al. (1985), Kettinger & Lee (1997), Song (2011), Kwon & Kim (2007)
Characteristics of contents	Mobile services' unique personalization service, location situation service, and situation-based service	Kalakota & Robinso (2001), Lee & Jeon (2004)
Innovation	Degree of individuals' spontaneous attempt to use new IT	Agarwal & Prasad (1998), Agarwal & Karahanna (2000), Baek (2007)
Security of information	Trust in the protection and security of personal information	Gunasekaren & Ngai (2003), Jang et al. (2008), Kim et al. (2010)
Cost rationalization	Degree of user-perceived rationalization of the cost of the product or services	LaiVS (2005), Kim et al. (2008), Kim (2011)
Perceived ease of use	Degree of perceived ease of using the service	Davis (1989), Venkatesh & Davis (2000), Choe (2010)
Perceived usefulness	Degree of perceived efficiency and benefit of using the service	Davis et al. (1989), Venkateshetal (2003), Lee (2008)
Behavioral intention to use	Degree of the plan or determination to use mobile-based healthcare services	Davis (1989), Venkatesh & Davis (2000)
Perceived playfulness	Trust in satisfying the essential motivation through interaction on the health information website	An (2005), Song (2011)

3. METHODOLOGY

3.1 Research Instrument

To develop effective health improvement and healthcare service systems for the elderly, the following were identified in

this research: (1) the subjects' EQ-5D, TAM, and general characteristics; (2) the subjects' computer and smartphone use status and healthcare service experience; and (3) the factors that influence the perceived necessity of an exclusive elderly healthcare website and the subjects' UI preferences according to their characters.

The survey items are presented in Table 3. The survey dealt with the subjects' general characteristics, past healthcare service experience, demand for healthcare services, and UI/UX preference. Based on the elderly web interface evaluation criteria and the Korean-version Web Contents Access Guideline, the following UI preference survey items were included: the main menu exposure pattern in the layout category, the data amount and pattern in the typographic category, the main menu pattern in the navigation category, and the icon recognition degree.

Table 3. Survey items

Category	Description
General characteristics	• Age (1) • Sex (1) • Final education (1) • Annual household income (1)
Past service experience	• Status of using smartphone-based health services (3) • Experience in participating in healthcare services (3)
EQ-5D	• Exercise ability (1) • Self-care (1) • Ordinary activities (1) • Pain/inconvenience (1) • Anxiety/depression (1)
TAM	• Acceptance of online healthcare technology (5)
Demand for healthcare services	• Necessity of an exclusive elderly healthcare website (1)
UI preference	• Preference for menu screen (1) • Preference for screens that present the results (1) • Preference for screen composition (1) • Pattern of search function icon recognition (1)

3.2 Research subjects and data collection

The demand survey was conducted as the pretest on March 20-23, 2015, and the main survey was conducted from March 30 to April 20, 2015, by interviewing elderly people aged 55 and above living in Incheon, South Korea. The subjects were selected from among the participants in the elderly welfare center program in Incheon, the elderly people residing in apartments and houses for the elderly, and the elderly people in the surrounding areas. The data were gathered by a research firm's surveyors in the presence of this researcher and the research fellows. The purpose of the research was explained to the subjects before they were interviewed. A total of 308 people were interviewed, considering their age and recognition degree, and 300 accomplished questionnaires were finally analyzed and used.

3.3 Data analysis

To identify the subjects' ages and EQ-5D, TAM, and healthcare web management services and UI requirements, the collected data underwent the editing-coding-key in-programming process and statistical processing using the SPSS 18.0 statistical package. According to the Ministry of Health and Welfare's 2009 elderly status survey, most of the South Koreans then (51.3%) began to think of themselves as elderly at ages 70-74, and according to the current survey, many South Koreans aged 65 do not think of themselves as elderly. As such, the subjects of this study were categorized into the 55-to-69-year-old group (52%) and the 70-year-old-and-older group (48%), and the aforementioned domestic research's health quality weight scale was applied to EQ-5D's five question items (which are used in national health and nutrition surveys, community health surveys, etc.) to produce a single-indicator EQ-5D index as another variable. Then the elderly's health quality was categorized into three stages, based on which the subjects' healthcare service experience and demand for healthcare services were compared with their relevant UI requirements. Based on the results of the comparison, a conclusion was arrived at. With regard to the subjects' elderly health quality stages considering their age range ratios, 128 (42.7%) of the subjects were classified as healthy elderly (health quality weight = 1), 77 (25.7%) as relatively healthy elderly (health quality weight = 0.8 to under 1), and 95 (31.7%) as elderly (health quality weight = under 0.8). TAM, as explained above, classified the average of the answers to the five questions into three groups, and established stages. $\chi 2$ test was conducted through cross-analysis, T-test and ANOVA were conducted through the comparison of the averages, and regression analysis was conducted to evaluate the effects of diverse variables on the perceived necessity of web services for elderly healthcare.

4. RESULTS

4.1 EQ-5D

In this study, the weight by item was assessed using the aforementioned prediction formula for the Koreans' health state quality weight, and the subjects' EQ-5D quality weights were found to range from -0.035 to 1, averaging 0.858. Jo (2007) reported, however, that the national health state weight was predicted to be 0.984, marking a difference from this study, which targeted 55-year-old and older South Koreans. Table 4 presents the survey results by item. Of the subjects, 50.7% (the lowest percentage) reported "having no pain and discomfort," and 87.7% (the highest percentage) reported "having no problem with washing and wearing clothes alone." These results were converted into quality weights: the "under 0.8" weight encompassed 95 subjects (31.7%), the "0.8-1" weight encompassed 77 people (25.7%), and the "1" weight encompassed 128 people (42.7%).

Table 4. Measured values and weights by EQ-5D-3L item

Unit: N(%)

Category		N(%)	Weight
Mobility	I have no problem with walking around.	202(67.3)	
	I have some problem with walking around.	96(32.0)	0.096
	I am confined to a bed.	2(0.7)	0.418
Self-care	I have no problem with self-care.	263(87.7)	
	I have some problem with washing or dressing myself.	37(12.3)	0.046
	I am unable to wash or dress myself.	-	0.136
Usual activities	I have no problem with performing my usual activities.	223(74.3)	
	I have some problem with performing my usual activities.	76(25.3)	0.051
	I am unable to perform my usual activities.	1(0.3)	0.208
Pain/ discomfort	I have no pain or discomfort.	152(50.7)	
	I have moderate pain or discomfort.	141(47.0)	0.037
	I have extreme pain or discomfort.	7(2.3)	0.151
Anxiety/ depression	I am not anxious or depressed.	235(78.3)	
	I am moderately anxious or depressed.	60(20.0)	0.043
	I am extremely anxious or depressed.	5(1.7)	0.158
Total			

4.2 TAM

To identify the subjects' acceptance of IT, this study used the following TAM composition concepts: two items for perceived usefulness, and one item each for playfulness, cost rationalization, and perceived ease of use. The question "Would you consider using a computer or a smartphone to enter your personal health information online and to continue to receive relevant information regarding healthcare from the relevant medical teams?" was asked, and the answer to it was scored based on a 5-point Likert scale. Table 5 presents the following results (average scores): "will consider using the service if the cost is free," 3.99 (the highest score); "helps save healthcare time," 3.98; "effective in managing and preventing chronic diseases," 3.95; and "healthcare sounds interesting," 3.72. Thus, "healthcare sounds interesting" got the lowest score. The average score by age and item was higher in all the items in the under-70-year-old group than in the 70-year-old and older group, and the group with an EQ-5D quality weight of 1 got a higher average score than the group with a weight of under 0.8. TAM by individual averaged the five question scores and classified them. The total average was 3.43, and the subjects, considering the frequency, were classified into three groups (under 3, 3 to under 4, and 4 and higher), and the results were converted into variables. As a result, those with a score of under 3 accounted for 27.7% of the subjects; those with a score of 3 to under 4, 29.7%; and those with a score of 4 or higher, 42.7% (see Table 6).

Table 5. Demand for PC- and smartphone-based healthcare services

Category		Age			EQ-5D quality weight				Total average
		>70	70≤	t	> 0.8	0.8 - ~1	1	F	
Perceived usefulness	Effective in managing and preventing chronic diseases	3.95	2.99	8.197 ***	3.02	3.61	3.76	15.592 ***	3.49
Perceived usefulness	Helps save healthcare time	3.98	2.85	9.445 ***	2.98	3.58	3.69	14.819 ***	3.44
Perceived playfulness	Healthcare sounds interesting	3.72	2.83	7.598 ***	2.98	3.45	3.44	7.024 **	3.30
Cost rationalization	Will consider using the service if the cost is free	3.99	2.96	8.225 ****	3.02	3.73	3.71	15.731 ***	3.50
Ease of use	Can easily obtain healthcare information	3.90	2.88	8.322 ***	2.98	3.57	3.63	13.006 ***	3.41
Total average		3.91	2.90		3.00	3.59	3.65		3.43

*: p<0.05, **: p<0.01, *** : p<0.001

4.3 General characteristics

Table 6 presents the general characteristics of the subjects according to EQ-5D and TAM. The subjects consisted of 211 females (70.3%) and 16 males (16.9%), with the females far exceeding the males in number, and the group with low EQ-5D quality weights had a higher ratio of females. By age, those in their 50s numbered 46 (15.3%); those in their 60s, 110 (36.7%); and those in their 70s and above, 144 (48.0%). The groups with low EQ-5D quality weights and low TAM index scores were older. By final education background, the elementary graduates numbered 102 (34.0%); the middle school graduates, 66 (22.0%); the high school graduates, 101 (33.7%); and the university graduates, 25 (8.3%). The groups with high EQ-5D weights and high TAM index scores were more educated. By annual household income, there were 79 subjects (26.3%) belonging to the under-KRW10-million category, 34 (11.3%) belonging to the 10-million-to-under-KRW30-million category, 37 (12.3%) belonging to the 30-million-to-under-KRW50-million category, and 9 (3%) belonging to the over-KRW50-million category, and 61 subjects (20.3%) answered "no idea." In terms of income, the groups with low EQ-5D quality weights and low TAM index scores had a higher percentage of subjects in the under KRW10 million category and who answered "no idea."

Table 6. General characteristics

Unit: N(%)

Category		EQ-5D quality weight (1 or under)			TAM (full score of 5 points)			Total
		Under 0.8	0.8-1	1	Under 3 points	3 points or higher	4 points or higher	
Gender	M	16(16.8)	15(19.5)	58(45.3)	18(21.7)	27(30.3)	44(34.4)	89(29.7)
	F	79(83.2)	62(80.5)	70(54.7)	65(78.3)	62(69.7)	84(65.6)	211(70.3)
	χ^2	26.334***			3.912			
Age	50-59	4(4.2)	13(16.9)	29(22.7)	0(0.0)	20(22.5)	26(20.3)	46(15.3)
	60-69	26(27.4)	22(28.6)	62(48.4)	10(12.0)	37(41.6)	63(49.2)	110(36.7)
	≤70	65(68.4)	42(54.5)	37(28.9)	73(88.0)	32(36.0)	39(30.5)	144(48.0)
	χ^2	39.378***			76.044***			
Educational level	≤ Elementary school	59(62.1)	26(33.8)	17(13.3)	53(63.9)	21(23.6)	28(21.9)	102(34.0)
	Middle school	19(20.0)	22(28.6)	25(19.5)	14(16.9)	31(34.8)	21(16.4)	66(22.0)
	High school	15(15.8)	26(33.8)	60(46.9)	14(16.9)	28(31.5)	59(46.1)	101(33.7)
	≥ College	2(2.1)	3(3.9)	26(20.3)	2(2.4)	9(10.1)	20(15.6)	25(8.3)
	χ^2	77.570***			61.076***			
Yearly income (10,000 won)	>1,000	51(53.7)	38(49.4)	32(25.0)	38(45.8)	29(32.6)	54(42.2)	79(26.3)
	≤1,000->3,000	5(5.3)	10(13.0)	19(14.8)	1(1.2)	15(16.9)	18(14.1)	34(11.3)
	≤3,000->5,000	3(3.2)	8(10.4)	26(20.3)	2(2.4)	16(18.0)	19(14.8)	37(12.3)
	≤5,000	3(3.2)	8(10.4)	36(28.1)	6(7.2)	17(19.1)	24(18.8)	9(3.0)
	Do not know well	33(34.7)	13(16.9)	15(11.7)	36(43.4)	12(13.5)	13(10.2)	61(20.3)
	χ^2	69.560***			57.835***			
Total		95(31.7)	77(25.7)	128(42.7)	83(27.7)	89(29.7)	128(42.7)	300

*: p<0.05, **: p<0.01, ***: p<0.001

4.4 Overview of the use of smartphones and computers

Fig. 1 presents an overview of the use of smartphones or computers by the subjects. It is numbered 84 (28.0%) who are using both devices; 55 (18.3%) using only smartphones, 22 (7.3%) using only computers, 139 (46.3%) using neither of the two devices. Fig. 2 presents the use period. Those who have been using a computer for over 5 years numbered 70 (the highest share), and those who have been using a smartphone for 1 to under 3 years numbered 45 (the lowest share).

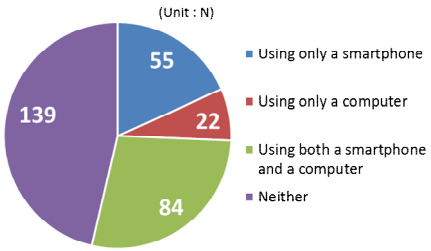


Fig. 1. Results of the survey on the use of smartphones and computers

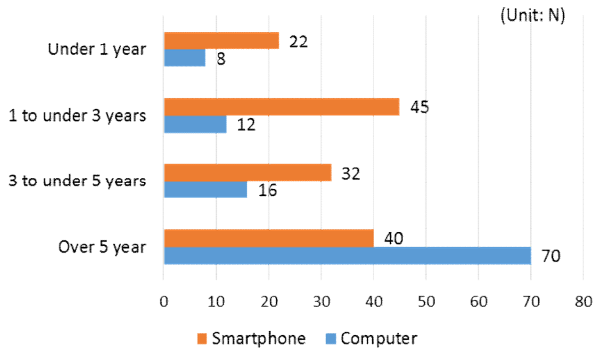


Fig. 2. Smartphone and computer use periods

4.5 Experience in availing of healthcare services

Fig. 3 presents the subjects' experience in availing of healthcare services. Those who have experienced participating in offline programs numbered 105 (35%), those who have experienced availing of online services using a computer numbered 6 (2.0%), and those who have experienced availing of health services using a smartphone numbered 2 (0.7%), which are all very low figures.

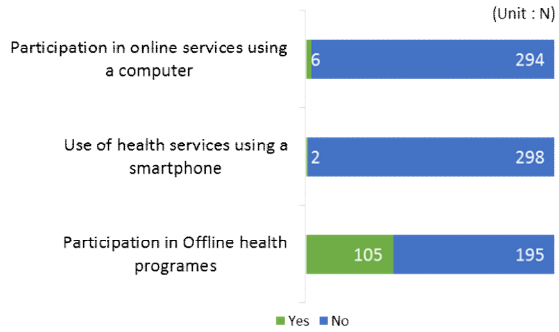


Fig. 3. Experience in availing of healthcare services

4.6 Perceived necessity of a website for elderly healthcare

Regarding the subjects' perception of the necessity of an exclusive elderly healthcare website, 37.7% gave a positive reply, 26.7% gave a negative reply, and 35.7% indicated that they did not know. Table 7 presents the results of the binominal logistic regression analysis of the 193 respondents indicating their perception of the necessity or non-necessity of such a website. The TAM values showed significant results, and Exp(B)=2.992 suggested a positive influence. These results revealed that in the case of TAM, the higher the TAM values were, the higher the perceived necessity of an exclusive elderly healthcare website, while in the case of the general characteristics, age, gender, income, and EO-5D quality weight had no significant impact. The model's explanation power was expressed by Cox and Snell's R-square = 0.215 and Nagelkerke's R-square = 0.289, and the predication accuracy was found to be 73.1%. P-value of the Hosmer-Lemeshow test was .800, proving that the results were significant.

Table 7. Perception of the necessity of an exclusive healthcare website for elderly people

Independent variables	P	Exp(B)	95% confidence interval for Exp(B)	
			Lower limit	Upper limit
Age	.079	.963	.924	1.004
Gender	.070	1.889	.949	3.758
Education	.195	1.296	.875	1.920
Income	.568	1.060	.868	1.295
EQ-5D	.069	1.436	.972	2.122
TAM	.000	2.992	1.994	4.488
Constant	.043	.010		
Cox and Snell's R-square = .215 Nagelkerke's R-square: .289 Hosmer-Lemeshow test result: .800 Classification accuracy: 73.1%				

The logistic regression analysis revealed that the higher the TAM value was, the higher the perceived necessity of an exclusive elderly healthcare website. Table 8 presents the results of the cross-analysis of the logistic regression analysis results. In the group with a TAM value of under 3 points, only 13.2% (the lowest figure) perceived the necessity of an exclusive elderly healthcare website; in the group with a TAM value of 3 to under 4 points, 59.3% perceived such; and in the group with a TAM value of 4 or above, 75.2% perceived such.

Table 8. Perceived necessity of an exclusive elderly healthcare website

Unit: N(%)

Category		TAM (full score of 5 points)			χ^2	Total average
		Under 3 points	3 to under 4 points	4 points or above		
Necessity of an exclusive elderly healthcare website	Needed	5(13.2)	32(59.3)	76(75.2)	43.876***	80(42.5)
	Not needed	33(86.8)	22(40.7)	25(24.8)		113(58.5)
Total		38(19.7)	54(28.0)	101(52.3)		193(100)

*: p<0.05, **: p<0.01, ***: p<0.001

4.7 UI preference

The ease of operation, ease of implementation, and ease of recognition of different UIs were extracted in this study, and the user groups' UI preferences based on these items were confirmed. The subjects were shown screen samples according to such items to measure their UI preferences. Table 9 presents the sample screens by item.

Table 10 presents the subjects' UI preferences by item according to the characteristics of the subject groups. First, in the ease-of-operation category, regarding the main menu exposure type, the screen featuring a fixed menu on the left side was preferred by 175 subjects (58.3%) and the screen allowing wide use of the space (with a hidden menu) was preferred by 125 subjects (41.7%), but no significant results were shown according to the characteristics of the groups. In the ease-of-implementation category, the screen containing detailed explanations of the items was preferred by 122 subjects (40.7%), the largest number; the screen that can confirm the standard scope by item and the user status in a graph was preferred by 109 subjects (36.3%); and the simple screen that allows the user to know his status right away was preferred by 69 subjects (23.0%). Significant results were shown according to age. Among those under 70 years, 51.9% preferred the screen containing detailed explanations of the items, and among those 70 years or above, 43.8% preferred the screen that can confirm the standard scope by item and the user status in a graph. In the ease-of-recognition category, the screen featuring both large letters and large icons was preferred by 190 subjects (63.3%), the largest number; the screen featuring only the menu titles in the text was preferred by 60 subjects (20.0%); and the screen featuring both icons and the menu titles was preferred by 50 subjects (16.7%). By age, the 70-year-old or older subjects (72.2%) with an EQ-5D index score of under 0.8 (55.1%) and the subjects with a TAM score of under 3 (79.5%) preferred large letters and large icons. In the ease-of-recognition category, three types of icons were similarly preferred, but the picture+text type was preferred by the largest number (114 subjects, 38%). By age, 67 subjects (42.9%) in the under-70-year-old category and 63 (43.8%) in the 70-year-old-and-above category preferred the picture+text type the most. In terms of EQ 5DS, 42 subjects (44.2%) with an under 0.8 score preferred the picture type, 34 subjects (44.2%) with a score of 0.8 to under 1 preferred the text type, and 63 subjects (49.2%)

with a score of 1 or above preferred the picture+text type. In terms of TAM, 51 subjects (61.4%) with a score of under 3 preferred the picture type, 38 subjects (42.7%) with a score of 3 to under 4 preferred the picture+picture type, and 57 subjects (44.5%) with a score of 4 or above preferred the picture+text type.

Table 9. UI samples by item

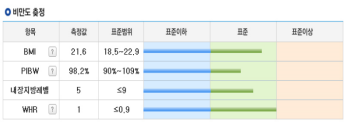
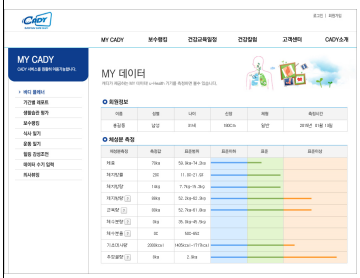
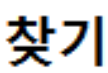
		Category
Ease of operation	Main menu expo-sure type	 A. Screen featuring a fixed menu on the left  B. Screen allowing wide use of the space (with a hidden menu)
Ease of understand-ing	Data amount/ type	 A. Screen that can confirm the standard scope by item and the user status in a graph  B. Simple screen that allows the user to know his status right away  C. Screen containing detailed explanations of the items
Ease of recognition	Main menu type	 A. Screen featuring only the menu titles in the text  B. Screen featuring both icons and the menu titles  C. Screen featuring both large letters and large icons
ase of recognition	Icon	 A. Picture+text  B. Picture  C. Text(Search)

Table 10. Evaluation of UIs

Unit: N(%)

Category			Age		EQ-5D			TAM			Total
			Under 70	70 and older	Under 0.8	0.8 to under 1	1	Under 3	3 to under 4	4 and above	
Ease of operation	Main menu exposure type	A	95 (60.9)	80 (55.6)	53 (55.8)	38 (49.4)	84 (65.6)	49 (59.0)	44 (49.4)	82 (64.1)	175 (58.3)
		B	61 (39.1)	64 (44.4)	42 (44.2)	39 (50.6)	44 (34.4)	34 (41.0)	45 (50.6)	46 (35.9)	125 (41.7)
	χ^2		0.879		5.609			4.643			
Ease of understanding	Data amount/ type	A	46 (29.5)	63 (43.8)	31 (32.6)	28 (36.4)	50 (39.1)	35 (42.2	32 (36.0)	42 (32.8)	109 (36.3)
		B	29 (18.6)	40 (27.8)	21 (22.1)	23 (29.9)	25 (19.5)	21 (25.3)	23 (25.8)	25 (19.5)	69 (23.0)
		C	81 (51.9)	41 (28.5)	43 (45.3)	26 (33.8)	53 (41.4)	27 (32.5)	34 (38.2)	61 (47.7)	122 (40.7)
	χ^2		17.067***		4.316			5.413			
Ease of recognition	Main menu type	A	38 (24.4)	22 (15.3)	10 (10.5)	16 (20.8)	34 (26.6)	7 (8.4)	26 (29.2)	27 (21.1)	60 (20.0)
		B	32 (20.5)	18 (12.5)	11 (11.6)	14 (18.2)	25 (19.5)	10 (12.0)	18 (20.2)	22 (17.2)	50 (16.7)
		C	86 (55.1)	104 (72.2)	74 (77.9)	47 (61.0)	69 (53.9)	66 (79.5)	45 (50.6)	79 (61.7)	190 (63.3)
	χ^2		9.427**		14.295**			16.943**			
Ease of recognition	Icon	Picture+text	67 (42.9)	47 (32.6)	33 (34.7)	18 (23.4)	63 (49.2)	19 (22.9)	38 (42.7)	57 (44.5)	114 (38.0)
		Picture	40 (25.6)	63 (43.8)	42 (44.2)	25 (32.5)	36 (28.1)	51 (61.4)	28 (31.5)	24 (18.8)	103 (34.3)
		Text	49 (31.4)	34 (23.6)	20 (21.1)	34 (44.2)	29 (22.7)	13 (15.7)	23 (25.8)	47 (36.7)	83 (27.7)
	χ^2		10.893**		23.284***			42.198***			
	Total		156 (52)	144 (48)	95 (31.7)	77 (25.7)	128 (42.7)	83 (27.7)	89 (29.7)	128 (42.7)	300 (100)

5. CONCLUSION

To present tailored user interfaces (UIs) for the provision health promotion web services, this study surveyed relevant variables and prepared the basic data needed for the development of such services by statistically processing and analyzing the results of the survey that was conducted. It further surveyed and analyzed the elderly subjects' preference for healthcare web service UIs and their requirements according to the three variables of age, EQ-5D, and TAM.

The study subjects were selected from among elderly people, including those entering the elderly age stage (in their 50s and above), living in Incheon, South Korea. A demand survey was conducted as a pretest on March 20-23, 2015, targeting 12 people. Then the main survey was conducted from March 30 to April 20, 2015, with the help of the surveyors of a research firm. A total of 308 subjects, considering their age and cognition degree, were interviewed, and 300 effective cases were analyzed and used.

The obtained data were analyzed using the SPSS statistical program, and simple frequency analysis, χ^2 test, t-test, ANOVA, and logistic regression analysis were used according to the research problem.

The following analysis results were obtained:

1) The average EQ-5D quality weight was predicted to be 0.858 when calculated using the Korean-type quality weight formula. Those who were found to belong to the “under 0.8” category numbered 95 (31.7%); in the “08 to under 1” category, 77 (25.7%); and in the “1” category, 128 (42.7%).

2) TAM averaged 3.43 points based on a full score of 5. Cost rationalization obtained a score of 3.99, the highest score. This suggests that if cost rationalization is ensured, the elderly’s demand for healthcare services will increase. To group TAM, the five question scores were averaged, revealing that 27.7% of the subjects belonged to the “under 3” category, 29.7% to the “under 3 to under 4” category, and 42.7% to the “over 4” category.

3) The general characteristics and the characteristics of the groups classified by EQ-5D and TAM were examined, and it was found that there were high correlations between age, EQ-5D, and TAM. The groups with lower scores in EQ-5D and TAM were older and had lower education and income.

4) Regarding the use of smartphones and computers, 53.7% of the subjects used them, and regarding the use period, most of the subjects used the devices for over 5 years, followed by 1-3 years. Smartphones were used more frequently than computers. This suggests that mobile-based services, together with computer-based services, must be provided.

5) Regarding experience in availing of healthcare services, 35% of the subjects participated in offline healthcare programs, but 0.7 and 2.0% had experienced availing of mobile- and computer-based services, respectively, revealing that the elderly subjects had insufficient experience in availing of smart healthcare services.

6) The regression analysis of the factors that influenced the necessity of putting up an exclusive elderly healthcare website revealed that TAM had a significant impact and that the groups with a higher TAM index needed the website more. Of the group with a TAM score of under 3, 13.2% showed a need for an exclusive elderly healthcare website (the lowest ratio); of the group with a score of 3 to under 4, 59.3%; and of the group with a score of 4, 75.2% (the highest ratio).

7) Regarding the UI preference, in the ease-of-implementation category, the older groups preferred the provision of data in graphs. In the ease-of-recognition category, the older groups and the groups with lower scores in EQ-5D and TAM preferred the main menu type. As it was found that in terms of the general characteristics, the older groups were associated with lower scores in EQ-5D and TAM, it was likewise found that with regard to the UI preference, age, EQ-5D, and TAM had high correlations. In the ease-of-recognition category, regarding the preference for icons, the older groups preferred the picture type.

In providing web or mobile-based healthcare services to the elderly, this study found that according to EQ-5D, TAM, and age, tailored UIs such as the icon type and screen composition are needed. Regarding the web and mobile-based healthcare services, prior to this study, no research had been conducted to simultaneously examine the impacts of age, EQ-5D, and TAM, and only studies on the correlations between the items had been conducted. Regarding researches involving age as a variable, Koh (2011) [18] found that older people have a higher demand for healthcare services. This differs from the finding of this study that younger people need web services more, but this can be explained by the fact that Go classified age into the 20s, 30s, 40s, and over 50s while this study targeted those entering the elderly stage and the advanced elderly people. In relation with EQ-5D, studies have thus far focused on defining the difference based on the class to which a person belongs, or on diseases. Regarding studies related to TAM, Song (2011) and Lee (2014) defined the TAM factors that have significant impacts on U-Health-based healthcare services. This study did not classify TAM by factor but instead defined the significant effects on the need for an exclusive elderly healthcare website by the average TAM and EQ-5D scores. It was found in this study that the younger groups with high scores in EQ-5D and TAM found it necessary to develop UIs with the aim of maximizing the use of web or mobile-based healthcare services, while the older groups with low scores in EQ-5D and TAM, who did not use mobile or web services that much, indicated the need to be provided with offline services and to be motivated to use such services.

Elderly people have to practice healthcare daily, and to manage various elderly diseases. As such, they are required to exert more efforts than the people of other ages to maintain and improve their health. A strong need for elderly healthcare has surfaced, and a greater need for elderly healthcare services using advanced health IT and communication technologies and web or mobile technologies, is emerging, along with offline elderly healthcare services. The findings of this study are expected to be of help in developing an exclusive elderly healthcare website by providing diverse services for diverse levels of users, based on individual characteristics and quality of life, and on technology acceptance models. If UIs and contents fit for individuals are provided, it will increase individuals' access to healthcare services, and will expand the effect of health improvement. This study, however, limited the sampling to Incheon, South Korea; as such, further studies on UIs for the elderly covering diverse regions and research items should be conducted.

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REFERENCES

[1] Y. H. Oh, *Prevention-Oriented Health Care Services for Older Adults: Based on the Longitudinal Study of M City*, Korea Institute for Health and Social Affairs (KIHASA), 2011.

[2] J. S. Choi, *2011 Korea Health Panel Survey*, Korea Institute for Health and Social Affairs (KIHASA), 2011.

[3] E. S. Kim, H. C. Lee, J. H. Joo, and G. T. Hur, "Developing Functional Game Contents for the Silver Generation," Journal of the Korea Contents Association, Vol. 9, No. 9, 2009, pp.151-162.

[4] Statics Korea, e-Nara index, Internet use rate for 2014, mobile internet and device use overview for 2013. http://www.index.go.kr/

[5] M. R. Seo and A. K. Kim, "The Use of Persona Based Scenario Method for the Development of Web Board Game for the Pre-elderly," International Journal of Contents, Vol. 10, No. 2, 2014, pp. 37-41.

[6] M. Hiltunen, M. Laukka, and J Luomala, *Mobile user experience*, Hanbit Media Pub., 2007.

[7] R Oppermann, *Handbook on Information Technologies for Education and Training*, Springer Berlin Heidelberg, 2002, pp. 233-248.

[8] D. H. Sin, *Humanitas technology*, Communication Books Inc. Pub., 2013.

[9] S. A. Becker, "E-government visual accessibility for older adult users," Social Science Computer Review, Vol. 22, No. 1, 2004, pp. 11-23.

[10] O. S. Kweon, "Guidelines for mobile phone user interface development," Korean Journal of the Science of Emotion and Sensibility, Vol. 12, No. 3, 2009, pp. 325-330.

[11] E. J. Kang, H. S. Shin, H. J. Park, M. W. Jo, and N. Y. Kim, "A valuation of health status using EQ-5D, Korean

Journal of Health Economics and Policy," Vol. 12, No. 2, 2006, pp. 19-43

[12] J. H. Yun, J. M. Kang, K. S. Kim, S. H. Kim, T. H. Kim, Y. W. Park, Y. K. Sung, J. H. Sohn, B. J. Song, W. S. Uhm, H. J. Yoon, O. Y. Lee, J. H. Lee, C. B. Lee, C. H. Lee, W. T. Jung, J. Y. Choe, H. S. Choi, D. S. Han, and S. C. Bae, "Health-Related Quality of Life in Korean Patients with Chronic Diseases, Journal of Rheumatic Diseases," Vol. 11, No. 3, 2004, pp. 263-274.

[13] M. H. Kim, Y. S. Cho, W. S. Uhm, S Kim, and S C Bae. "Cross-cultural adaptation and validation of the Korean version of the EQ-5D in patients with rheumatic diseases," Quality of Life Research, Vol. 14, No. 5, 2005, pp. 1401-1406.

[14] M. W. Jo and S. I. Lee, "General Population Time Trade-off Values for 42 EQ-5D Health States in South Korea," Journal of Preventive Medicine & Public Health, Vol. 40, No. 2, 2007, pp. 169-176.

[15] F. D. Davis, "Perceived usefulness, perceived ease of use, and user acceptance of information technology," Management Information Systems Quarterly, Vol. 13, No. 3, 1989, pp. 319-341.

[16] T. M. Song, "Analysis of acceptance factors for U-Health-based healthcare services. Samsung SDS JrIT Service," Vol. 9, No. 1, 2011, pp. 142-162.

[17] J. Y. An, *Correlates and predictors of consumers' health information and services usage behavior on the internet: A structural equation modeling approach*, Doctoral dissertation New York University, 2005.

[18] D. Y. Koh and H. S. Cho, "Analysis on the Demand for Ubiquitous Healthcare Services : Focusing on Home-based Telemedicine and Telehealth management Services." Journal of the Korea Society of IT Services, Vol. 10, No. 3, 2011, pp. 265-284.

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