The Role of Health Status in Older Adults' Perceptions of the Usefulness of eHealth Technology

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Abstract. Objectives: To investigate the relationship between an older individual's self-reported health and the perceived usefulness of computers in assisting with health-related tasks. Methods: A total of 210 older adults (age ≥ 60) completed questionnaire items pertaining to demographics, general health, perception of importance of daily activities, technology experience and use, and perceived usefulness of computers and the Internet. Results were obtained using a factor analysis and multiple regression. Results: Self-reported health was found to have a significant negative relationship with the importance of health-related activities to daily living (Beta = -0.210) but a significant positive relationship with the perceived usefulness of computers in assisting with the same health-related activities (Beta = 0.151). Discussion: Results indicate that adoption of health-supporting technologies could be facilitated by user-centered designs that better accommodate older adults in poor health. Alternatively, adoption may be facilitated by making the potential usefulness of computers more salient to older adults.

Keywords: Self-reported health · eHealth technology · Technology adoption

1 Introduction

eHealth technologies are a potentially valuable tool for addressing the rising health care needs of the aging American population [1]. These technologies have the potential to facilitate health interventions by both increasing the availability and efficiency of existing health care activities as well as providing additional services. For example, computers and the Internet can be useful in assisting patients with contacting physicians, scheduling appointments, tracking health metrics, maintaining schedules (e.g., for medications or appointments), and searching for health-related information. eHealth alternatives to traditional physician visits have the potential to reduce associated costs of health care by increasing efficiency of patient interaction without sacrificing quality of care [2].

However, subjective attitudes toward the use of eHealth technologies are a potential barrier to adoption. In general, older adults are less likely to use technology than their

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younger counterparts [3, 4]. However, the relationship between attitudes toward the usefulness of eHealth technology and health status is not well-specified. In this study we assess whether those in poorer health, who potentially stand to benefit the most from eHealth interventions, perceive technology as less useful in the health domain.

1.1 Aging and Self-reported Health Status

Health status is often measured by self-report. As a measure, self-rated health is meant to convey an individual's overall sense of physical well-being [5]. Self-rated health has been found to be associated with functional status and objective measures of health [6, 7], mortality [8], and the use of health care services [9]. With regard to functional health, Pinquart [10] found stronger associations between perceived health and basic competence (activities of daily living) than with expanded competence (instrumental activities of daily living and leisure activities). That is, people's perceptions about their health and their competence in basic daily living skills (e.g., bathing, dressing) was more related to their functional health than their competence in activities such as cooking, cleaning, financial management, and medication adherence. Specifically related to technology, self-rated health has been found to display a significant positive relationship with general computer use [11].

Compared to young and middle age adults, older adults are more likely to self-report their health as being fair or poor (23.3 % of 65 + year old adults) and make more visits to the offices of doctors or other health care professionals. Nearly 60 % of 65 + year old adults make more than four office visits per year [12] and perceived health status likely underlies the decision to seek health care.

Critical to interpreting self-reported health ratings, how individuals gauge their subjective health may change over the life span. Older adults may be more likely than younger adults to attribute lower levels of function to the aging process, rather than to poor or deteriorating health [13–15]. Pinquart [10] observed an age-associated decrease in the relationship between perceived health and actual physical and functional health, and concluded that older adults mitigated the aging process's (presumed) negative effect on their global health perception by adapting the objective criteria that they used to judge their perceived health to account for the growing number of age-associated objective health problems. This flexibility in older individuals' definition of perceived health deteriorates in the old-old though, shown by stronger ratings of decline in absolute health in this group. For a more in-depth review of the correlates of subjective health ratings in older adults, and what factors older adults consider when making these ratings, see [9, 16]. Thus, although health status declines with age, perceived health ratings may provide a conservative view of actual health status and potentially mask relationships between health status and other variables.

1.2 Aging and Technology

Older adults may particularly benefit from eHealth technologies due to their disproportionately greater health care needs compared to younger cohorts. An important

prerequisite for the adoption of eHealth technologies is that the intended user must be comfortable using computers, the Internet, and other related communications technologies [17]. Unfortunately, age is negatively related to perceived ease of use and perceived usefulness of the Internet [18], two significant predictors of technology acceptance [19], which could represent a barrier for eHealth adoption. Although an age bias against older adults using computer technology has been documented [20], recent Pew reports show that the number of older adults using the Internet grew from 40 % of those polled in 2010 [21] to 57 % in 2014 [4]. Additionally, when provided with training and an opportunity to use the Internet, older adults seem willing to adopt Internet use into their repertoire. In a randomized controlled trial, White et al. [22] taught a group of older adults how to use the Internet in a total of nine hours of small group training over two weeks and found that five months after the end of the trial, 60 % of those in the trained group still used the Internet on a weekly basis. Moreover, older adult Internet users are reportedly comfortable with using the Internet for health-related tasks [23]. Therefore, there is reason to believe that eHealth adoption by older adults has the potential to increase in the future.

1.3 Self-reported Health and eHealth Adoption

Like age, health status could serve as a barrier for eHealth adoption, but the evidence of a relationship between the two variables is mixed. White et al. [22] reported no significant effect of self-reported health status on general Internet use in a convenience sample of 48 older adults in their intervention group (being trained to use a computer system), finding that 65 % of those reporting good to excellent health used the Internet compared to 53 % of those who reported fair to poor health. But, lower self-reported health may be negatively related to using the Internet specifically for health-related activities. In fact, a cross-sectional survey of a representative Parisian sample (n = 3023) investigating the use of the Internet for seeking health information found that after adjusting for socioeconomic characteristics, all ages of individuals reporting lower levels of health used the Internet less for health-related purposes than healthy individuals [24]. Similarly, a study of seven European countries' use of eHealth services found that those individuals who described their health status as poor were less likely to use the Internet for health information, *but* being diagnosed with a long-term illness or disability and a high number of visits to a general practitioner were related to more use of the Internet to access health information [25]. It seems, from the evidence provided in this 2007 study, that those who suffer from illness but who nevertheless feel healthy use the Internet the most for health purposes.

Although previous studies have reported on the relationship between self-reported health and Internet use for health-related purposes, the factors driving those relationships are unclear. Additionally, many of the aforementioned studies investigated a general population, with potential confounds between age and technology use. Among older adult populations, we propose that perceptions about the usefulness of computers for health-related activities may be a contributing factor in the relationship between self-reported health and use of computers and the Internet for health-related purposes. In a focus group study with older adults [26], the perceived benefit of technology was

more indicative of technology acceptance than perceived cost. For the individuals who have less computer and Internet experience [20], the perception of usefulness of computers for health-related tasks may be a more appropriate dependent variable than current use of the Internet for health-related tasks. The current study specifically investigated the relationship between older adults' self-reported health status, the importance of health-related activities, and perceived usefulness of computers for health-related activities while controlling for age, income, education, computer use, and frequency of computer use. The control variables were included to account for variance not described by the primary variables.

2 Methods

2.1 Participants

Three hundred and twenty-one older adults (57 % female) between the ages of 60 and 93 (M = 74.62; SD = 5.98) completed and returned the Computer Preferences and Usage questionnaire. Questionnaires were distributed by mail to individuals drawn from databases of older adults in the Tallahassee, FL and Atlanta, GA metro areas. Participants were not compensated for their participation. Further information about the total sample is available in [27].

Only individuals who completed all of the target items (described below under the heading "measures & descriptive statistics") were included in the final analysis, resulting in total sample of 210 older adults (53.5 % female) between the ages of 60 and 89 (M = 74.1; SD = 5.75). An additional 16 respondents completed the questions necessary for computation of the dependent variable but did not provide their age, resulting in a final sample size of 194 older adults for the analysis including age as a variable.

2.2 Materials

The 381-item Computer Preferences and Usage questionnaire comprised five sections. The first two sections of the questionnaire collected information on demographics and technology experience, respectively. The third addressed the individual's perceptions of the importance of various tasks in their daily life. The fourth section addressed the perceived usefulness of computers in assisting with the tasks described in the third section. The fifth section of the questionnaire, which was not used in the current analysis, collected data on preferences for design and features for a hypothetical computer system. Preference and importance-related items were answered on a 5 point Likert scale with "1" indicating strong disagreement, "3" indicating a neutral response, and "5" indicating strong agreement. More information on the measure can be found in [27].

2.3 Measures

The current analysis focuses on only a subset of the overall questionnaire data. The goal was to assess the degree to which self-reported general health was predictive of the perceived importance of health care/maintenance tasks to daily life and the perceived usefulness of computers in assisting with these tasks.

Demographics. In addition to self-reported general health rating, data pertaining to potentially confounding variables (education, income, computer use, and frequency of computer use) were included.

Table 1. Demographics of Participants (total n = 210)

	Sample n	%
General Health		
Poor	2	1
Fair	26	12.3
Good	76	36.2
Very good	79	37.6
Excellent	27	12.9
Education		
Less than high school graduate	1	0.5
High school graduate/GED	25	11.9
Vocational training	3	1.4
Some college/Associate's degree	55	26.2
Bachelor's degree	65	31.0
Master's degree (or other post-graduate training)	50	23.8
Doctoral degree (PhD, MD, EdD, DDS, JD, etc.)	11	5.2
Income		
Less than $10,000	3	1.4
$10,000-$19,999	16	7.6
$20,000-$39,999	42	20.0
$40,000-$59,999	52	24.8
$60,000-$79,999	22	10.5
$80,000 or more	44	21.0
Do not know /Do not wish to answer	31	14.8
Computer Use		
Yes	208	99.0
No	2	1.0
Frequency of Computer/Internet Use		
Less than 1 h per week	13	6.2
Between 1-5 h per week	44	20.9
More than 5, but less than 10 h per week	65	31.0
10 or more hours per week	88	41.9

Importance of Health-Related Tasks. A subset of questions asked participants to rate the importance of 9 different health-related tasks in their daily life. The tasks included communicating with doctors and health professionals, creating appointment reminders, creating medication reminders, managing illnesses, researching health-related issues, researching symptoms, researching health insurance, researching medications, and scheduling appointments.

Usefulness of Computers in Health-Related Tasks. A separate subset of questions asked participants to rate the perceived usefulness of computers in assisting with the same 9 tasks described above.

3 Results

3.1 Demographic Data

The demographic data is presented in Table 1. Out of the 210 participants included in the current analysis, response rate for the demographics questions was 100 % with the exception of the questions pertaining to yearly household income to which 31 individuals indicated either that they did "not know for certain" or did "not wish to answer" and age to which 16 individuals did not respond.

Overall, respondents rated their health positively with a median of "very good". Median values for education (Bachelor's degree; national average: Completed high school), income ($40,000-$59,999; national average: $25,704 for males and $15,072 for females), computer/Internet use (99 %, national average: 53 %), and frequency of computer use (> 5 but < 10 h per week) indicated a rather well educated [28] and technology experienced [21] sample when compared to the national average.

3.2 Factor Analysis

The questionnaire items of interest to the present analysis (importance of health-related tasks and usefulness of computers in health-related tasks) were presented in separate sections of the questionnaire. Even though the two groups of questions were conceptually separated during the questionnaire design, the lack of a priori hypotheses concerning the relationship between self-reported health and the dependent variables led us to conduct an exploratory factor analysis as a method of reducing the health-related task questionnaire items to a set of factor scores. The exploratory factor analysis was conducted on the 18 items covering perceptions of importance to daily life and usefulness of computers for the 9 health-related tasks using principal components extraction and varimax rotation. The initial factor analysis discovered multicollinearity. An investigation of the individual item correlations uncovered that the item "researching symptoms" in both the importance and usefulness subsets was highly correlated (> 0.8) with the other "researching" related items. This item was removed in both subsets, resulting in a final group of 16 items.

The factor analysis on the remaining 16 items used principal components extraction with varimax rotation. Three factors emerged explaining 68.09 % of the variance and were labeled: "usefulness of technology for functional support of health", "importance

of functional support of health", and "health-related information gathering". Items and factor loadings are presented in Table 2.

Table 2. Factor loading by questionnaire item. Responses on a scale of 1 to 5, where 1 indicates strong disagreement, 3 indicates a neutral position, and 5 indicates strong agreement

Factor /Items	Factor	
(sorted from highest to lowest mean)	Loading	Mean (SD)
1. Usefulness of Technology for Functional Support of Health		
Computers/Internet are useful…		
Communicating with doctors or other health care professionals	.71	2.75 (1.40)
Creating appointment reminders	.87	2.63 (1.46)
Managing Illnesses	.74	2.63 (1.38)
Scheduling appointments	.86	2.49 (1.50)
Creating medication reminders	.88	2.37 (1.35)
2. Importance of Functional support of health		
Health activity important to my daily life…		
Communication with doctors and health professionals	.74	4.55 (.80)
Managing Illnesses	.77	4.37 (.97)
Scheduling appointments	.80	4.30 (.95)
Creating appointment reminders	.75	4.25 (.90)
Creating medication reminders	.76	3.76 (1.19)
3. Health-Related Information Gathering		
Health activity important to my daily life…		
Researching general health issues	.72	3.79 (1.04)
Researching medications	.76	3.72 (1.10)
Computers/Internet are useful…		
Researching general health issues	.74	3.58 (1.36)
Health activity important to my daily life…		
Researching health insurance	.73	3.46 (1.16)
Computers/Internet are useful…		
Researching health insurance	.63	2.80 (1.45)
Researching medications	.77	3.33 (1.44)

3.3 General Health X Health-Related Factors

We examined the unique contribution of health to attitudes by conducting regression analyses predicting each of the three factor scores from general health rating (n = 210). As seen in Table 1, only 2 participants (< 1 % of the total sample) reported their general health as "poor". For purposes of the regression analyses, general health was recoded to combine individuals who reported either "poor" or "fair" health into one group, resulting in four distinct health classifications. A significant positive relationship was found between general health rating and Factor 1 (Usefulness of technology for

functional support of health) (Beta = 0.146, p = .044), whereas a significant negative relationship was found between general health rating and Factor 2 (Importance of functional support of health) (Beta = -0.197, p = .006). No significant relationship between general health rating and Factor 3 (Health-related information gathering) was found (Beta = 0.092, p = .202).

To control for the effects of potentially confounding variables, a second regression analysis was conducted with the inclusion of age, education, income, gender, and frequency of computer use (n = 194). The control variables were added in an attempt to isolate the relationship between general health and the health-related factor scores. Overall, in this second model the relationships between general health rating and health-related factor scores were unchanged. A significant positive relationship was found between general health rating and Factor 1 (Usefulness of technology for functional support of health; Beta = 0.151, p = .040), whereas a significant negative relationship was found between general health rating and Factor 2 (Importance of functional support of health; Beta = -0.210, p = .003). No significant relationship between general health rating and Factor 3 (Health-related information gathering) was found (Beta = 0.084, p = .243). Along with the effect of general health rating in these expanded models, age was found to have a positive relationship with Factor 2 (Beta = 0.225, p = .002) and frequency of computer use (Beta = 0.191, p = .008) and being female (Beta = 0.222, p = .005) were found to have a positive relationship with Factor 3.

4 Discussion

In the current study, we investigated the relationship between self-reported health and perceptions of the importance of health-related activities and the usefulness of computers in supporting health-related activities. As a method of reducing the questionnaire data into factor scores, an exploratory factor analysis uncovered three factors among the health-related questionnaire items. The factors were characterized by items pertaining to the functional support of health (Factor 2: Importance of functional support of health), the usefulness of computers in assisting with the same aforementioned support-related activities items (Factor 1: Usefulness of technology for functional support of health), and items related to both the importance of- and usefulness of computers in searching for health-related information (Factor 3: Health-related information gathering).

Self-reported health significantly predicted factor scores for the first two factors; those containing items pertaining to the importance of health-supporting activities and the usefulness of computers in assisting with the same activities. As might be expected, self-reported health had a negative relationship with the importance of health-related activities to daily living (i.e., increasing self-reported health was related to decreasing ratings of importance for health-related activities). On the other hand, self-reported health had a positive relationship with the perceived usefulness of computers in assisting with health-related activities (i.e., increasing self-reported health is related to increasing ratings of perceived usefulness of computers for health-related activities). Even though health management activities were reported to be increasingly important

as self-reported health decreased, computers were perceived as being decreasingly useful in assisting with these tasks along the same self-reported health trend.

Unfortunately, the design of the study did not allow us to investigate why individuals reporting lower levels of health perceive computers as being less useful in assisting with health-related tasks that they find important to their daily lives. Two potential reasons can be postulated. First, these individuals may have attempted to use computers to assist with their health management activities but found that computers were too difficult to use or provided no benefit over other methods. Second, these individuals may not have experience with computers being used in the capacities identified in the questionnaire items. Perceptions of computers being less useful for assisting in these activities may be driven by preconceived notions of a computer's ability to assist with a health management activity or a general technology aversion. To better understand these findings, future studies should separate preconceived perceptions and those resulting from experience.

Individuals who have experience with computers in assisting with health-related activities may find them less useful when compared to low-tech aids with which they are familiar. For example, one of the items that loaded onto the "Usefulness of technology for functional support of health" factor asked individuals about their perceptions of the usefulness of computers in assisting with creating medication reminders. Park et al. [29] found that older adults (who were allowed to use external aids to promote medication adherence) were actually more likely than younger adults to adhere to a medication schedule. Participants were able to adhere to the medication schedule at a high level without the use of computer-based reminders. Another item queried perceptions of the usefulness of computers in creating appointments and communicating with doctors. Leong et al. [30] found that patients were satisfied with email communication with physicians, finding it convenient. But, response time for email correspondence was slower compared to traditional telephone contact (i.e., 83.5 % of phone messages were addressed the same day compared to only 38 % of emails being answered the same day). Individuals in poorer health might prefer the low-tech option because they may have more time sensitive health-related issues for which they need to promptly reach their physician. Computers would be less useful in this instance compared to telephone communication.

Our results indicate that self-reported health status was not related to items pertaining to searching for health-related information. Searching for health-related information is the third most frequently reported activity of individuals using the Internet, with 80 % of all Internet users reporting looking for health information online [20]. Of the 40 % of 65 + aged adults who reported using the Internet in 2010, nearly three quarters have looked online for health information. More recent data report 53 % of 65 + aged adults now go online [21], likely resulting in an increase in the population of seniors searching for health information online. But, personal health status may not always act as the catalyst for health information searching online. Seniors reported that their last search for health information was on their own behalf only 48 % of the time [31]. An individual's health status as well as the health status of friends and family could result in an individual searching for health information online.

When dealing with older adults' subjective health measures it is important to note that the number of health problems and general frailty increase in old age. More

critically, this one-item rating scale may not provide factorial invariance with age, that is, it may measure different health constructs at different ages. Thus, the relationships observed between this one-item measure of health status and perceptions of the importance of health to everyday activities and the usefulness of computers for supporting health care activities needs further replication. Nonetheless, health status held different relationships with other variables (positive, negative, zero) suggesting that it is a promising predictor.

5 Conclusion

eHealth technologies have the potential as health care aids to increase the availability, efficiency, and effectiveness of health care interventions. In order to facilitate the adoption of these technologies, it is necessary to identify and address potential barriers within the target user base. The current study highlights the importance of educating potential older users about such technologies given current negative perceptions about their utility in supporting health care activities. Individuals reporting lower levels of health, who may receive the most potential benefit from health-related technologies, may be resistant to technology adoption due to a lower perception of usefulness of computers in assisting with health-related activities. Models of technology adoption, such as UTAUT2 [32], indicate that perceived usefulness and perceived ease of use are robust predictors of acceptance and adoption. Melenhorst et al. [26] found that perceived benefit was more related to technology acceptance than perceived cost. The potential benefits provided by the integration of technology in health care interventions should be clearly communicated to potential users to increase the likelihood of adoption. Alternatively, low-health seniors who have found computers less useful than low-tech solutions for supporting health can be specifically included in participatory design. The addition of these individuals in the design process could provide designers with information needed to improve usability and functionality of health technology as well as lower the costs associated with learning to use eHealth technology in the target population.

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