

Evaluation of a Nutrition and Health Educational Online Computer Program for Older Adults

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Abstract

Background: Many older adults are at increased risk for nutritional deficiencies and foodborne illnesses. The objective of this study was to develop and evaluate the effectiveness of a user-friendly computer application that provides nutrition, food safety, and health information tailored to the needs of older adults.

Methods: To determine the effectiveness of the program, a 12-month intervention study was conducted in which subjects were assigned to an experimental (HE-HA) group (access to the computer program) or a control (CON) group (no access to computer program). Computers were placed in each of two Vermont rural congregate meal sites. One site served as the HE-HA group site and the other as the CON site. Forty-one adults congregate meal users (HE-HA group: n=16; CON group: n=25) age ≥ 55 , were recruited to participate in the study. The Nutrition Screening Initiative (NSI) checklist, food behavior checklist, and computer attitude surveys were completed by participants at baseline, 3, and 12 months. Focus groups were conducted between 8 and 9 months. Between and within group over time differences were statistically analyzed by Chi-square analyses and repeated measures ANOVA.

Results and Conclusions: A significant positive impact of our program was noted on fruit and vegetable consumption ($p < 0.005$) and attitude regarding use of computers ($p < 0.02$). Focus group results indicated that all HE-HA participants claimed to have changed at least one aspect of his/her diet and that the Website contributed to this positive change. They also noted that the help of the "peer mentors" was a significant factor in their positive experience with using the Web application and with the use of computers in general. In this study, we demonstrated the successful use of a nutrition and health computer application in improving both nutrition behavior and computer skills and attitudes in older adults.

Keywords: Elderly; Computers; Nutrition education; Tailored message

Introduction

The proportion of the U.S. population over the age of 65 is expected to increase to nearly 20% by the year 2030 [1]. Older adults are at increased risk for chronic disease and poor nutrition increases the risk for many of these chronic diseases, including diabetes, hypertension, cardiovascular disease, osteoporosis and arthritis. One or more of these nutrition-related chronic diseases occur in 80-86% of adults over the age of 70 [2]. Their risk for food-borne illness is also high because of compromised immune function and other age-related physiological changes. The impact on health care costs is dramatic. Per capita health care cost for individuals over the age of 65 is three to five times higher than for those under 65 years of age [1].

Increasingly, public health efforts are aimed at trying to prevent or delay the onset of chronic disease and disease-related complications. Good nutritional status can help accomplish this goal. The question remains, to what extent will nutrition interventions adopted later in life improve nutrition-related risk factors and quality of life for older adults? Older adults are seeking health information more than any other age group and are willing to adopt behavioral changes in order to promote their health and remain independent [3, 4]. Successful models for delivering health and nutrition education messages include the following components: a limited number of messages (one or two); simple and practical messages targeted to specific needs, such as a disease or condition; participant goal-setting; evaluation of participant readiness for change and goal setting; social supports; and interaction with health professionals [5].

The present study investigated the effectiveness of a computer-based model for delivering nutrition and health information to older adults living independently in Vermont. The rural nature of Vermont and the limited availability of nutrition professionals present challenges for providing face-to-face nutrition education interventions. Internet-based technologies may offer an effective alternative. Older adults represent one of the fastest growing cohorts of computer users. Between 2000 and 2004, the number of older adults connected to the Internet has increased by 47% [6] and the most recent 2011 survey found that 42% of people over 65 were accessing the Internet [7]. Therefore, we developed an interactive, multimedia, touch-screen computer application designed to collect nutrition and health information as well as to deliver tailored messages to this population. Four survey instruments were selected for pre- and post-evaluation: the Nutrition Screening Initiative (NSI) determine your nutritional health checklist; a health belief model questionnaire; a food behavior checklist; and a computer attitude survey. Evaluation of the study's impact included

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quantitative analysis of survey instrument data and qualitative analysis of three focus group sessions with control and treatment group participants and peer mentors.

Study Design and Procedures

Participants

Study participants were recruited from two senior centers co-located with congregate meal settings in rural Vermont. One senior center (treatment site) was provided with two touch-screen computers, Internet access, and access to our nutrition and health education computer application. The control site was also provided with two computers with Internet access, but no access to our nutrition and health computer application. The two senior sites were selected based on their similarities with regard to town population and socio-economic demographics. Participants age 55 or older were recruited via posters placed in the senior centers and through recruitment visits during which the researchers explained the study and answered questions. The study protocol was approved by the Committee on Human Research in Behavioral Sciences at the University of Vermont and a signed informed consent was obtained from all study participants.

Intervention

The touch-screen computer application, entitled *Healthy Eating ~ Healthy Aging* (HE-HA), employed senior-friendly large fonts and graphics and provided users with tailored messages, educational modules and activities, email accounts and a discussion board with access to a Registered Dietician. Food safety, exercise, and general health information were also provided. After logging on with their username and password, first time users completed a demographic questionnaire and an online version of the NSI Checklist [8]. Based on their responses, they were then presented with tailored messages built around constructs of the Health Belief Model [9,10]. We selected five questions from the NSI Checklist from which to develop tailored messages. They were: 1) Have you made changes in lifelong eating habits because of health problems? 2) Do you eat fewer than 2 complete meals a day? 3) Do you eat fewer than 5 servings of fruit or vegetables every day? 4) Do you have fewer than 2 servings of dairy products or tofu every day? and 5) Are there times when you do not have enough money to buy the food you need?

Study design

The study involved a 12-month, repeated measure, nonequivalent control design employing a convenience sample of subjects. All subjects completed a series of survey instruments at baseline, 3 months, and 12 months. Participants who were unable to complete follow-up questionnaires at the sites were mailed the questionnaires.

Changes in reported dietary intake were measured using a validated Food Behavior Checklist [11]. Computer attitudes were measured using a Computer Survey developed by a University of Vermont Extension team. We selected two risk items from the NSI Checklist on which to base a Health Belief Model questionnaire. The two items related to 1) changes in lifelong eating habits due to health problems, and 2) intake of dairy products. Six questions were developed for each of these risk items, based on the six theoretical dimensions of the Health Belief Model. The questionnaire was modeled after the validated instrument developed by Kim et al. [12] for use in an elderly population.

Mentors

To encourage use of the HE-HA program, eight trained peer mentors were available approximately 10-15 hours per week to assist the participants. The mentors were seniors from the community and were not study participants. The mentor's role was to assist seniors with basic computer functions and skills. For nutrition-related questions, mentors directed users to our Registered Dietitian via email or the discussion board.

Focus groups

In order to gather input on the efficacy of our computer application in meeting seniors' needs and to determine how well the program was working overall, three focus groups were conducted at approximately two-thirds of the way into the 12-month study using standard focus group procedures defined by Morgan [13]. The two participant focus groups included HE-HA participants (n=9) and control site participants (n=13). These groups were formed using purposive sampling procedures designed to get a cross-section of participants based on gender, age, socio-economic background, and physical and cognitive abilities. The third focus group of "peer mentors" was a convenience sample selected based on availability (n=5). Each focus group session lasted approximately 90 minutes. A single moderator facilitated all sessions. Focus group questions fell into three broad categories: technology-related; nutrition and health information; and method(s) of learning. The focus group sessions were audio taped and transcribed verbatim.

Data analysis

Survey instrument results were analyzed at baseline, 3 months, and 12 months using SPSS for Windows (Chicago Ill, version 11.5, 1999). Means and SD's were calculated for continuous discrete variables, and frequencies were determined for non-continuous variables. Chi square analysis was used to analyze yes/no data (NSI Checklist results). The grouped mean results for the fruit and vegetable questions from the Food Behavior Checklist at baseline, 3, and 12 months were compared by repeated measures ANOVA. The Mann-Whitney non-parametric comparison was used to analyze the results from the computer attitude survey.

Transcripts of all three focus groups were analyzed systematically by coding responses using the NVivo (QSR International, Cambridge, MA) qualitative analysis computer program, which supported the identification of emergent themes. Four members of the research team independently reviewed the original transcripts to identify common themes and patterns before discussing them as a group.

Results

Demographics

A total of 16 individuals enrolled in the study from the HE-HA site and 25 individuals from the control site. There was no significant difference in gender distribution (81% female in the HE-HA group and 72% female in the CON group), and no significant difference in percent above the poverty level (88% in the HE-HA group and 95% in the CON group). There was also no difference in the proportion of participants living alone. The only significant difference between the groups was found with respect to age, with the control group significantly older (76.4 ± 6.1 years) than the experimental group (67.6 ± 7.8 years).

Nutrition and health

Changes in nutrition behavior were assessed via the NSI checklist, the UC Davis Food Behavior Checklist, and focus group feedback. Results for the five NSI checklist questions on which we based our Health Belief Model intervention are presented in Table 1. No significant differences were detected between the HE-HA group and the control group for any of these individual NSI checklist items, nor the total NSI score. Nor were we able to detect any significant effect of our intervention on the two Health Belief Model questionnaire items related to changes in lifelong eating habits due to health problems, and intake of dairy products (data not shown). However, when we compared the mean responses to the nine questions from the Food Behavior Checklist identified by Murphy et al. [11] as predictors of fruit and vegetable intake, we found a significant beneficial effect of our computer application on these measures (Figure 1).

Perceptions of their own improved dietary changes were also expressed by HE-HA focus group participants. Each member of the HE-HA focus group claimed to have changed at least one aspect of his or her diet (reduced alcohol consumption, increased fruit intake, increased calcium, etc.) and noted that the Website was a factor that contributed to the dietary change. For example, one participant said, "I have used the Internet for getting recipes for kale. Before I used to boil it and hated it, and I've learned to do different things with kale." Another said that he hoped to learn "how I can extend my life – and I have indeed learned that."

Computer experiences

After 12 months, the HE-HA group mean scores were significantly better than the CON group in response to several questions related to

computer skills and attitudes (Table 2). To gather more in-depth, open-ended feedback about computer experiences, we asked technology-related questions to participants in all three focus groups. HE-HA focus group participants had an excellent overall impression of the computer application, with all participants commenting that the information was useful. One participant commented "I think the computers themselves are what drew people." They described being pleased with the variety of educational experiences that were integrated into the computer application, expressing that they found the computer-based approach to be "fun, playing and learning about nutrition at the same time." They liked the interactive features of the website, such as the opportunity to dialogue with a dietitian, and they especially liked having the peer mentors help ease their way into computer technology. All focus group participants were fascinated with the abundance of information the Web had to offer "at their fingertips." Many of the seniors planned to continue using the computers beyond our study.

Although the overwhelming majority of their comments were positive, participants in the HE-HA focus group identified a few areas needing improvement. Technical glitches were described as causing frustration. The chat room feature was not seen as being useful, and they disliked the fact that they couldn't print information from some Websites. Some also mentioned that they would have preferred to have the content updated with new material on a more regular basis. In contrast, control group participants thought computers were hard to learn. "We need someone to teach us how to use them. I'm afraid of the computers".

Methods of learning

Comments from focus group participants in both the HE-HA group and the mentor group showed positive overall experiences with

	Group	Baseline	3 months	12 months
Have you made changes in lifelong eating habits because of health problems?	HE-HA	75 ± 45.2	50 ± 52.2	83 ± 38.9
	CON	52 ± 51.0	40 ± 50.0	56 ± 50.7
	P Value	P=.286	P=.726	P=.149
Do you eat fewer than 2 complete meals a day?	HE-HA	8 ± 28.9	17 ± 38.9	0 ± 0.0
	CON	8 ± 27.7	8 ± 27.7	12 ± 33.2
	P Value	P=1.000	P=.582	P=.537
Do you eat fewer than 5 servings of fruits and vegetables every day?	HE-HA	67 ± 49.2	25 ± 45.2	33 ± 49.2
	CON	44 ± 50.7	48 ± 51.0	40 ± 50.0
	P Value	P=.295	P=.286	P=1.000
Do you have fewer than 2 servings of dairy products every day?	HE-HA	25 ± 45.2	8 ± 28.9	17 ± 38.9
	CON	20 ± 40.8	16 ± 37.4	24 ± 43.6
	P Value	P=1.000	P=1.000	P=1.000
Are there times when you do not have enough money to buy the food you need?	HE-HA	0 ± 0.0	8 ± 28.9	0 ± 0.0
	CON	0 ± 0.0	0 ± 0.0	0 ± 0.0
	P Value	P=1.000	P=.324	P=1.000

HE-HA group received a computerized nutrition education program. Control group had access to computers but did not receive nutrition education program 18

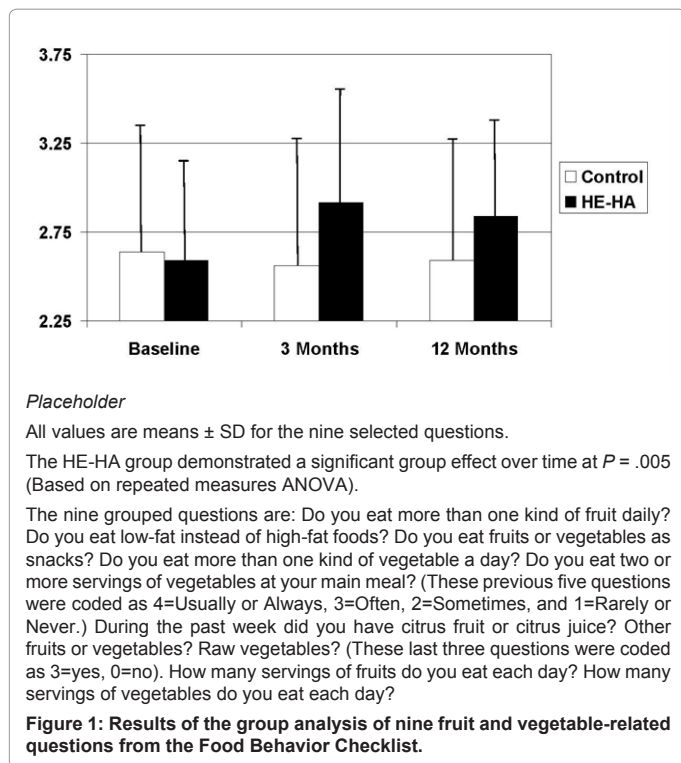
^a Participants in the HE-HA group responding "yes" to any of these questions at baseline were presented with a series of tailored video messages built around the components of the Health Belief Model.

^b n=16 (at Baseline and 3 Months), n=12 (at 12 Months).

^c n=25

Results are presented as means ± SD. Statistical analysis was performed using the Chi Square comparison between HE-HA and CON groups at baseline, 3 months, and 12 months.

Table 1: Percent of treatment group and control group participants in the Healthy Eating ~ Healthy Aging Nutrition Program responding "yes" to the five target NSI questions from baseline to 12-month follow-up^a.



the intervention. HE-HA participants expressed the view that learning to use the computers was a good way to gain knowledge about food and nutrition, and that the senior center was a good location for learning. Involvement of peer mentors appeared to be a significant factor in

their positive experiences. They indicated that the primary reasons they became involved with the project were to learn computer skills, learn about health issues, and connect with others. Participants' health beliefs did not shift over time as measured by the Health Belief Model questionnaire.

Additional benefits, outside of the computer technology and food/nutrition realms, were mentioned by some participants. For example, the opportunity to connect with family and friends via e-mail was seen as particularly valuable and a gateway to their whole computer experience. Additionally, peer mentors said they noticed increased self-esteem and confidence among program participants, and a greater diversity of seniors visiting the senior center.

Discussion

This project demonstrated the effectiveness of a computer-based multimedia, interactive nutrition and health education program targeted at older adults. Despite a relatively small sample size, we have demonstrated the success of this program in improving nutritional behavior (fruit and vegetable consumption) and the essential role of peer mentors. We were pleased to note the significant improvement in fruit and vegetable behavior since it is well-established that nutrition education efforts, particularly those that employ computer-generated tailored messages, can be beneficial in this regard [14-18].

Perhaps the most striking result of this study is the extent to which computer attitudes improved among participants in the HE-HA group. We began this project intending to determine if computer technology would be an effective means of helping seniors learn about nutrition. In fact, the results of our study suggest the reverse; that nutrition education may be an effective means of helping seniors learn to use computers. These results are in agreement with those of Dennison et al. [19], who

	Group	Baseline	3 Months	12 Months
Computers seem Complicated. ^a	HE-HA	3.4 ± 1.15	2.9 ± 1.26	2.8 ± 1.05
	CON	3.7 ± 0.89	3.8 ± 0.87	3.8 ± 0.90
	P Value	$P = .404$	$P = .026$	$P = .006$
Computers seem hard to learn. ^a	HE-HA	3.0 ± 1.21	2.6 ± 1.02	2.7 ± 0.99
	CON	3.7 ± 0.99	3.8 ± 0.93	3.6 ± 0.87
	P Value	$P = .095$	$P = .002$	$P = .014$
Computers are useful for helping to understand nutrition. ^b	HE-HA	2.4 ± 0.81	2.1 ± 0.68	2.0 ± 0.55
	CON	2.6 ± 0.71	2.6 ± 0.51	2.7 ± 0.75
	P Value	$P = .483$	$P = .035$	$P = .007$
I know how to turn on a computer. ^b	HE-HA	2.1 ± 1.00	1.6 ± 0.51	1.4 ± 0.51
	CON	2.1 ± 1.30	2.1 ± 1.10	2.5 ± 1.29
	P Value	$P = .802$	$P = .165$	$P = .009$
How confident are you in your ability to use a computer? ^c	HE-HA	2.5 ± 1.30	3.4 ± 0.98	3.8 ± 0.94
	CON	2.2 ± 1.27	2.6 ± 1.27	2.5 ± 1.19
	P Value	$P = .588$	$P = .062$	$P = .003$

^a Values are means ± SD, based on a scale of Strongly Agree = 5, Agree = 4, Not Sure = 3, Disagree = 2, and Strongly Disagree = 1.

^b Values are means ± SD, based on a scale of Strongly Disagree = 5, Disagree = 4, Not Sure = 3, Agree = 2, and Strongly Agree = 1.

^c Based on a scale from 1 = No confidence, to 5 = Lots of confidence

^d n=16 (at Baseline and 3 Months), n=12 (at 12 Months).

^e n=25

Statistical analysis was performed using the Mann-Whitney non-parametric comparison between HE-HA and CON groups at baseline, 3 months, and 12 months.

Table 2: Computer attitude survey results from Baseline to 12 Months for Participants in the Healthy Eating ~ Healthy Aging Nutrition Program.

reported that seniors enjoyed learning nutrition via computer-assisted instruction, and to the successful approach reported by Stadler and Teaster [20] in which they designed and employed a nutrition website to help seniors learn computer skills.

While we had hoped to see a decline in total nutritional risk score among the experimental group from baseline to follow-up, it is perhaps not surprising that we did not. A question such as, "Have you gained or lost 10 pounds or more in the last 6 months without trying?" is given a numerical score of 2. Several seniors in the experimental group had surgery during the study and answered yes to this question at three- or twelve-month follow-up. Therefore, it is possible for a risk factor to have declined in one area (e.g. increasing consumption of fruits and vegetables) but have the total risk score remained unchanged. Furthermore, the response to individual checklist items, rather than total score, is considered to be of more value from the standpoint of user awareness and education [21].

The fact that we detected a beneficial effect of our intervention on the fruit and vegetable cumulative score from the Food Behavior Checklist, but not on the NSI checklist, may be related to confusion regarding the interpretation of the term "servings." The Food Behavior Checklist items rarely refer to the term, while the NSI checklist does. It is well recognized that the term "serving" is often not interpreted correctly nor consistently by the general public [22-24].

We had also expected to see some changes in health beliefs as measured using our Health Belief Model questionnaire. However, we did not. It could be that our questionnaire was not sensitive enough to detect small changes (particularly among a small sample size, such as ours), or that the model does not apply well to an older audience receiving this type of intervention.

Morrell et al. [25] identified two principle barriers to older adults using the Web; opportunity and training. By opportunity, these researchers were referring to access to computers and the Internet. In our study, we have demonstrated that placing computers in a congregate meal setting is an effective means of addressing this need. With regard to training, focus group participants in our treatment group repeatedly mentioned the value of peer mentors in helping them gain comfort with the computer application. The mentors were all older adults of comparable age to, or slightly younger than, the study participants. Several other recent studies report the effectiveness of mentors and collaborative learning environment to help older adults become more comfortable with computer use and the Internet [26-30].

Morrell et al. [25] also reported that the primary reason that older adults wanted to learn to access the Web was to use email, access health information, and access information about traveling for pleasure. With the exception of the latter, we found similar reasons among our HE-HA participants. Email was clearly one of the most popular features of our HE-HA program. Not surprisingly, research has demonstrated that providing older adults with Internet access and training results in less loneliness, less depression, and more positive attitudes about computers [31-37].

Conclusions

In this study, we demonstrated the successful use of a nutrition and health computer application in improving both nutrition behavior (fruit and vegetable intake) and computer skills of elderly participants.

They reported feeling more confident with computers, more informed about nutrition and food safety, and in better control of their health. We believe that groups of older adults in many different types of community settings could be offered computerized educational programs focused on nutrition and health.

Finally, it is important to recognize the value of the qualitative portion of this experimental design when conducting a study such as this. The quantitative instruments that we used are all excellent tools when the researcher has complete control of the intervention and the delivery of the nutrition and health messages. However, the nature of the Web is such that we often do not have control. We have no way of knowing, for example, whether our video messages were actually viewed or whether some other relevant information was obtained while surfing the Web. Without knowing exactly what messages the user received, we can only guess about what measurement tool(s) to use. The focus group interviews allowed us to capture more specific or unanticipated results that stemmed from computer use.

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