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Abstract

E-health usage is often studied at the level of online health portals, which is invaluable in understanding how these important portals are utilized by various health consumers. However, this approach does not provide information about usage of the underlying e-health services, which is crucial in improving the overall success of e-health portals. In this study, we examine variations in use of 12 distinct e-health services based on five demographic factors: age, gender, race/ethnicity, income, and education. Our results highlight the need for examining usage of distinct e-health services. They also show that demographic factors can play a significant role in how these services are used. Because the results of our study provide a fine-grained picture of e-health usage, they extend those studies and observations that are based on overall use of e-health portals or personal health records. Hence, our results provide important insights for the design, development, and management of specific e-health services, which in turn can improve the overall success of e-health portals.

1. Introduction

With rapid advances in information and communications technologies, receiving and exchanging information and services via the web has become an accepted and expected practice [10]. Not surprisingly, web-based e-health services tend to be popular with health consumers. For example, healthcare consumers in US consider the Internet as an important source of health information and want to be able to make appointments and access their medical records via the web [9]. Despite this preference, however, research shows that e-health services such as personal health records are often underutilized [13].

Two recent studies [33,34] suggest that consumers' demographic characteristics have important yet evolving relationships with the specific e-health services that consumers use. In particular, paying attention to age, gender, race, education, and income level of health consumers can provide valuable insights for understanding variations in usage not only of overall e-health portals, but also usage of distinct e-health services. Wilson et al. [33,34] demonstrate the utility of a "fine-grained" research approach by showing that each of these demographic groupings has significant relationships to use of at least one distinct e-health service. However, Wilson and his colleagues were able to study only three e-health services, which they note as an important limitation to their research [34]. In this current study, we investigate the relationship of demographics to consumers' use of an extended range of 12 distinct e-health services using data from a recent administration by the U.S. National Cancer Institute of the Health Information National Trends Survey (HINTS).

2. Background

Prior work shows that gender, age, race/ethnicity, income level, and education level are associated with differential adoption and use of numerous online services, including shopping [2], Internet search [12], and financial applications [25]. These demographic factors also are associated with general online health activities—including use of online health information sources [4], e-health portals [27], and personal health records [24,36]—and use of distinct e-health services, including purchasing health supplies, communicating with a healthcare provider, and accessing peer support [33,34]. Because relationships between demographics and online behaviors are ubiquitous, it may be anticipated that learning more about these relationships in the context of healthcare can be very beneficial in addressing unmet needs and untapped opportunities for improving health outcomes [5,7,14,21]. The following

sections provide a brief background for each of the demographic factors examined in this study.

2.1 Gender

While gender is no longer a determining factor in Internet usage [11], it continues to play a role in overall e-health service usage. For example, women use the Internet for health-related purposes more than men [3,22], and the majority (about 60%) of people who register to access online PHRs are female [24]. Yet while women access online peer support groups more than men, there is no difference from men in their level of buying health supplies or communicating with health providers online, indicating that gender is not universally predictive across all e-health services [34].

2.2 Age

Healthcare need tends to increase as individuals age, and use of e-health services can benefit older consumers in several important ways. E-health services are more convenient than traveling to health clinics, are available around the clock and throughout the year, and typically are free or inexpensive to use. While research suggests that older people tend to have less positive attitudes towards computers and use computers less frequently than younger users [31,20], it is reasonable to assume that Internet use by older adults will increase over time due to generational shifts,. In fact, Wilson et al. [33,34] show that between 2003 and 2012 use of the three e-health services they studied grew faster among elderly consumers than younger consumers.

2.3 Race/Ethnicity

Research suggests that race/ethnicity can affect use of healthcare services. For example, Blacks and Hispanics are less likely than Whites to complete addiction treatment programs [26] or participate in colorectal screening [29]. Wilson et al. [33,34] find that the association between race/ethnicity and use of the three e-health services they studied has diminished during the 2003-2012 time period. However, anticipated growth of the non-White race/ethnicity to more than half the US population by 2050 [30] suggests that it remains important to understand effects of race/ethnicity demographics in order to effectively guide design and funding of future e-health projects.

2.4 Income

Because individuals with higher income levels can more easily afford to purchase computer hardware and software and to access the Internet, income level is positively correlated with Internet use [8]. For example, income level is associated with adopting broadband access, shopping online, and using search engines [2,12,17]. Wilson et al. [33,34] showed that income level has significant association with buying health supplies and communicating with health providers online but has no association with use of online peer support.

2.5 Education

Similar to income level, education level tends to positively correlate with Internet use. Highly educated individuals access the Internet more often and they are more likely to shop online and use search engines [12,17]. People with higher level of education tend to exhibit more positive attitudes toward computers [18]. Additionally, research shows that education is associated with the use of a number of various e-health services in Europe [3]. Wilson et al. [33,34] find that education level has significant association with buying health supplies and communicating with health providers online but has no association with use of online peer support.

3. Method

Designing and developing user-centered e-health services are highly relevant to Information Systems (IS) scholars and practitioners [35]. As discussed above, we argue that understanding the impact of demographics on use of distinct e-health services will help guide and improve online health resources. This current study augments prior work completed by Wilson et al. [33,34] by investigating the relationship of demographic characteristics to a much more extensive range of distinct e-services.

We used data from the Health Information National Trends Survey (HINTS) 4, Cycle 1 survey administered by the U.S. National Cancer Institute. This data was collected using mail surveys sent to recipients of age 18 and above selected through stratified random sampling from the Marketing Systems group database [32], yielding a total population of 3,959 respondents. The data were collected between October 2011 and February 2012.
The stated goal of HINTS is to capture trends and changes in health information usage by surveying

representative samples of adult population in the U.S. The HINTS website describes the program in this way:

> "The HINTS data collection program was created to monitor changes in the rapidly evolving field of health communication. Survey researchers are using the data to understand how adults 18 years and older use different communication channels, including the Internet, to obtain vital health information for themselves and their loved ones." [16]

Our analysis focuses on comparing usage proportions for 12 distinct e-health services between/among the subgroups that make up each demographic factor.

3.1 Demographic Factors

As in prior research [33,34], we investigated demographic factors as independent variables in our research: gender, age, race/ethnicity, income and education. Consistent with prior research [34] and because of limitation of HINTS data subgroups within each demographic factor were developed as follows:

- **Gender** was defined as male vs. female.
- **Age** was grouped into two categories: 18 through 64 vs. 65 or over.
- **Race/ethnicity** was categorized into Hispanic, White, or Black because response rates in other race/ethnicity groups were too low to allow effective analysis.
- **Income** was grouped into two categories: yearly income less than $20,000 vs. $20,000 and higher yearly income.
- **Education** was grouped into two categories: at most completion of high school or its equivalency vs. completion of some higher education or a college degree.

3.2 E-Health Services

While e-health services have been the subject of a number of studies, these services are often studied in an aggregated form within an e-health portal. Yet growth in use of these services can vary substantially [34]. This observation suggests that consumers choose whether to use each service based on its specific affordances [19] rather than overall functionality, e.g., overall use of an e-health portal or personal health record. We identified 12 questions in the HINTS 4, Cycle 1 dataset that address use of a distinct e-health service. Each question (shown in the first column of Table 1) requested respondents to enter a Yes/No response.

We used all data from the HINTS 4 Cycle 1 survey administration for our analysis. Where valid responses were missing, items were dropped from that specific analysis. In addition, records with race/ethnicity responses other than White, Black, or Hispanic were not included due to lack of sufficient numbers necessary to support analyses with a reasonable level of statistical power.

4. Results

Analysis was conducted using SPSS 17 one-way ANOVA with Scheffe multiple groups comparison among the race/ethnicity subgroups. Results are reported in Table 1. Significant proportional differences between/among demographic subgroups were found in 37 of 60 tests (62%) across the 12 studied e-services. These significant difference results break down by demographic factor as follows.

- Gender: 58% differences
- Age: 75% differences
- Race/Ethnicity: 33% differences
- Income: 75% differences
- Education: 67% differences

4. Discussion

As expected and revealed by the results, demographics have a major impact on the use of distinct e-services examined in this study. In particular, the results extend prior research in this area [33,34] in several interesting ways, as explained in the next paragraphs.

The current study examines the impact of demographics on a substantially larger set of distinct e-health services than the study by Wilson et al. [34]. This expanded investigation reveals a higher proportion of significant differences than was reported by them. For example, Wilson et al. [34], who studied only the e-health services represented by questions 3-5, report that only 47% of their tests produced differences based on demographic characteristics. In this current study, 62% of tests produce differences. These results highlight the need for future researchers to implement fine-grained research designs and investigate diverse demographic characteristics rather than primarily studying overall use of e-health portals and personal health records by homogeneous populations.

The results show that gender has a stronger effect on use of multiple e-health services than reported by Wilson et al. [34]. We find female consumers show greater use of 58% of studied e-health services vs. 33% reported by Wilson et al. [34]. These results call for paying closer attention to the needs and interests of this segment of health consumers. Additionally, there is a need to understand what portion of female e-health use is focused on caregiving vs. personal needs and to study factors that can encourage male users to increase use of e-health.

The results reveal that the largest proportional differences involve age (75%) and income (75%) demographic subgroups. Younger consumers generally use e-health services more than older consumers. These results emphasize that there is still a need to find ways to support increased use by the elderly. We also find consumers with 20K or higher income level use e-health more except for two specific e-health services. Consumers with lower income levels looked for information about quitting smoking and visited a social-networking site to read and share about medical topics. The results regarding information about quitting smoking are consistent with CDC reports [1] that show a significant relationship between smoking and income level. Smoking is significantly more prevalent among U.S. adults living below the poverty level (27.9% smoke) than among those living at or above poverty levels (17.0% smoke). Hence, the results of our study suggest that the self-guided access to e-health smoking cessation support has been successful in attracting a population that can benefit from this service.

The results also show that low-income consumers use social media more for health-related purposes. These results are consistent with a recent Pew report indicating that low-income consumers form the largest user group of social networking sites (72% use social media) [23]. The results of our study are particularly applicable to public health information dissemination initiatives that target low-income populations [15]. The results provide support for the use of social media for such initiatives and highlight the need for faster adoption of social media by public health organizations.

The results show the fewest associations between demographic subgroups and use of e-health services occurs for race/ethnicity demographics (33% associations). These results reinforce the proposition by Wilson et al. [34] that race/ethnicity has diminished in importance as a factor in use of e-health services.

Our investigations show that Hispanics, more than other ethnic groups, use e-health to seek help with diet, weight, or physical activity. According to the Centers for Disease Control and Prevention (CDC) Adult Obesity Facts [6], Hispanics are the second largest group of people in US that suffer from obesity. Hence, as with heightened use of smoking cessation e-health support by lower-income consumers reported previously, these results provide additional support for the premise that consumers can effectively self-guide to use e-health services that are relevant to their personal needs. The results also suggest the need for further research to identify factors that can motivate non-Hispanic blacks—currently the largest statistical group of obese adults in US [6]—to seek health information about diet, weight and exercise.

We find that more Blacks and Hispanics than Whites download health information to a mobile device, which is consistent with a recent report that shows Blacks and Hispanics have above average smart phone ownership [28]. The report shows that ownership trends are rising among Whites, however. Thus, the results of our study highlight the need for expanding mobile e-health in order to support mobile device access across the overall U.S. consumer population.

In addition to revealing the impact of each demographic factor on e-health use, the results also provide interesting insights regarding the joint impact of some of these demographics factors. For example, the summarized information in Table 1 reveals several implications.

- E-services are used more overall by younger educated female users with 20K or higher income level—except for e-services related to smoking and social networks. These services are used more by younger low-income female users with a lower level of education.

- Talking to doctors is used more by higher income, well-educated White female users.

- Hispanic female users with higher level of income and education use diet websites and download to mobile devices more.

- Low-income young female Hispanic users use the social networking sites more.

Table 1: E-health by Demographic Grouping*					
E-health services questions	Gender	Age	Race/Ethn	Income	Education
Q1: *Looked for health or medical information for yourself?*	F > M	Y > O		H > L	H > L
Q2: *Looked for health or medical information for someone else?*	F > M	Y > O		H > L	H > L
Q3: *Looked for a health care provider?*	F > M	Y > O		H > L	H > L
Q4: *Bought medicine or vitamins on-line?***				H > L	H > L
Q5: *Participated in an on-line support group for people with a similar health or medical issue?***	F > M	Y > O			
Q6: *Used email or internet to communicate with a doctor or doctor's office?***			W > H, B	H > L	H > L
Q7: *Use a website to help you with your diet, weight, or physical activity?*	F > M	Y > O	H > B, W	H > L	H > L
Q8: *Looked for information about quitting smoking?*		Y > O		L > H	
Q9: *Downloaded health-related info to a mobile device?*		Y > O	B, H > W		H > L
Q10: *Visited a social-networking site to read and share about medical topics?*	F > M	Y > O	B, H > W	L > H	
Q11: *Wrote in an on-line diary or blog about any type of health topic?*	F > M	Y > O			
Q12: Kept track of personal health information?				H > L	H > L

* One-way ANOVA, between-group differences significant at p < .05; Scheffe multiple comparisons significant at p < .05; F = Females, M = Males, Y = Younger, O = Older, B = Black, H = Hispanic, W = White, H = Higher, L = Lower

** E-health services questions studied by Wilson et al. [33,34]

- Young and highly educated Black consumers download to mobile devices more, and low-income young Black female users use social networks more.

We propose that the fine granularity inherent in these implications is more useful in guiding design, development, funding, promotion, and administration of e-health than are observations based on overall use of e-health portals or personal health records.

6. Limitations

As with any scientific investigation, our study is not without limitations. First, it is important to note that our study reports results that are correlational, not causal. Second, because we used an external data source (HINTS) in our study, this necessarily constrained the scope of our investigation to those measures that were included in the HINTS questionnaire. While we extended research on specific e-health services, our list was limited to 12 specific services. Additionally, finer grained information regarding each service (e.g., frequency, duration, intensity, etc.), had they been available, may have improved the statistical and analytical power of the research design.

7. Conclusion
A major objective of this study was to extend prior research in e-health usage, which primarily focus on aggregated services within portals. We achieved this goal by examining demographic trends in use of 12 distinct e-health services. This approach allowed us to identify which demographic factors played a major role in use of these 12 distinct e-health services across the U.S. population. The identification of demographic factors that play a major role in the use of health services, in turn, highlights the strategic benefits of focusing on specific services rather than overall use.

From a practical point of view, these results help to design and develop better services for health consumers based on demographics factors. From a theoretical point of view, our findings highlight the need to extend research practices in this area to include fine-grained research designs that can address use at the level of distinct e-health services. Such investigation can provide valuable insight for designing models that can predict whether, which, and

how e-health services are used by various consumer groups.

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