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Intention to Use mHealth in Older Adults with Heart Failure

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Abstract

Background—mHealth, or the use of mobile technology in healthcare, is becoming increasingly common. In heart failure (HF), mHealth has been associated with improved self-management and quality of life. However, it is known that older adults continue to lag behind their younger counterparts when it comes to mobile technology adoption.

Objective—The primary aim of this study was to examine factors that influence intention to use mHealth among older adults with HF

Methods—An adapted Technology Acceptance Model was used to guide this cross-sectional, correlational study. Convenience sampling was used to participants from a large university hospital and online.

Results—A total of 129 older adults with HF participated in the study. Social influence (β=0.17, P=0.010), perceived ease of use (β=0.16, P<0.001), and perceived usefulness (β=0.33, P<0.001) were significantly associated with intention to use mHealth even after controlling for potential confounders (age, gender, race, education, income, and smartphone use). Perceived financial cost and eHealth literacy were not significantly associated with intention to use mHealth.

Conclusions—Researchers should consider using the participatory approach in developing their interventions in order to ensure that their mHealth-based interventions will not only address the patient's HF self-management needs, but also be easy enough to use even for those who are less technology-savvy.

Keywords

mHealth; mobile technology; self-management; older adults; eHealth literacy

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Conflict of Interest: None

Background

Heart failure (HF) is especially prevalent in the older population.[1] It is estimated that 11.8% of older adults have HF.[2] Older adults also account for the majority of HF-related hospitalizations,[3] which in turn accounts for 68% of the total cost of treating HF. Effective HF self-management is the key to reducing the enormous healthcare costs associated with treating HF. However, HF self-management can be complex, especially for older adults who usually have comorbid conditions.[1] Hence, it is not surprising that nonadherence to recommended treatment plans is common among this population.[4]

mHealth, or the use of mobile technology in health care, has the potential to revolutionize HF self-management. The ubiquity of mobile technology, such as mobile phones and tablet computers, has made it an ideal medium to deliver health interventions. In HF studies, mHealth-based interventions have used mobile devices as part of a larger monitoring system, usually in conjunction with a blood pressure measuring device and a weighing scale.[5–7] Mobile devices have also been used to deliver HF-related educational messages.[8,9] mHealth-based interventions have been associated with improved HF self-management,[8,9] improved quality of life,[8,10] and lower mortality.[11] However, despite the promising impact of mHealth on HF outcomes, very little is known regarding individual characteristics and perceptions that influence its adoption, especially among older adults, who continue to lag behind their younger counterparts when it comes to technology adoption.[12] Therefore, the primary aim of this study was to examine factors that influence intention to adopt mHealth among older people with HF. The secondary aims of this study were to explore current smartphone use in this population and to assess their intention to use mHealth if recommended by their primary healthcare provider.

Theoretical Framework

An adapted Technology Acceptance Model (TAM) was used to guide this study. The TAM is derived from the Theory of Reasoned Action and was first proposed by Dr. Fred Davis in 1985.[13] The model posits that the strongest predictor of *technology use* is *behavioral intention*, which is in turn influenced by the individual's *perceived ease of use* and *perceived usefulness*.[13] Even in its most parsimonious version, the TAM has been shown to account for 30–40% of technology acceptance.[14] In healthcare, TAM has been shown to explain from 30% to 70% of the variance in the acceptance of health technologies.[14]

Perceived usefulness is conceptually defined as the degree to which the person with heart failure believes that using mHealth will enhance the management of his heart failure. In previous studies, perceived usefulness has been consistently shown to be significantly associated with intention to use technology and is thought to be the most important predictor of technology acceptance.[14] Perceived ease of use is conceptually defined as the degree to which a person [with heart failure] believes that using a [mHealth] would be free of effort.[15] Although not as consistent as perceived usefulness, perceived ease of use has also been shown to be associated with intention to use behavioral intention in several studies.[14] Behavioral Intention is conceptually defined as the intention to use mHealth in the context of heart failure self-management. Being more proximal than the actual use of technology, it is often the outcome of choice for the majority of the TAM-guided studies. In longitudinal studies that actually measured actual use, behavioral intention has been shown to significantly predict actual use of technology.[14]

In order to improve the predictive ability of the TAM, additional constructs were added to the model, namely: social influence, eHealth literacy, and perceived financial cost. Social influence is defined as a person's perception that most people who are important to him/her think that he/she should perform the behavior in question,[16] which in this case is technology adoption. Previous studies have shown that older adults are susceptible to the effects of social influence when it comes to technology acceptance.[16] eHealth literacy is defined as "*the ability to seek, find, understand, and appraise health information from electronic sources and apply the knowledge gained to addressing or solving a health problem*".[17] Higher eHealth literacy has been found to be associated with higher perceived self-efficacy in using health-related mobile apps[18] and with the adoption of a physician-rating mobile app.[19] Perceived financial cost, defined as the extent to which the person believes that using mHealth will cost money, has been found to be significantly negatively correlated to behavioral intention.[20]

Methods

Study Design and Sample

A cross-sectional, correlational design was used for this study. A convenience sample was recruited via two means: an "in-person" group from a large urban teaching hospital and an "online" group through Qualtrics™. We opted to include an online sample in order to obtain a more geographically diverse sample. Potential "in-person" participants were identified through an electronic list of patients admitted with a history of heart failure, which was obtained daily from the hospital's HF care coordinator. The patients on the list were then screened for eligibility through electronic chart review. Online participants were identified with the help of the Qualtrics™ project coordinator, who was given the inclusion and exclusion criteria for the study. Online sampling was limited to persons living in the United States.

Qualtrics is partnered with over 20 online panel providers. Panelists are often recruited to participate in research through online advertisements, or for groups that are hard-to-reach on the Internet, Qualtrics utilizes niche panels brought about through specialized recruitment campaigns (e.g. newspaper ads, inserts in product packaging, at trade events, or through direct mail). Hundreds of profiling attributes are collected to guarantee detailed knowledge of every potential respondent. Qualtrics panel partners randomly select respondents for surveys where respondents are highly likely to qualify. Each sample from the panel base is proportioned to the general population and then randomized before the survey is deployed. All sample partners redirect members by matching qualifying demographic information from their profiles to a specific survey. To ensure the quality of the data, Qualtrics will replace "quality check fails", or respondents who straight-line through surveys, finish in less than 1/3 of the average survey completion length, or wrongly respond to attention checks (e.g. "This is an attention filter. Please select 'Sometimes' for this statement"). In order to prevent fraudulent respondents, panel providers utilize confirmation procedures such as TrueSample, Verity, SmartSample. USPS verification, and digital fingerprinting to verify respondent address, demographic information, and email address. (Lincoln Bradshaw, Qualtrics Project Coordinator, email communication, January 22, 2016).

Participants were recruited if they had a history of HF and were 65 years or older. Current use of mHealth or smart phone technology was not an inclusion criterion because we wanted a range of experiences and perceptions. Potential "in-person" participants were excluded if they were unable to read/understand English, had a history of dementia or had cognitive impairment (Mini-Cog[21,22] score ≤ 2), resided in a nursing home (prior to hospital admission), or were hospitalized for acute MIs and/or need emergent cardiac surgery, or advanced stage of HF (NYHA functional class IV – patient exhibits HF symptoms/shortness of breath even at rest per assigned nurse's report). Intact cognitive functioning was assumed for the "online" group. Of the 168 who were eligible, 39 declined to participate in the study (23 were not interested, 12 did not feel well, and 4 had other reasons). There was no significant difference between those who participated in the study and those who declined to participate in terms of gender, race, educational attainment, income, and marital status. However, those who declined to participate were significantly older than the study participants (77 years vs. 71.3 years, P=0.001). Figure 1 shows the participant recruitment flowchart.

Procedures

The university's institutional review board approved this study. Before approaching the potential in-person participant, we obtained their permission to recruit them for the study through their assigned nurse. Once permission was obtained, they were approached by a trained research staff who briefly described the study. Written informed consent was then obtained from in-person participants, who screened negative for cognitive impairment, prior to the self- or staff-administered paper-based survey. The in-person group required approximately 45 minutes to complete the survey. The online participants were presented with an implied consent form at the beginning of the online survey. The online group required approximately 30 minutes to complete the survey. The in-person data collection was conducted between February and June 2016. The online surveys were collected between March and August 2016. Each participant was given $10 as an incentive for completing the survey.

Survey

An adapted TAM scale was used to measure the participants' perceived social influence, ease of use, usefulness, and financial cost, and their intention to use mHealth.[20,23] The adapted TAM scale had a total of 12 items (5 subscales) and used a 7-point Likert scale (see Appendix). Higher scores indicated higher perceived social influence, ease of use, usefulness, and financial cost, and higher intention to use mHealth. The internal consistency (Cronbach's alpha) of the adapted TAM subscales for this sample is as follows: social influence (α=0.91), perceived ease of use (α=0.78), perceived usefulness (α=0.92), and behavioral intention (α=0.82). To give the participants a general sense of the types of mobile technology that could be used in HF self-management, pictures showing examples of mHealth (i.e. physical activity tracker wristband, heart rate tracker wristband + heart rate monitoring app, electronic blood pressure cuff that connects to an app) were included in the survey. eHealth literacy was measured using eHEALS, which had 8 items and used a 5-point Likert scale.[17] Higher scores indicated higher eHealth literacy. The internal consistency (Cronbach's alpha) of eHEALS for this sample was 0.93. In addition, the participants were asked whose advice mattered the most to them when it comes to their health and whether they would use mHealth if their doctor or primary healthcare provider recommended it. Finally, demographic information (age, gender, race, educational attainment, income, and marital status) and information on the participant's smartphone use were also collected using a questionnaire developed for the purpose of the study.

Data Analysis

Descriptive statistics were calculated for all study variables. Simple linear regression was used to test the relationship between the main study variables (eHealth literacy, social influence, perceived financial cost, perceived ease of use, and perceived usefulness) and intention to use mHealth. Hierarchical regression analysis was used to identify correlates of intention to use mHealth in the study sample and to determine the specific contributions of the main study variables in explaining intention to use mHealth above and beyond those of the covariates (age, gender, race, educational attainment, income, and current smartphone use). Stata 14 was used for all analyses. Level of significance was set at 0.05.

Results

Sample Characteristics

A total of 129 older adults with HF participated in the study. The mean age of the participants was 71.3 ± 4.6 years and the majority were male (73.6%). More than half (56.6%) identified themselves as White, followed by 22.5% who identified themselves as Black, and 20.9% as another race. The majority of the participants had at least some college education (79.1%), had an annual income of at least $50,000 (55.2%), and was married (64.3%). (Table 1)

Use of Smartphone and Intention to Use mHealth

Seventy-four (57.4%) of the participants used a smartphone, of which fifty-five (74.3%) reported using their smartphones daily. Among the non-smartphone users, thirty-six (27.9%) reported that they only need their phones to make calls; twenty (15.5%) indicated that smartphones were too complicated/difficult for them to use; and thirteen (10.1%) reported that smartphones were too expensive.

The majority of the participants (n=111, 86.1%) indicated that when it comes to their health their doctor's/nurse practitioner's advice mattered the most. Moreover, when asked whether they would use mHealth if their doctor (or primary healthcare provider) recommended it, 35 (27.1%) strongly agreed, 48 (37.2%) agreed, 27 (20.9%) somewhat agreed, 15 (11.6%) neither agreed nor disagreed, and the remaining participants either somewhat disagreed (1.6%) or disagreed (1.6%). Even among those who did not have a "high intention" to use mHealth (behavioral intention score <12), 55 (54.5%) agreed or strongly agreed that they would use mHealth if their doctor (or primary care provider) recommended it.

Correlates of Intention to use mHealth

Higher perceived ease of use (β=0.16, P<0.001) and higher perceived usefulness (β=0.33, P<0.001) were both associated with higher intention to use mHealth, even after controlling for the covariates. Perceived ease of use and perceived usefulness explained 9.5% and 13%, respectively, of the variability in intention to use mHealth Higher. Perceived financial cost was associated with lower intention to use mHealth at the bivariate level but the association was no longer significant after adjusting for the covariates (β=−0.04, *P*=0.345). We also observed that social influence was associated with intention to use mHealth (β=0.17, *P*=0.010), even after controlling for the covariates; however, eHealth literacy was not (β=−0.01, *P*=0.799). (Table 2)

Discussion

Consistent with findings reported in the literature,[14] we found that perceived usefulness was significantly associated with intention to adopt mHealth. In a recent systematic review, Chen and Chan[15] reported that older adults will adopt new technology if it addressed an existing need or at least improved their daily living. Rather than focus on the technology's high-tech features, older adults tend to value technology's usefulness more and how it supports their activities and make tasks convenient.[24] Perceived ease of use was also found to be associated with intention to adopt mHealth. This is also consistent with previous research.[14] The functional and cognitive changes that come with aging, such as decreased dexterity, poorer vision, and diminished working memory,[15] could make learning and using new technology more challenging for older adults. Hence, it only makes sense that the easier the new technology is to use; the more willing older adults will be to use it. Future researchers should consider using the participatory approach when designing their mHealth intervention. This would not only ensure that their intervention addresses the target user's needs, but that its operability, or the amount of effort needed to use a device[25], matches the user's abilities and capacity to learn the new technology. Health researchers could also benefit from collaborating with experts in human factors engineering (the study and practice of designing equipment and environments to accommodate human users[25]) when developing mHealth-based interventions.

While it is to be expected that intrinsic factors, such as their perceptions on the usefulness and ease of use of the technology, will play a significant role in whether older adults intend to adopt mobile technology to help manage their HF, it is worth noting the significant impact of social influence, particularly that of their primary healthcare provider. This significant association could be a reflection of the trust that older adults tend to put on their physicians[26,27] and on nurses[28]. Future research should explore the role of primary healthcare providers in promoting the adoption of mHealth-based HF interventions.

Unlike the findings from previous studies,[19,20] we found that eHealth literacy and perceived financial cost were not significantly associated with intention to adopt mHealth. In their study of mobile physician-rating apps, Bidmon et al. found that eHealth literacy was associated with adoption of the mobile app.[19] However, their study sample was considerably younger and had higher average eHealth literacy.[19] Unlike the findings of Tung et al.[20] perceived financial cost was not associated with intention to use mHealth. A possible explanation for the lack of association could be the higher annual income reported by this study's sample, which was significantly higher than the $35,611 national median income previously reported for this age group[29]. The cost of mobile technology might not factor into someone's decision to adopt mHealth if they can easily afford it. Another potential explanation could be the higher rate of smartphone ownership among this study's participants in comparison to the national average (57% vs. 27%[30]). Since they already have a mobile device; hence, the cost of mobile technology would not really affect their decision to use mobile technology to help manage their HF.

This study has several limitations. The cross-sectional design of the study precludes causal inferences. While behavioral intention has been previously shown to predict actual technology adoption[14], future research should consider using a longitudinal design. Additionally, the majority of the study's participants (94%) were "younger" older adults (65 – 79 years); hence, our findings may not be generalizable to the oldest members of the HF population. Similarly, the study sample tended to include those with higher education and income than the average older adult American[29,31], which further limits the generalizability of the study findings. In addition, given that the use of mobile technology in HF self-management is still in the research phase, we assumed that the participants have not yet used mHealth for HF self-management and only surveyed the participants regarding their use of smartphones.

Conclusions

In order to promote the adoption of mHealth-based HF interventions among the older HF population, it is essential that researchers use a participatory approach in the development phase of their interventions in order to ensure that their mHealth-based interventions will not only address the end user- or older adult's-most pressing HF self-management needs, but also be easy enough to use even for the less technology-savvy. Lastly, implementation of research-tested mHealth interventions could benefit from the endorsement of primary healthcare providers in order to promote their adoption, especially among older adults.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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What's New?

- Among older adults with HF, their perceptions of mHealth's ease of use and usefulness influenced their intention to adopt it. Researchers looking to use mobile technology to deliver HF interventions should consult their target population when designing their interventions in order to ensure that it will address their needs and that it would be easy enough to use even for those who are not technology-savvy.
- Social influence, particularly from one's primary healthcare provider, influenced the older adult's intention to adopt mHealth. This suggests that implementation of research-tested mHealth interventions could benefit from the endorsement of primary healthcare providers.

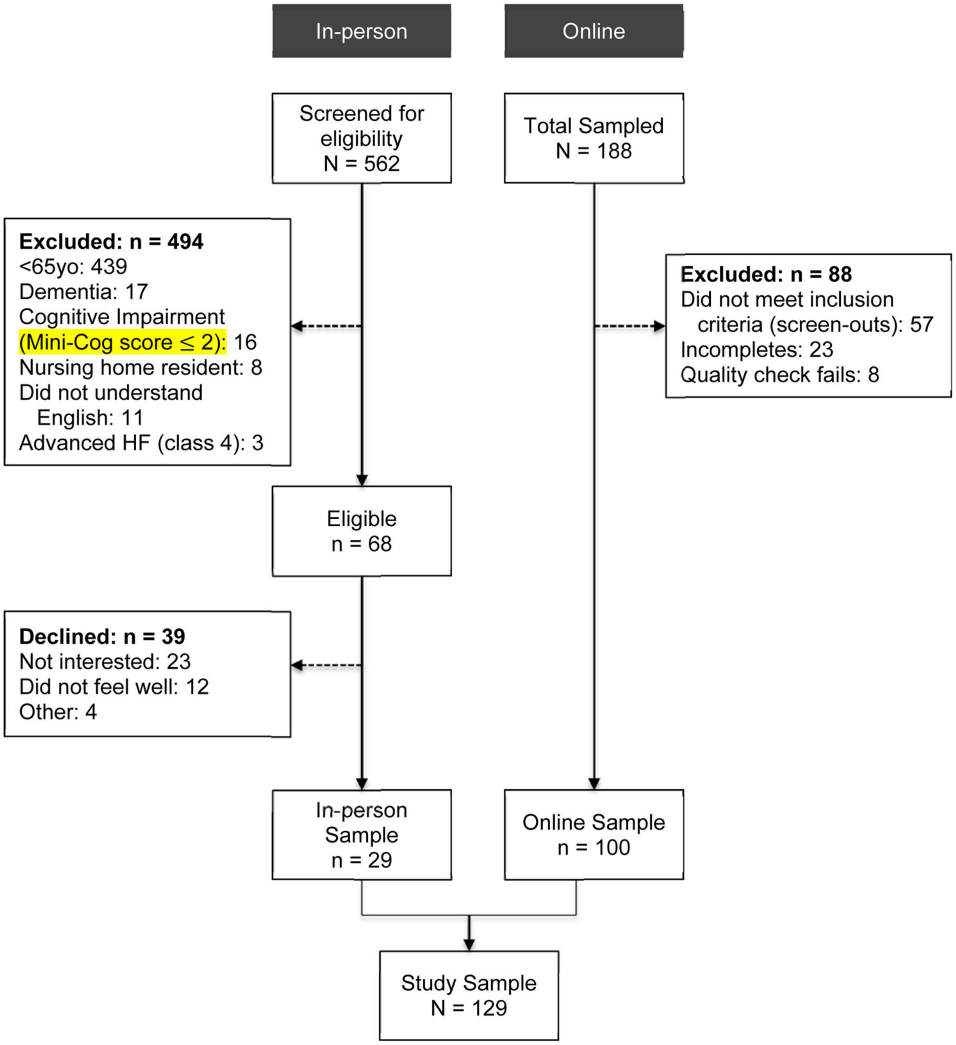

Figure 1.

Participant recruitment flowchart (Abbreviation: HF – heart failure)

Table 1

Participant Characteristics

Variable, N (%)	**Overall (N=129)**	**In-Person (n=29)**	**Online (n=100)**
Age, mean ± SD (range)	71.3 ± 4.6y (65–86)	71.5 ± 5.1y(66–86)	71.2 ± 4.4y(65–83)
Gender*			
Male	95 (73.6)	17 (58.6)	78 (78.0)
Female	34 (26.4)	12 (41.4)	22 (22.0)
Race/Ethnicity**			
White	73 (56.6)	11 (37.9)	62 (62.0)
Black	29 (22.5)	16 (55.2)	13 (13.0)
Other	27 (20.9)	2 (6.9)	25 (25.0)
Education**			
High school grad or less	27 (20.9)	15 (51.7)	12 (12.0)
College grad or less	69 (53.5)	9 (31.0)	60 (60.0)
Professional/Grad school	33 (25.6)	5 (17.3)	28 (28.0)
Income**			
<$15,000	10 (8.0)	8 (32.0)	2 (2.0)
$15,000–$$50,000	46 (36.8)	5 (20.0)	41 (41.0)
$50,001–$100,000	46 (36.8)	7 (28.0)	39 (39.0)
> $100,000	23 (18.4)	5 (20.0)	18 (18.0)
Marital Status*			
Married	83 (64.3)	13 (44.8)	70 (70.0)
Not Married	46 (35.7)	16 (55.2)	20 (30.0)
Smartphone users*	74 (57.4)	12 (41.4)	62 (62.0)
eHealth Literacy**, mean ± SD (range)	27.3 ± 6.4 (8–40)	22.1 ± 7.6 (8–37)	28.7 ± 5.1 (13–40)

Note: Difference between the in-person and online groups were significant at *P<0.05, **P<0.001

Table 2

Correlates of Intention to Use mHealth

Variable	β[1] (95% CI)[1]	*P*-value[1]
Block 1: R^2=0.223, *P*=<0.001		
Age	0.05 (−0.01–0.11)	0.089
Gender		
Male	Reference group	
Female	−0.39 (−1.06–0.27)	0.243
Race		
White	Reference group	
Black	0.47 (−0.25–1.18)	0.199
Other	−0.68 (−1.32– −0.03)	0.040
Education		
High school grad or less	Reference group	
College grad or less	−0.05 (−0.82–0.71)	0.889
Professional/Grad school	−0.001 (−0.88–0.87)	0.998
Income		
$35K or less	Reference group	
> $35K	−0.28 (−0.96–0.40)	0.422
Smartphone use		
Non-user	Reference group	
User	0.77 (0.21–1.34)	0.008
Block 2: change in R^2<0.001, *P*=0.829		
eHealth literacy	−0.01 (−0.05–0.04)	0.799
Block 3: change in R^2=0.281, *P*<0.001		
Social Influence	0.17 (0.04–0.30)	0.010
Block 4: change in R^2=0.017, *P*=0.049		
Perceived financial cost	−0.04 (−0.14–0.05)	0.345
Block 5: change in R^2=0.095, *P*<0.001		
Perceived ease of use	0.16 (0.07–0.24)	<0.001
Block 6: change in R^2=0.130, *P*<0.001		
Perceived usefulness	0.33 (0.24–0.41)	<0.001

[1]Regression coefficients presented are from the full model