Original Paper

A Survey of Heart Failure Patient Interest in mHealth Applications for Self-Care

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Abstract

Background: Heart failure (HF) is a serious public health concern that afflicts millions of individuals in the United States (US). Development of behaviors that promote HF self-care may be imperative to reduce complications and to avoid hospital readmissions. Mobile health (mHealth) solutions, such as Fitbit activity trackers and smartphone applications, could potentially help to promote self-care through remote tracking and issuing reminders.
Objective: The objective of this study was to ascertain HF patients' interest in a smartphone application to assist them in managing their treatment and symptoms, and to determine factors that influence their interest in such an application.
Methods: In the clinic waiting room on the day of their outpatient clinic appointments, 50 HF patients participated in a self-administered survey. The survey consisted of 139 questions from previously published, institutional review board-approved questionnaires. The survey measured patients' interest in and experience using technology, as well as their function, HF symptoms, and HF self-care behaviors. The Minnesota Living with Heart Failure Questionnaire (MLHFQ) was among the 11 questionnaires and was used to measure the HF patients' health-related quality of life (HRQOL) through patient-reported outcomes (PROs).
Results: Patients were 64.5 years of age on average, women 32.0%, and New York Heart Association (NYHA) Class II or higher 91.1%. Greater than 60% of the survey participants expressed interest in several potential features of a smartphone application designed for HF patients. Participant age correlated negatively with interest in tracking, tips, and reminders in multivariate regression analysis ($p < 0.05$). In contrast, MLHFQ scores (worse health status) produced positive correlations with these interests ($p < 0.05$).
Conclusions: The majority of HF patients showed interest in activity tracking, HF symptom management tips, and reminder features of a smartphone application. Desirable features and an understanding of factors that influence patient interest in a smartphone application for HF self-care may allow researchers to address common concerns and to develop applications that demonstrate the potential benefits of mobile technology.

Keywords: mHealth; patient-reported outcome; heart failure; self-care; patient monitoring

Introduction

Heart failure (HF) is a complex clinical syndrome characterized by the impairment of the heart's function to fill or eject blood [1,2]. It is a major global health problem with an estimated prevalence 6.5 million adults in the United States (US) [3] and 37.7 million people worldwide [4]. Every year in the US, there are approximately one million new cases of HF and 330,000 deaths to which it is linked [3]. Projections suggest that HF's prevalence will increase by 46% between 2012 and 2030 [5]. Its total cost, which includes the expense of health care services, medications, and sick leave, may reach $69.7 billion by 2030, a 127% increase from roughly $30.7 billion in 2012 [5].

Several cohort studies have indicated the prevalence of HF increases significantly with age. In the Framingham Study, the prevalence was 0.8% in both men and women ages 50 to 59 before rising to 6.6% in men and 7.9% in women ages 80 to 89 [6]. Similarly, the

Rotterdam Study showed a prevalence of 1% in the age group of 55-64, while it surpassed 10% in individuals age 85 and over [7]. Much like its prevalence, incidence of HF is substantially higher in the elderly. In contrast to the annual incidence rates of 0.3% in men and 0.2% in women ages 50 to 59, rates were 2.7% and 2.2%, respectively, in those aged 80 to 89 [6]. The Cardiovascular Health Study that focused on individuals over the age of 65 approximated an incidence of 19.3 per 1000 person-years [8].

Due to the increasing prevalence of HF and rising financial implications, forming efficient HF prevention and treatment strategies is imperative. Currently, there are behavior-specific guidelines to which HF patients should adhere while managing the condition, including taking prescription drugs, exercising, monitoring daily weight, and restricting sodium intake [9]. Divergence from these guidelines contributes to hospital readmission rates that surpass 20% within the first 30 days of discharge [10,11] and approach 50% within six months of discharge [12], with a substantial proportion of the 30-day rehospitalizations considered preventable [13].

As HF patients show poor adherence to self-care behaviors, mobile health (mHealth) has emerged as a potential solution to improve their health outcomes and quality of care. mHealth is defined as the application of mobile technology [14,15], including software applications in mobile devices [16] and wireless sensors such as activity trackers [17]. These technological developments monitor activity and provide reminders of self-care behaviors as well as HF symptoms, which may be difficult for patients to ascertain [16]. Moreover, they are minimally-invasive options that may also be preferable due to their relatively high adherence rates. In a previous study performed by members of our team, adherence rates for wearing activity trackers were observed to be as high as 90% [18]. The purpose of the current study was to assess patient interest, specifically needs and preferences, regarding their HF self-care, as well as their perceptions regarding a smartphone application integrated with home monitoring sensors. Results were analyzed to achieve the secondary endpoint of this study, which was to determine the factors that influence their interest.

Methods

Recruitment

From February 2018 through September 2018, study personnel collaborated with internal medicine, cardiomyopathy, and cardiology outpatient clinics to prescreen all patients diagnosed with HF at a university-based health system. HF patients between the ages of 50 and 80 were eligible to participate in this anonymous study if they were scheduled for an appointment at any of the three outpatient clinics. Exclusion criteria included having a cognitive (e.g., dementia) disability, being unable to communicate in English, and having visual or auditory impairments to the extent that a smartphone could not be used. Research personnel contacted potential research subjects over the phone, provided additional information about the study, and conducted the verbal consent process with those who were interested in participating. In the clinic waiting room, an informational

sheet that described the study was given to those who consented to participate. The research team asked the participants to complete the survey prior to their scheduled appointment and informed them that omitting answers to any questions was permitted. Enrolled subjects received a $20 gift card.

Survey Questions

The survey was comprised of 15 sections, all written in American English. Four sections consisted of questions relating to sociodemographic information, interest in specific smartphone application features, preferences regarding specific smartphone application notifications, and experience using technology. The section pertaining to interest in specific smartphone application features for HF self-care management evaluated the participants' interests using a 5-point Likert scale [19]. It included questions regarding symptom tracking, tips, and reminders (Supplemental Table 1). Each participant's responses to questions in these groups were averaged for data analysis. The section concerning notification preferences instructed subjects to indicate how often they would like to receive reminders and information related to HF self-care: never, once a day, every 12 hours, every 6 hours, every 4 hours, or every 2 hours (Supplemental Table 1). To determine the participants' experience with technology, 12 yes-no questions from the Health Information National Trends Survey (HINTS) were asked (Supplemental Table 1) [20].

The remaining sections included questions regarding function, HF symptoms, and HF self-care behaviors. The participants' function and behaviors were detailed using the following institutional review board-approved questionnaires: Minnesota Living with Heart Failure Questionnaire (MLHFQ), Self-Care of Heart Failure Index (SCHFI), shortened version of the Seattle Angina Questionnaire (SAQ-7), shortened version of the Kansas City Cardiomyopathy Questionnaire (KCCQ-12), Patient-Reported Outcomes Measurement Information System (PROMIS) Global Health, and PROMIS Physical Function short form (SF). Symptoms were measured using a variety of PROMIS questionnaires: Fatigue SF; Anxiety SF; Depression SF; Sleep Disturbance SF; and Social Isolation SF. Scores from these questionnaires represented patient-reported outcomes (PROs), which are reports of a patient's health status directly from the patient.

Scoring

The 21-item MLHFQ is among the most widely used patient-oriented measurements of health-related quality of life (HRQOL) [21]. It accounted for three ways HF affected the participants: physical, emotional, and socioeconomic. Though there is no scale for the socioeconomic score, physical (0-40) and emotional (0-25) scores were calculated by summation of corresponding responses. Lower scores signified better HRQOL while higher scores signified worse HRQOL in regard to physical and emotional well-being [21]. A total (0-105) score was also generated by addition of all 21 responses. Scores were classified as good (<24), moderate (24-45), and poor (>45) HRQOL [21].

SCHFI is a 22-item questionnaire that assesses the patient's ability to care for their heart failure via three subscales: maintenance, management, and confidence [22]. For each

subscale, the raw score was calculated by summation of corresponding responses. Raw scores were then standardized to a 0 to 100 range with higher scores indicating better self-care. Management scores were calculated only if HF patients acknowledged having trouble breathing or ankle swelling within the past month of taking this survey. For all sections of the SCHFI, scores ≥70 proposed adequate self-care [22].

The SAQ–7 and KCCQ–12 also assessed the HRQOL of patients with respect to angina and HF, respectively [23,24]. Scores for both questionnaires were calculated by summation of all seven and 12 responses, respectively, and by standardization of those values to a zero to 100 range. Scores were classified as poor (0-24), fair (25-49), good (50-74), and excellent (75-100) HRQOL [23,24].

PROMIS questionnaires are publicly available individual-centered measures of PROs [25,26]. The aforementioned physical and mental health questionnaires were administered to HF patients to assess their function and symptoms. Raw scores were computed by addition of all corresponding responses and conversion of those values to t-scores, which were standardized scores set to a mean of 50 and a standard deviation (SD) of 10 [25,26]. Function scores ≥40 were normal whereas scores <40 denoted moderate to severe adverse health effects. Symptom scores ≤60 were normal whereas scores >60 represented moderate to severe adverse health effects [25,26].

Prior to calculating raw scores, questionnaires were examined for completion. For any missing items, the mean of the participant's responses from the same questionnaire was substituted [27]. The cohort was characterized using proportions, means, SDs, medians, and interquartile ranges (IQRs). Summaries of responses and scores, if applicable, for each questionnaire were reported. Linear regression analyses, including multivariate regression analysis, were performed with the participants' age and MLHFQ scores as the independent variables to quantify the linear relationships with their interest in smartphone application features. For all analyses, a significance level of 0.05, which corresponds to a 95% confidence interval, was used to determine statistical significance.

Results

Over the seven-month period, a total of 95 eligible HF patients were contacted. Of the 95 qualified patients, 50 consented to participate in this study (Table 1). However, one participant only completed the demographics section of the survey. The participants' mean age was 64.5 years (SD = 8.3, range 50-78). Most participants were men (68.0%), of non-Hispanic or non-Spanish origin (81.6%), and white (66.7%). Additionally, 38% had received a bachelor's degree or higher, while for 18% a high school degree was their highest level of education. As for annual household income, the proportions of individuals whose families earned less than $50,000 (46.0%) and more than $50,000 (54.0%) were fairly similar.

Table 1: Demographics of study population

Characteristic	No. (%) of Patients
Age, mean (SD) (*n* = 50)	64.5 (8.3)
New York Heart Association (NYHA) Class (*n* = 45)	
I	4 (8.9)
II	26 (57.8)
III	15 (33.3)
IV	0 (0.0)
Ejection Fraction (EF) (*n* = 50)	
≤40%	28 (52.0)
41%–49%	3 (6.0)
≥50%	19 (38.0)
Sex (*n* = 50)	
Male	34 (68.0)
Female	16 (32.0)
Hispanic or Spanish origin (*n* = 49)	
No	40 (81.6)
Yes	9 (18.4)
Race or Ethnicity (*n* = 48)	
White	32 (66.7)
Black or African American	11 (22.9)
Asian	5 (10.4)
American Indian or American Native	0 (0.0)
Native Hawaiian or other Pacific Islander	0 (0.0)
Education (*n* = 50)	
High school	9 (18.0)
Some college, associate degree, or trade school	22 (44.0)
Bachelor's degree	10 (20.0)
Master's degree or above	9 (18.0)
Annual Income ($) (*n* = 50)	
0-25,000	15 (30.0)
25,001-50,000	8 (16.0)
50,001-75,000	8 (16.0)
75,001 or more	19 (38.0)

Note—Data are number (%) of responses.

The median MLHFQ score was 52 (24-75) (Table 2), which corresponded to a poor HRQOL for the average participant. On the other hand, SAQ (68, 55-84) and KCCQ (61, 47-80) median scores suggested a good HRQOL in relation to angina and HF, respectively. The median SCHFI maintenance (70, 60-81) and SCHFI confidence (72, 50-83) scores revealed adequate ability to perform maintenance behaviors and adequate confidence level for the average participant. Of the 49 participants, 28 indicated recent breathing complication or ankle swelling (Table 2), which qualified them to complete the management section of the

SCHFI questionnaire. Similar to the other section scores, the median SCHFI management score (70, 50-85) indicated adequate ability to manage HF. Median scores for all PROMIS questionnaires were within the normal range except for Physical Function SF (38, 34-43), which denoted moderate adverse health implications.

Table 2: Patient-reported outcomes

Questionnaire	Median Score (IQR)
MLHFQ (*n* = 49)	52 (24-75)
Physical (*n* = 49)	19 (12-32)
Emotional (*n* = 48)	10 (2-20)
SCHFI	
Maintenance (*n* = 49)	70 (60-81)
Management (*n* = 28)	70 (50-85)
Confidence (*n* = 49)	72 (50-83)
SAQ (*n* = 49)	68 (55-84)
KCCQ (*n* = 49)	61 (47-80)
PROMIS Global Health	
Physical (*n* = 49)	42 (35-51)
Mental (*n* = 49)	48 (44-51)
PROMIS Physical Function (*n* = 49)	38 (34-43)
PROMIS Fatigue (*n* = 49)	57 (46-63)
PROMIS Anxiety (*n* = 49)	54 (39-61)
PROMIS Depression (*n* = 49)	52 (41-61)
PROMIS Sleep Disturbance (*n* = 49)	52 (46-60)
PROMIS Social Isolation (*n* = 49)	40 (35-50)

Greater than 60% of the participants were somewhat interested or very interested in a smartphone application that provides information related to symptoms (identification 64.6%, tips 72.9%), medication or treatment (side effects 68.8%), activity (steps 68.8%, exercise 64.6%), and sleep (patterns 66.7%, tips 66.0%) (Table 3). On the other hand, more than a quarter of the participants expressed little to no interest in mood-related information (documentation 35.4%, tips 29.2%). 30 participants answered somewhat interested or very interested for both symptom-related statements (Supplemental Table 2). 28 (93.3%) of those 30 participants owned a smartphone and 10 (33.3%) owned an activity tracker or a smartwatch. Of the 28 participants who expressed interest (somewhat interested or very interested) in both activity-related statements, 26 (92.9%) owned a smartphone and 11 (39.3%) owned an activity tracker or a smartwatch. There were 27 participants who showed interest in both items regarding sleep. From that total, 24 (88.9%) owned a smartphone and 11 (40.7%) owned an activity tracker or a smartwatch.

Table 3: Patient answers to HF Self-Care Management Application Interest

Statement	No interest	Not Very Interested	Neutral	Somewhat Interested	Very Interested
Symptom identification, such as noticing swelling in your ankles or legs (*n* = 48)	7 (14.6)	2 (4.2)	8 (16.7)	11 (22.9)	20 (41.7)
Providing symptom management tips (*n* = 48)	7 (14.6)	1 (2.1)	5 (10.4)	13 (27.1)	22 (45.8)
Providing medication reminders (*n* = 48)	9 (18.8)	4 (8.3)	9 (18.8)	9 (18.8)	17 (35.4)
Documenting when you experience side effects from medication or treatment (*n* = 48)	5 (10.4)	2 (4.2)	8 (16.7)	10 (20.8)	23 (47.9)
Documenting your level of activity/number of steps (*n* = 48)	6 (12.5)	4 (8.3)	5 (10.4)	9 (18.8)	24 (50.0)
Providing reminders to get more exercise (*n* = 48)	7 (14.6)	2 (4.2)	8 (16.7)	10 (20.8)	21 (43.8)
Documenting your sleep patterns (*n* = 46)	5 (10.9)	3 (6.5)	6 (13.0)	10 (21.7)	22 (47.8)
Providing tips to get better sleep (*n* = 47)	6 (12.8)	4 (8.5)	6 (12.8)	6 (12.8)	25 (53.2)
Documenting your mood (*n* = 48)	9 (18.8)	8 (16.7)	8 (16.7)	7 (14.6)	16 (33.3)
Providing tips to improve your mood (*n* = 48)	9 (18.8)	5 (10.4)	10 (20.8)	8 (16.7)	16 (33.3)

Note—Data are number (%) of responses. Cells are shaded based on their relative values.

In the HF Self-Care Management Application Interest questionnaire, 66.7% said they were interested in tracking while 64.5% said they were interested in tips and 72.9% said they were interested in reminders (Figure 1). Interest in all three features of the smartphone application achieved statistically significant negative correlations with age ($p = 0.001$, $p = 0.002$, $p = 0.001$, respectively). In contrast to age, MLHFQ scores generated positive correlations with their interests. These correlations were also statistically significant ($p = 0.003$, $p < 0.001$, $p = 0.004$, respectively). Similarly, when multivariate regression analyses were performed with age and MLHFQ scores, they generated negative coefficients for age and positive coefficients for MLHFQ scores. Moreover, both identifiers achieved statistically significant results with tracking ($p = 0.007$, $p = 0.02$, respectively), tips ($p = 0.01$, $p = 0.002$, respectively), and reminders ($p = 0.007$, $p = 0.02$, respectively).

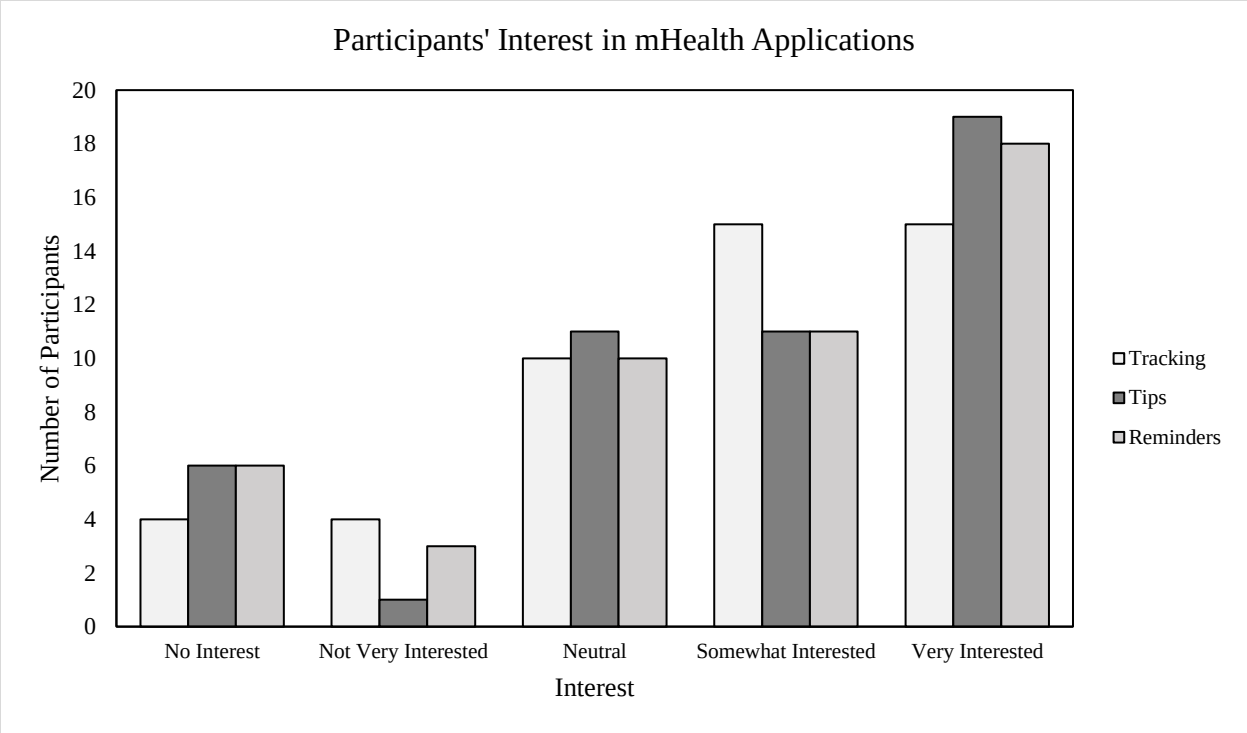

Figure 1. Averaged response distribution for participants' interest in tracking (light gray), tips (dark gray), and reminders (gray). Questions from the HF Self-Care Management Application Interest questionnaire (Table 3) are related to three distinct smartphone features: tracking, tips, and reminders. Participants' responses were averaged corresponding to each of those three features. Decimals were rounded to the nearest whole number to stratify their interest into responses in the Likert scale.

No relationship between age and frequency of the six different reminders was statistically significant: symptoms, symptom management tips, medication reminders, activity/steps, exercise reminders, and sleep tips ($p = 0.09$, $p = 0.26$, $p = 0.09$, $p = 0.09$, $p = 0.13$, $p = 0.40$, respectively). Between 80-90% of the participants indicated their desire to receive reminders at least once per day for all but medication reminders, which was 70.8% (Table 4). Once a day was the most popular response for the other five features. The proportion exceeded 50% for symptom management tips (55.1%), activity/steps (51.0%), exercise reminders (55.1%), and sleep tips (59.2%).

Table 4: Patient answers to HF Self-Care Management Application Engagement

Statement	Never	Once a day	Every 12 hours	Every 6 hours	Every 4 hours	Every 2 hours
Notify you of symptoms (*n* = 49)	9 (18.4)	20 (40.8)	8 (16.3)	3 (6.1)	4 (8.2)	5 (10.2)
Provide you with symptom management tips (*n* = 49)	6 (12.2)	27 (55.1)	9 (18.4)	1 (2.0)	3 (6.1)	3 (6.1)
Provide you with medication reminders (*n* = 48)	14 (29.2)	12 (25.0)	9 (18.8)	4 (8.3)	3 (6.3)	6 (12.5)
Provide you with your level of activity/number of steps (*n* = 49)	5 (10.2)	25 (51.0)	3 (6.1)	4 (8.2)	6 (12.2)	6 (12.2)
Provide you with exercise reminders (*n* = 49)	5 (10.2)	27 (55.1)	5 (10.2)	3 (6.1)	5 (10.2)	4 (8.2)
Provide you with sleep tips (*n* = 49)	8 (16.3)	29 (59.2)	6 (12.2)	2 (4.1)	0 (0.0)	4 (8.2)

Note—Data are number (%) of responses. Cells are shaded based on their relative values.

The majority of participants had access to technology. While only 24 (49.0%) participants owned a tablet, 44 (89.8%) participants owned a smartphone (Table 5). Additionally, high proportions of participants had access to the Internet through a cellular network (83.7%) or a wireless network (87.8%). Most participants also had experience using their smartphone (42 of 44 smartphone owners, 95.5%) and accessing the Internet or their e-mail account(s) (89.8%). Fewer patients had activity trackers and smartwatches as only 14 (28.6%) participants owned one and nine (64.3%) used it regularly. Ownership of an activity tracker or smartwatch was not related to income as half of them earned a household income that surpassed $75,001 annually.

Table 5: Patient answers to Health Information Nation Trends Survey

Question	No	Yes
Do you ever go online to access the Internet or World Wide Web, or to send and receive e-mail? (*n* = 49)	5 (10.2)	44 (89.8)
When you use the Internet, do you ever access it through a regular dial-up telephone line? (*n* = 49)	48 (98.0)	1 (2.0)
When you use the Internet, do you ever access it through Broadband such as DSL, cable or FiOS? (*n* = 49)	15 (30.6)	34 (69.4)
When you use the Internet, do you ever access it through a cellular network (i.e., phone, 3G/4G)? (*n* = 49)	8 (16.3)	41 (83.7)
When you use the Internet, do you ever access it through a wireless network (Wi-Fi)? (*n* = 49)	6 (12.2)	43 (87.8)
Do you own a tablet? (*n* = 49)	25 (51.0)	24 (49.0)
Do you own a smartphone? (*n* = 49)	5 (10.2)	44 (89.8)
If so, do you use your smartphone at least once daily? (*n* = 43)	1 (2.3)	42 (97.3)
Do you own a cell phone? (skip if yes answer to smartphone) (*n* = 5)	1 (20.0)	4 (80.0)
If so, are you comfortable using the cell phone? (*n* = 4)	1 (25.0)	3 (75.0)
Do you own an activity tracker/smartwatch? (*n* = 49)	35 (71.4)	14 (28.6)
If so, do you wear it daily? (*n* = 14)	5 (35.7)	9 (64.3)

Note—Data are number (%) of responses.

Discussion

The results indicate that 38 out of 48 survey participants (79.2%) were interested in at least one of the following features of a smartphone application to assist their HF management: symptoms, medication or treatment side effects, activity/steps, and sleep. Consequently, this study suggests the prospect of HF patients utilizing a smartphone application to self-monitor their condition while also receiving tips and reminders related to HF. Access to and experience with technology should not pose major concerns to its potential as 43 out of 49 participants (87.8%) owned a smartphone and had access to the Internet.

MLHFQ score and age were two factors that influenced the participants' degree of interest. Their responses to questions in this survey and subsequent scores imply many experienced adverse health outcomes due to their HF. The statistically significant positive correlations between their MLHFQ score and interest in tracking, tips, and reminders show that HF patients with lower HRQOL express greater interest in a smartphone application for HF than those with higher HRQOL. Because the MLHFQ is reliable and sensitive to differences in symptom severity [28], HF patients with lower MLHFQ scores are likely more prominently afflicted by HF. Therefore, their interest in receiving HF-related information and reminders may suggest a greater likelihood of utilizing it as an individual-tailored intervention.

Analysis of age was a key aspect of this study because both prevalence and incidence of HF increases with age [6,7]. Accordingly, older HF patients are the primary target population for any intervention. In contrast to the increase of their interests with MLHFQ score, HF patients' interest significantly decreased with age. This result is consistent with and can be explained by previous studies that examined adults' technology usage and attitudes. In those studies, older adults acknowledged the benefits of technological advances, but expressed several issues with technology, such as lack of security and reliability as well as inconvenience [29,30]. Additionally, they identified low self-efficacy, high anxiety, and increased efforts as reasons for their reluctance to adopt technology [31,32]. As a result, their unfavorable outlook on technology poses a challenge to the prospect of implementing the smartphone application as an intervention. Providing incentives or alternatives, however, could address this challenge for those who may not be interested in mHealth applications.

Questionnaire scores from this survey revealed unexpected results. Both the MLHFQ and KCCQ were intended to quantify patients' HRQOL with respect to their HF, but revealed contrasting results with statistical significance ($p < 0.001$). The MLHFQ generated a median score that corresponded to poor HRQOL, whereas the KCCQ produced a median score that suggested good HRQOL. This discrepancy may be due to the fact that questions in the KCCQ examined a much shorter time frame (two weeks) than those in the MLHFQ (four weeks). Furthermore, the KCCQ is primarily concerned with two symptoms of HF, shortness of breath and fatigue, while the MLHFQ is more general. Whereas the scores from questionnaires regarding behavior and function produced mixed results, all those regarding symptoms generated scores that fell within the normal range (Table 2). This

outcome suggests that the mental health conditions of the participants were in favorable states despite their adverse health effects from HF. This finding appears to not align with a previous study that found HF patients have high levels of anxiety, which leads to decreased adherence to medications [33]. The normal mental health of the participants may have influenced their interests in the smartphone application as a self-care strategy.

This study was confined to patients from a university-based health system and was limited to those age 50-80. There was greater representation of male (68.0%) and white (66.7%) patients in the study cohort (Table 1), which may have generated results that are not applicable to the general population with HF. One reason for the disproportionate representation is that this study was limited to English-language speakers. Literacy in English was necessary to understand the directions and questions because there was only an English version of the survey. Future work will include translation of this survey into other languages, particularly Spanish. In regard to the results, the statistically significant correlations do not indicate causation. Self-reporting of interest in mHealth may not translate to actual use, adherence, or persistence. Prospective testing will of mobile technology applications will be needed along with evaluation of their effectiveness, safety, and value.

Conclusion

Overall, this study proposes that a smartphone application may be a viable minimally invasive alternative intervention for monitoring HF patients due to the generally positive reception. Participants were interested in all three features of the proposed smartphone application, which were tracking, tips, and reminders. Because these are common features of activity trackers and smartwatches, they, along with a smartphone application, may be potential solutions for HF patients' self-care needs. Age and MLHFQ scores may be useful predictors in determining whether a HF patient is interested in a smartphone application for self-care. These findings suggest certain populations may be more inclined to utilize mobile technology to manage their treatment and symptoms.

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Conflicts of Interest

Gregg C Fonarow, MD, reports consulting for Abbott, Amgen, Bayer, Janssen, Medtronic, and Novartis.

Abbreviations

EF: ejection fraction
HF: heart failure
HINTS: Health Information National Trends Survey

HRQOL: health-related quality of life
IQR: interquartile range
KCCQ: Kansas City Cardiomyopathy Questionnaire
mHealth: mobile health
MLHFQ: Minnesota Living with Heart Failure Questionnaire
NYHA: New York Heart Association
PRO: patient-reported outcome
PROMIS: Patient-Reported Outcomes Measurement Information System
RCT: randomized clinical trial
SAQ: Seattle Angina Questionnaire
SCHFI: Self-Care of Heart Failure Index
SD: standard deviation
SF: short form
US: United States

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