Self-management of Older Korean Adults Living with Chronic Diseases: The mHealth Intervention Protocol and Feasibility Study

ABSTRACT

Background: Although 90% of older Korean adults have at least one chronic disease, most self-management interventions are clinic-based, delivered through face-to-face education, and highly focused on disease information only in South Korea. Therefore, older Koreans living in the community continue to seek an adjunct to manage chronic disease by themselves and expect mobile health (mHealth) to meet their healthcare needs in daily life.

Objective: This feasibility study (1) developed an mHealth protocol to empower older adults to manage their chronic diseases at home, (2) examined the feasibility of the mHealth intervention using mobile tablets and applications (apps), and (3) discussed contextual and methodological challenges when applying an mHealth intervention for older Koreans with chronic diseases.

Methods: The mHealth intervention protocol was developed based on the eHealth Enhanced Chronic Care Model. Our mHealth intervention included four phases. Phase 1 included mobile tablet training and standardized technology training with guidebooks, demonstrations, and guided practice. Phase 2 included standardized information for disease management retrieved from both governmental and professional healthcare organizations. Phase 3 included training to use the pre-selected high-quality mHealth apps to consider types of individuals’ chronic disease. Phase 4 included encouragement to practice self-selected mHealth apps based on their individual needs. Quantitatively descriptive and qualitative content analyses of user evaluation were completed to assess feasibility and user acceptance.
Results: Among the 27 older adults, 25 completed mHealth training for 4 weeks. The attrition rate was 7.4% (2/27), due to time conflicts, emotional distress, and/or family discouragement. The men required little or no time for Phase 1, while the women seemed to depend on the interventionists for Phase 3. At least 4 weeks with weekly meetings were required to complete training of the mHealth intervention. Sex, educational level, and previous experience using smartphones were associated with learning speed, confidence, and competence.

Conclusions: A highly person-centered approach is required to implement mHealth interventions for older adults. Self-management of chronic diseases via mHealth requires careful consideration regarding the complex nature of human behavior, emotional response, and family influence; therefore, integrating a theoretical-clinical-technical approach is necessary for successful implementation and higher effectiveness among older adults.

Keywords
mobile health; feasibility study; chronic disease; eHealth Enhanced Chronic Care Model; aging; community health service
Introduction

Chronic diseases are a significant health concern in Korean. According to 2014 Statistics Korea data, chronic diseases are major causes of death including cancer, heart disease, diabetes, chronic lower respiratory disease, liver disease, hypertension, and cerebrovascular disease [1]. According to the 2014 Ministry of Health and Welfare report, 90.4% of older Koreans reported having the chronic diseases listed above, consisting of 18.2% of older adults with one, 22.8% with two, and 49.4% with three or more chronic disease(s) [2]. In 2016, Statistics Korea reported that life expectancy at birth was 82.1 years in 2015 [3]; however, there is a 10-year difference from the disability-adjusted life expectancy (i.e., 70.72 years). This phenomenon results from advances in chronic disease treatment or long-lasting disability for an extended period in late adulthood [4].

Self-management of chronic disease is a critically important behavior to decrease the negative influence on older adults’ health status. It is vital to emphasize maintaining good health behaviors and active disease management among older adults, which promotes a better quality of life as they age [5,6]. To achieve sustainable self-management outcomes, it is necessary to consider characteristics of older adults to develop effective interventions and encourage them to engage in healthy behaviors at a younger age [5]. Therefore, there is greater need than ever to diversify self-management interventions to overcome these identified limitations and aging effects [7].

However, promoting self-management in chronic diseases is challenging among older Koreans. Most current self-management programs related to chronic diseases are delivered via face-to-face educational programs that provide group-based teaching sessions of general disease information, and they are primarily driven by healthcare providers [7,8]. The information-focused approach has not been effective in changing older people’s health behaviors, which predispose positive outcomes resulting from chronic disease management.
and sustainable treatment compliances [9]. Moreover, that most programs are provided for a brief period (4–12 weeks) in class, and they are intensively centered on delivering disease and medication information with a one-way communication approach from healthcare providers to patients [7]. This standardized educational approach has limitations in providing a person-centered approach, although most older adults are living with different progression of chronic diseases [8,9].

Mobile health (mHealth) interventions are an emerging alternative to enhance self-management of diseases [10-12]. mHealth is defined as medical and public eHealth approaches to improve health and wellbeing, which allows delivery of healthcare services via various solutions using mobile devices and associated technologies [10,12]. mHealth enables users to utilize resources through network services and diverse technological applications in a timely manner without physical travel [10,12,13]. In addition, mHealth services empower people to be active partners; people are likely to participate in their healthcare practice through interactive communications with healthcare providers [12]. mHealth helps people to recognize their healthcare needs, facilitates access to health services, and assists in solving problems regarding their illnesses [12,13]. More importantly, mHealth has increased adherence to treatment and disease management for better patient outcomes across the chronic disease trajectory [10,13].

There are significant gaps in the literature investigating how mHealth interventions help older adults self-managing of chronic diseases [10,13-19]. Past studies have reported the efficacy of disease-centered interventions focusing on a single disease group. The interventions highly depend on mobile communication using telephone calls and a short message service rather than multi-factorial interventions integrating applications and web-based interactive programs [10]. Moreover, there is limited information of the process how the mHealth intervention protocols were developed, considering the key challenges faced by
community-dwelling older adults [10,13,20]. No previous theory-based Korean study aimed to develop specific components of mHealth interventions tailored to older Koreans with diverse types of chronic diseases. Therefore, it is necessary for a feasibility study to conduct successful intervention effectiveness research prior to larger randomized controlled trials [21]. Consequently, we (1) developed an mHealth intervention protocol to empower community-dwelling older adults to manage their chronic diseases, (2) examined the feasibility of the mHealth intervention among older adults using mobile tablets and applications (apps), and (3) discussed the contextual and methodological challenges when developing the mHealth intervention protocol for older adults with chronic diseases.

Methods

Study design

This study consisted of two parts: (1) a methodological design with development of an mHealth intervention protocol and (2) a descriptive design of user evaluation (N = 27) after they participated in the mHealth intervention.

Developing the mHealth intervention protocol

Description of mHealth intervention based on the eHealth Enhanced Chronic Care Model (eCCM) The eCCM [22] guided the development of our mHealth intervention protocol and was used to evaluate feasibility. eCCM explains how adults with chronic diseases become active, educated, engaged, and empowered while working with their healthcare providers, community, and social networks in actual and virtual communities as well as healthcare systems [22]. Since current care of chronic diseases for Korean adults is highly centered on acute care settings, our mHealth strategies encouraged those living in the community to enhance their integrative knowledge and practice of self-management when
dealing with chronic diseases.

Our mHealth intervention focused on two main components of eCCM: self-management and eHealth education. Our intervention included multiple phases including (1) Phase 1: standardized technology training, (2) Phase 2: general information of chronic diseases, (3) Phase 3: eHealth education using pre-selected mobile apps related to individual chronic diseases, and (4) Phase 4: active use of self-selected apps based on daily healthcare needs. Each of these phases are described below.

In Phase 1, for our mHealth intervention, iPad mini 2 retina display was selected to provide a standardized device and training for all study participants, rather than using their own devices. The iPad mini has some advantages regarding (1) proper size and weight to carry; (2) high pixel density in high quality images, which is key for older users to reduce burden due to limited visual difficulty; and (3) opportunities to use diverse types of apps developed internationally [23], as previous literature emphasizes [10,11,20].

Procedures regarding participants’ anonymity and confidentiality should be carefully designed and described to participants [13,20]. Based on the Association of Internet Research recommendations for ethical conduct for Internet, Computer, and Technology research [24], a unique participant code was assigned to each participant for data collection and entry to the database. A research assistant created an anonymous user identification number and password and participants were provided with these to log into the mHealth device.

Technology training included provision of mobile device guidebooks, standardized demonstrations by the interventionists, guided practice, and 24/7 telephone trouble-shooting calls. After one week for self-practice time, the interventionists evaluated the proficiency of the participants at using the mobile device independently [20]. In addition, participants reported their confidence in using the mobile tablets [20]. When participants were evaluated
as both proficient and confident, they moved forward to Phase 2. If participants were not proficient, confident, or comfortable, they were asked whether they were willing to continue the training. When they were willing to continue training, the interventionists provided additional training up to twice more.

In Phase 2, trained interventionists provided information retrieved from the Korean Center for Disease Control [25], Ministry of Health Welfare [26], Korean Academy of Medical Sciences [27], and Korean Diabetes Association [28] concerning healthy diet, exercise, lifestyle modification, prevention and management of complications secondary to primary diseases, and medication. We retrieved the content of chronic diseases based on the following principles: (a) the information focused on single or multiple chronic disease(s) of a specific individual; (b) the information should be evidence-based regarding risk factors and consequences for chronic diseases; (c) the information should be written at a sixth grade or lower level of literacy [29]; and (d) the information was designed to be delivered efficiently using diverse types of multimedia, including webpages’ script, educational video streaming, workbooks, or pictures.

In Phase 3, after each study participant and the interventionists assessed types of chronic disease, health status, individual needs, and mHealth proficiency, they selected specific mobile apps, such as a blood pressure measuring tool, fingertip glucose monitoring, a tracking log, and interactive games. Considering Internet connections, we carefully selected apps that operated both online and offline for possible operation at home without Internet access [10]. Our mobile tablet and the selected apps did not require participants to enter personal information. All participants were instructed that they were required to log out after using personal email or other apps for personal use.

In Phase 4, participants were instructed to use the selected apps for at least 30 minutes daily for a week to ensure feasibility [11]. All participants could still explore
additional apps and downloaded some of them with interventionists as needed. After completing the mHealth intervention, prior to equipment being rotated to the next participant, it was sanitized, inspected for safety, and retested per the manufacturer’s recommendations and our team’s research protocol. When study participants used web pages and apps outside of our mHealth intervention, we did not examine them due to protection of participants’ privacy regarding their history of Internet use [13,20].

Feasibility test
Study participants

We recruited a convenience sample of 30 older Korean adults throughout two community centers. Inclusion criteria were as follows: (1) aged ≥ 60 years; (2) understanding Korean; (3) living at their home in a community setting; and (4) living with at least one chronic disease including cardiovascular diseases, diabetes mellitus, hypertension, and cerebrovascular diseases, which are the most prevalent among older Koreans [2]. We excluded those who had a cognitive impairment, depressive mood, or psychiatric disorders based on screening using the Korean versions of the Mini-Mental Status Examination (MMSE-K) [30] and Geriatric Depression Scale-short form (SGDS-K) [31] as well as self-report. After excluding 3 ineligible volunteers, 27 participants began our mHealth intervention and 25 completed the intervention.

Measures

For screening purposes, the MMSE-K and SGDS-K were used to assess cognitive impairments and emotional distress, which were barriers to health education. The MMSE is a 30-point instrument that is internationally used to assess cognitive function in older adults [32]. The Korean version was valid, reliable, and culturally equivalent to the English version,
including diagnostic, concurrent, and discriminant validity [30]. In addition, the SGDS is a 15-item measure that is internationally used to assess geriatric depression ranging from 0 to 15 [33]. The Korean version was valid, reliable, and culturally equivalent to the English version, including internal consistency and discriminant validity [31]. MMSE scores lower than 24 and SGDS-15 scores higher than 11 indicate significant cognitive impairment and depressive mood, respectively, that were used as exclusion criterion due to possible inaccurate operation of the mHealth device [20].

As a baseline, all participants completed questionnaires including socio-demographic, clinical, and computer-related questions after screening. Socio-demographic characteristics included age, sex, education, marital status, living status, and employment. Clinical information included types and the number of chronic diseases and comorbidities, period of living with specific diseases, and history of medications. Computer-related questions were asked such as whether the participants had used computers, smart devices, or the Internet. We developed a self-reporting user evaluation and a proxy-report checklist of essential tasks based on previous literature [11,34]. After completing Phase 1, participants reported their confidence and a research assistant observed their basic skills in using mobile devices based on a standardized checklist. At the end of Phase 4, participants answered several questions to report their levels of subjective confidence, satisfaction, and usability regarding the mHealth intervention (Appendix 1 and 2).

Data collection

Community-dwelling older Koreans were recruited from two local community centers, which were similar regarding socio-demographic-economic status and proportions of older adults. The research team explained the study’s purposes, protocols, and human participant protection strategies to nurses working for the community centers. Participants
were recruited through advertisements posted on bulletin boards or word-of-mouth. Community nurses working at each center assisted in recruiting and screening study participants (e.g., cognitive function and psychiatric illnesses). Data were obtained via standardized self-report questionnaires, observation notes, and unstructured 5-minute interviews from May 2016 to January 2017. To reduce undue influence from the community nurses, anonymous questionnaires were collected at separate places. Data collection typically took less than 30 minutes, and the participants received a small gift worth US $5 for their time and effort.

Data evaluation

Based on feasibility evaluation criteria [21], we focused on (a) evaluating users’ subjective appraisal of the intervention and study procedures and (b) identifying strategies to implement the study intervention. Therefore, we identified contextual and methodological considerations to assist the researchers in understanding barriers when conducting further full-scale studies. Qualitative content analyses were used to evaluate data from structured interviews and observation. Quantitative data were reported by frequency (%) and mean (standard deviation, SD). Because of the exploratory nature of this feasibility study, we tested statistical significance between those who completed the 4-week mHealth intervention (n = 25) and those who did not complete it (n = 2). All statistical analyses were performed using IBM SPSS Version 23.0.

Ethical considerations

The Institutional Review Boards of Yonsei University and College of Nursing approved the study protocols. All participants provided written, informed consent. All participants were informed of the voluntary nature of the study, their freedom to withdraw
enrollment, and how their anonymity and confidentiality would be protected.

Results

Description of study participants

The demographic, clinical, and technological profiles of the 27 study participants are shown in Table 1. Our participants were 73.33 (SD = 5.98) years old on average and most were female (67%), married or partnered (70%), living with family members (70%), and unemployed (96%). Few of them were educated at college level or higher (15%). Older Koreans were living with 2.07 illnesses (SD = 1.21) on average for 11.68 years (SD = 11.32). Most participants had taken medication (70%) to manage their chronic diseases. About two thirds of participants had used computers (59%, 16/27) and smartphones (67%, 18/27).

Table 1. Characteristics of study participants

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Participants (n=27)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age</strong>, mean (SD^a)</td>
<td>73.33 (5.98)</td>
</tr>
<tr>
<td><strong>MMSE-K^b</strong>, mean (SD^a)</td>
<td>27.70 (1.73)</td>
</tr>
<tr>
<td><strong>SGDS-K^c</strong>, mean (SD^a)</td>
<td>3.67 (3.55)</td>
</tr>
<tr>
<td><strong>Period of living with chronic diseases</strong>, mean (SD^a)</td>
<td>11.68 (11.32)</td>
</tr>
<tr>
<td><strong>Number of chronic diseases</strong>, mean (SD^a)</td>
<td>1.56 (0.89)</td>
</tr>
<tr>
<td><strong>Number of comorbid conditions</strong>, mean (SD^a)</td>
<td>2.07 (1.21)</td>
</tr>
<tr>
<td><strong>Duration of computer use (n = 16, unit: month)</strong>, mean (SD^a)</td>
<td>6.69 (6.18)</td>
</tr>
<tr>
<td><strong>Duration of smartphone use (n = 19, unit: month)</strong>, mean (SD^a)</td>
<td>44.84 (22.49)</td>
</tr>
<tr>
<td><strong>Sex, n (%)</strong></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>9 (33)</td>
</tr>
<tr>
<td>Female</td>
<td>18 (67)</td>
</tr>
<tr>
<td><strong>Education, n (%)</strong></td>
<td></td>
</tr>
<tr>
<td>Less than middle school</td>
<td>9 (33)</td>
</tr>
<tr>
<td>Middle to high school</td>
<td>14 (52)</td>
</tr>
<tr>
<td>College or more</td>
<td>4 (15)</td>
</tr>
<tr>
<td><strong>Marital status, n (%)</strong></td>
<td></td>
</tr>
<tr>
<td>Married or partnered</td>
<td>19 (70)</td>
</tr>
<tr>
<td>Widowed</td>
<td>8 (30)</td>
</tr>
<tr>
<td><strong>Living status, n (%)</strong></td>
<td></td>
</tr>
<tr>
<td>Living with family members</td>
<td>19 (70)</td>
</tr>
</tbody>
</table>
Living alone 8 (30)

**Employed, n (%)**
Employed 1 (4)
Unemployed 26 (96)

**Chronic disease present**, n (%)  
Cerebrovascular disease 5 (19)  
Ischemic heart disease 4 (15)  
Diabetes mellitus 9 (33)  
Hypertension 14 (52)

**Medication, n (%)**
Yes 19 (70)  
No 8 (30)

**Computer use, n (%)**
Past or current 16 (59)  
Never 11 (41)

**Smartphone use, n (%)**
Past or current 18 (67)  
Never 9 (33)

**Internet access at home, n (%)**
Yes 14 (52)  
No 13 (48)

*aSD: standard deviation.*  
*bMMSE-K: Korean version of Mini-Mental Status Examination.*  
*cSGDS-K: Korean version of Geriatric Depression Scale-Short Form.*  
*dMultiple answers were allowed.*

**Attrition**

Attrition was used to evaluate the acceptability of mHealth intervention. Participants were classified to have completed the intervention if they completed all phases as well as a pre- and post-evaluation; otherwise, they were classified as a dropout. Of the 27 participants who took part in our mHealth intervention for 4 weeks, the attrition rate was 7% (2/27). Two dropouts occurred at Phase 1 due to time conflicts, emotional distress, and/or family discouragement. Those who did not complete the mHealth intervention were female, less educated, widowed, and living alone. In addition, both of them had cardiovascular diseases and significantly depressed mood.
Assessment of confidence and proficiency

Group sessions were delivered at Phase 1. Confidence and proficiency in using mobile tablets were determined when performing all eight key operating skills and expressing that they were “confident” or “strongly confident” when using the device without any assistance. Although participants had the opportunity to receive device training up to three times, most participants received only 1 training (88%, 22/25), while only 12% (3/25) of 25 study participants required additional training. Twenty-five older adults became proficient in completing key tasks in using the selected device and apps (mean = 3.68, SD = 1.75) compared to the status without any training (mean = 3.44, SD = 2.39). Their mean reported confidence level was 3.76 (SD = 1.17) on a 5-point Likert-type scale, where higher scores indicated more confidence. The number of confident participants increased from 44% to 52% after Phase 1 training.

Men and those with higher education were more likely to learn how to use devices and apps quickly and easily compared to women and those with lower education. Those who had used computers or mobile devices prior to this study required less training compared to the no-experience group. Previous users of mobile device needed time and information to become accustomed to Apple’s operating system because most had used Android devices.

Users’ satisfaction with the mHealth device

User satisfaction was self-reported for various items on a 5-point Likert type scale (1 = Strongly disagree, 5 = strongly agree). Device training was considered to be helpful before participants initiated the mHealth intervention (mean = 4.36, SD, 1.04) and appropriate for health promotion (mean = 4.44, SD = 1.00). The device was easy to carry (mean = 3.76, SD = 1.27) and use (mean = 3.80 SD = 1.19). Participants would recommend the device training to others (mean = 4.04, SD = 1.06). In addition, using the mHealth device was less likely to
disturb their daily life, including privacy concerns ($\text{mean} = 1.12, \text{SD} = 0.84$).

Participant’s preference selecting and using specific mobile apps

A highly tailored approach was requested by the participants from Phases 2 to 4 to select appropriate apps based on individuals’ healthcare needs. Therefore, the ratio between interventionists and participants became essential at Phases 3 and 4. Throughout our experience, one interventionist could assist 2–3 participants at a time in Phases 3 and 4 to provide instant feedback during the training.

Most participants preferred to use interactive apps rather than one-way information delivery. For example, participants frequently used an app measuring blood pressure with the fingertip and responded to its evaluation and instructions for lifestyle modification. In addition, they visited homepages of authorized organization websites to acquire information; however, they rarely re-visited these sites. The favored apps among participants were related to exercise, including tracking records, video streaming, or personalized recommendations. Table 2 summarizes the most frequently used apps by our participants. In addition, participants received weekly follow-up calls or text messages as reminders. They reported that this contact was useful and allowed them to ask further questions concerning solving technical problems and exploring more diverse types of apps on an as-needed basis.

Table 2. Most frequently used apps in this study

<table>
<thead>
<tr>
<th>Name of application</th>
<th>Provider</th>
<th>Major purpose</th>
<th>Feature participants most liked</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardiio</td>
<td>Cardiio, Inc</td>
<td>Monitoring heart rate in daily life</td>
<td>Suggestions of exercise programs based on heart rate variability</td>
</tr>
<tr>
<td>Application</td>
<td>Company</td>
<td>Function</td>
<td>Feature</td>
</tr>
<tr>
<td>-------------------</td>
<td>--------------------------</td>
<td>--------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------</td>
</tr>
<tr>
<td>iCare</td>
<td>Beijing Jiajiakangkang Co. Ltd.</td>
<td>Measuring heart rate, blood pressure, vision acuity and field, lung capacity, or mood</td>
<td>Alarms responding to abnormal results or dramatic changes of measured data</td>
</tr>
<tr>
<td>Hypertension</td>
<td>Dong-wha Pharm. Co.</td>
<td>Tracking trends in blood pressure and body weight</td>
<td>Personalized information based on levels of blood pressure in an easy and readable manner</td>
</tr>
<tr>
<td>Diabetes Guide</td>
<td>Innova Think, Corp.</td>
<td>Providing stepwise and diverse information on diabetes mellitus</td>
<td>Promotion of self-care regarding diet control, exercise, foot care, and infection control</td>
</tr>
<tr>
<td>Diabetes Note</td>
<td>Minister of Health and Welfare</td>
<td>Tracking trends in daily glucose levels</td>
<td>Depiction of trends in daily, weekly, and monthly blood glucose</td>
</tr>
<tr>
<td>Noom Coach</td>
<td>Noom, Inc.</td>
<td>Facilitating lifestyle modification</td>
<td>Suggestions of diverse types of lifestyle modification such as sleep, stress, management, depression prevention, diet, or exercise</td>
</tr>
</tbody>
</table>

**Discussion**

Principal results and comparison with prior work

Our protocol aimed to increase readiness of older adults to participate in an mHealth self-management intervention for chronic diseases in a community setting, where there are
limited staff and resources for adequate patient education [6,35,36]. Our findings showed that successful implementation of an mHealth intervention was associated with participants’ subjective perception, diverse effort to overcome barriers, and a tailored approach considering older adults’ characteristics [13,20]. Therefore, this study provides fundamental information on users’ experiences when implementing an mHealth intervention among older adults. Consequently, research should focus on conceptual and methodological lessons learned, which are essential for preparing resources and strategies of mHealth interventions for community-dwelling older adults dealing with chronic disease management.

Emotional responses are key components to successful implementation at the primary stage of mHealth intervention. Although mHealth intervention training is clearly useful, those dropping out or requiring additional training were likely to report higher depressive scores or feeling stressed. Respondents’ confidence is also critical to judge their emotional distress and to learn new skills of healthcare interventions, which previous studies also noted [10, 20]. Previous studies identified the main factors of successful outcomes in mHealth interventions for older populations as independence, understanding, and confidence to access complex interventions [13,20]. Tracking features during periodic training and regular follow-ups are essential to provide positive feedback of progression based on objective data obtained during the mHealth intervention [11,35].

Furthermore, a tailored approach is required to assure high adherence, specifically during Phases 3 and 4 [37,38]. Our interventionists tried to perform the role of health coaching rather than merely lecturing about chronic disease information [9]; therefore, we carefully assessed their healthcare needs before selecting apps. Strong interest and autonomy of selection based on individual needs are a driving force behind facilitating an mHealth intervention [20]. In our study, participants utilized physiological monitoring, information-based education, and self-management, which was consistent with another study of Asian
older adults in Taiwan [34]. Common features of the selected apps included recording individual information such as blood pressure and providing personal guidance and alerts based on inputted data. It appears that personalized data and responses enhance mHealth engagement in older adults [11, 13].

In addition, a grey digital divide exists. We carefully constructed group sessions considering (a) mixed sex to facilitate peer learning, (b) similar levels of education, and (c) previous experience using smart devices. Adults of an advanced age required more device training to become accustomed to using the device itself [10,13]. The interventionist needed to adjust some features based on their sensory impairment, such as text size, brightness, and volume to overcome possible sensory and functional impairment barriers [13,20]. Sex differences, as previous studies discussed [10,13], were identified during training and choosing specific types of apps. There was an unintentional increase in older and female users; therefore, special instruction should be provided to subgroups with a low level of literacy or e-literacy [10]. In addition, comprehensive assessment is required to consider end-user’s physical conditions and preparedness prior to implementing the mHealth intervention [39]. In addition, clinicians should be prepared to satisfy mHealth care needs of older adults, both clinically and technically. Consequently, organizational support and an interdisciplinary team approach should be planned when implementing mHealth interventions in community settings [39].

Successful self-management of chronic disease requires empowerment and support of informal caregivers [6], who make decisions about patients’ health care daily [9]. When older adults require technical support or positive rewards during smart device use and an mHealth intervention, they are likely to receive instant help or feedback from a significant other, such as a family member [38]. New devices and tasks are frequently discussed with family members, who influence older adults’ intent to use the intervention, which was shown
in previous studies [34,38]. Family attitudes toward telecare are a critical factor that supports older adults to continue using the services [34]. For example, the low technical support group mentioned that their family felt pressured to learn new skills or perform additional tasks dealing with mHealth devices or interventions [40]. Similar to older adults, family caregivers reported higher burden when they were not fully prepared to assist the older care-recipients concerning mHealth [40]. Therefore, mHealth interventions of chronic care need to integrate goals, which should be discussed among the patient, family, and healthcare providers [6,39]. In addition, family members should learn how to assist older adults in using mHealth interventions with effective feedback [38].

Technical assistance should be provided at any phase of mHealth interventions. Our participants expressed some degree of negativity toward technology use for daily practice of health care. The most common difficulty among participants was technical challenges; they were not familiar with using highly sensitive touch screens, completion of technology training, or diverse mobile apps. Many older adults felt concerned about incorrect operation or misunderstanding due to their lack of knowledge and experience [10,20,34,38]. In this study, participants received multiple device training adjusted to their progresses and technical support on continuous use of mHealth, as suggested by a previous study [20]. Participants received the benefit throughout a person-centered approach where the technical support was provided according to their unique characteristics and needs [38].

Implications for current research and practice

Our study protocol provides fundamental information to develop further mHealth interventions in large-scaled randomized controlled trials. It is essential to ensure consistency in initial device training to reduce the threat to internal validity [20], because poor ability to use mHealth devices may increase measurement error of clinical effect [11]. In addition,
exploring diverse retention strategies are key to prevent dropout for better mHealth interventions [41]. Consequently, special attention should be provided for those who are older, female, and not well-educated when retaining older adults in mHealth intervention studies and practices. This study provided information about participants’ concerns, which should be considered when implementing mHealth interventions to reduce subjective burden throughout evidence-based training [20].

A patient-centered approach has strengths in providing individualized healthcare services, reducing healthcare expenditures, and improving quality of life [42,43]. Although mHealth cannot be a total replacement for traditional face-to-face clinical-based treatment, it is expected to facilitate patient-centered care across settings [13]. This study provides fundamental information of mHealth interventions and effective delivery methods to facilitate clinicians caring for older Koreans living with chronic diseases. The barriers identified by this feasibility study offer opportunities for application developers, who need to consider consumers’ perspectives on healthcare purposes regarding aging populations.

Policymakers should consider the potential of mHealth to meet the needs of older adults living with chronic diseases. Public service and reimbursement should be established considering scientific evidence [13]. mHealth interventions could provide diverse routes to deliver healthcare services to community residents [10,36]. Community centers need to disseminate mHealth technology to vulnerable populations with elevated care needs in chronic disease management [20,36]. Future policy and public service should be prepared to take care of grey digital divide groups when mHealth services are provided with health equity.

Study limitations

Despite being the first feasibility study to develop the mHealth intervention protocol
for older Korean adults, this study had several limitations. The sample was small-scaled and recruited from only two community sites. Considering the nature of feasibility studies, future studies should include increasing sample numbers and control groups. Further studies with larger samples would enable us to identify factors influencing dropout; then, clinicians can develop evidence-based strategies to enhance completion or adherence of an mHealth intervention [44]. In addition, our study mainly used apps, websites, and video streaming. Further studies may consider expansion of other features such as text messaging, teleconferencing, and real-time feedback [10].

Conclusions

This study provided fundamental knowledge of methodological implications for researchers and clinicians to encourage older community-dwelling Koreans to implement an mHealth intervention for self-managing their chronic disease. Older adults showed strong interest and needed to learn and use mHealth intervention devices with careful assistance from professionals. Our findings emphasized that a highly person-centered approach is required to meet older adults’ needs for diverse types of chronic disease management; therefore, this study contributes to developing effective methods of mHealth for older adults based on their individualized healthcare needs, which has implications for further research and clinical practice in Korea.

Acknowledgements

We express our appreciation to all study participants for their time and effort in completing the surveys. In addition, we appreciate two community centers for their support in recruiting participants.
Funding

This study was supported by faculty research funds granted by College of Nursing and the Mo-Im Kim Nursing Research Institute at Yonsei University.

Conflicts of interest

The authors have no personal or financial conflicts of interest to disclose including those related to mobile devices, selected apps, government agencies, or profit companies.

Abbreviations

Apps: applications

eCCM: eHealth Enhanced Chronic Care Model

mHealth: mobile health

MMSE-K: Korean versions of Mini-Mental Status Examination

SD: standard deviation

SGDS-K: Korean version of Geriatric Depression Scale-Short Form
Multimedia Appendix 1

Confidence and proficiency in using mHealth devices
[caption]

Multimedia Appendix 2

User satisfaction evaluation form of the mHealth Device and Intervention
[caption]
References


27. Korea Academy of Medicine. Patient Information, 2014 URL: http://www.guideline.or.kr/newsletter/vol1503/file/5_%EB%8C%80%ED%95%9C%EC%9D%98%ED%95%99%ED%9A%8C%EB%8B%B9%EB%87%A8%EB%B3%91%20%ED%99%98%EC%9E%90%EC%97%90%EA%B2%8C%20%ED%95%84%EC%9A%94%ED%95%9C%20%EC


