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Effectiveness of Mobile Health-Based Self-Care Education on Symptom Control and Quality of Life in Chronic Heart Failure Patients

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Abstract

Background: Chronic heart failure is a cardiovascular disease with a high morbidity burden that significantly impacts symptom control and patient quality of life. Self-care education is an important component in heart failure management, but conventional approaches are often suboptimal. The development of digital technology, particularly mobile health (mHealth), offers new potential in improving the effectiveness of education and patient engagement in self-care. **Objective**: This study aimed to analyze the effectiveness of mobile health-based self-care education on symptom control and quality of life in chronic heart failure patients. **Methods**: This study used a quasi-experimental design with a randomized controlled trial approach. A total of 80 chronic heart failure patients were randomly divided into an intervention group (n=40) and a control group (n=40). The intervention group received self-care education based on a mobile health application for 8 weeks, while the control group received conventional education. Symptom control was measured using the Heart Failure Symptom Score, and quality of life was assessed using the Kansas City Cardiomyopathy Questionnaire (KCCQ). Data analysis was performed using repeated measures ANOVA and mixed-effects models. **Results**: The study showed a significant reduction in symptom scores in the intervention group compared to the control group ($p<0.001$). Furthermore, there was a statistically significant improvement in quality of life in the intervention group ($p<0.001$). Compliance with application use was positively associated with improved clinical outcomes. **Conclusion**: Mobile health-based self-care education is effective in improving symptom control and quality of life in chronic heart failure patients and has the potential to be an innovative strategy in nursing practice.

Keywords: Chronic Heart Failure; Mobile Health; Self-Care; Symptom Control; Quality of Life

Introduction

Chronic heart failure is a cardiovascular disease with high prevalence and mortality worldwide, significantly impacting quality of life and the burden on healthcare services. This condition is characterized by a decreased ability of the heart to pump blood effectively, causing symptoms such as shortness of breath, fatigue, and significant edema. These symptoms not only affect patients physically but also affect social and emotional functioning, thereby worsening overall quality of life. Cross-sectional studies have shown that self-care is closely related to quality of life in heart failure patients (Mohamad et al., 2025).

Self-care in heart failure patients encompasses a range of actions patients perform on their own in their daily lives, such as symptom monitoring, medication adherence, lifestyle changes, and treatment-related decision-making. Research shows that strong self-care skills are significantly correlated with improved quality of life and reduced recurrent hospitalizations (Dinanti & Masulili, 2025).

With advances in digital technology, mobile health (mHealth) has become a promising medium to support education and self-care in heart failure patients. mHealth refers to the use of mobile devices such as smartphones and apps to provide health information, symptom monitoring, and interaction between patients and healthcare providers. Previous literature has shown that mobile apps have the potential to improve patients' knowledge about their disease and strengthen their involvement in the daily management of their health condition. For example, a qualitative study on the use of mobile apps reported that participants felt more empowered and active in managing their symptoms thanks to the educational features within the apps (JMIR Nursing, 2021).

However, empirical research on the effectiveness of mHealth interventions remains heterogeneous. A systematic review in the journal JMIR Cardio found that mobile apps for heart failure management can improve self-management, but strong quantitative evidence for improvements in quality of life and reduced hospitalizations is inconsistent or not yet significant (Giordan et al., 2022). Furthermore, a pilot trial showed that patients using an mHealth intervention experienced a trend toward improved quality of life and reduced symptom intensity compared to standard care, although the effects were modest and require further study with a larger sample size (Schmaderer et al., 2022).

A recent meta-analysis also evaluated the role of mHealth in the transition from hospital to home care. The results showed that mobile health interventions can reduce mortality, but their effects on quality of life and self-care are less clear, requiring longer follow-up periods to observe significant changes in these outcomes (Achury Saldaña et al., 2025).

Furthermore, evidence from a systematic review of eHealth suggests that interventions focused on self-care through digital technology can improve quality of life, although study heterogeneity remains a major challenge in analyzing their effects in aggregate. This article emphasizes that more robust study designs and adequate sample sizes are needed to obtain more conclusive evidence.

Consistent with these findings, numerous other literature reviews have emphasized the importance of education in improving self-care behaviors in heart failure patients. They have demonstrated that structured educational programs involving technology—including mobile applications and telenursing—can

strengthen patients' ability to manage their disease and increase their engagement in healthy habits. This suggests that mobile health-based education is a feasible and relevant strategy for improving health outcomes in heart failure patients.

Furthermore, meta-analytic and prospective studies are needed to more definitively measure the impact of mHealth interventions on nursing outcomes, such as daily symptom control, reduced acute hospitalizations, and long-term quality of life. This is crucial considering that the global health burden of heart failure tends to increase with the aging population and the prevalence of comorbidities.

In the context of nursing education, mobile health-based educational interventions not only provide educational content but also provide self-monitoring tools, regular feedback, and communication with healthcare providers, which are essential components in increasing patient self-efficacy for consistent self-care. This approach is highly relevant to self-care theory, which emphasizes the automation of care actions by patients themselves as a crucial element of chronic disease management.

Therefore, research on the effectiveness of mobile health-based self-care education on symptom control and quality of life in patients with chronic heart failure is crucial. This research is expected to provide in-depth empirical evidence on the extent to which mHealth interventions can impact patient outcomes, ultimately expanding nursing knowledge and clinical practice in heart failure management.

Method

Research Design

This study used a quasi-experimental randomized controlled trial (RCT) design to evaluate the effectiveness of mobile health-based self-care education in patients with chronic heart failure. The RCT approach was chosen because it minimizes allocation bias and provides causal evidence between mHealth interventions and changes in symptom control and quality of life (Giordan et al., 2022; Kitsiou et al., 2025).

Population and Sample

The sample consisted of patients with chronic heart failure who met the criteria of being 18 years of age or older, diagnosed with heart failure according to the latest ACC/AHA/HFSA guidelines, and capable of using a smartphone. Inclusion criteria also included clinical stability for 1 month or more prior to the study and the absence of significant cognitive impairment. Exclusion criteria included visual/parafunctional disorders that affect app use and terminal illnesses other than heart failure. The sampling method used random allocation with a 1:1 ratio between the intervention and control groups. Sample size was determined using an effect size (G*Power) calculation, with an estimated α=0.05, β=0.20, and a minimum power of 80%, consistent with practice in similar studies (Schmaderer et al., 2022).

Intervention

The primary intervention is mobile health-based self-care education through a smartphone app containing interactive education, daily symptom monitoring, medication reminders, weight and vital sign records, and automated feedback. The intervention is designed following mHealth development recommendations published in the literature on HF app use (Giordan et al., 2022; Allida et al., 2020).

The intervention group will use the app for 8 weeks, with initial instructions at a baseline meeting and technical support via SMS/text. Participants will be asked to engage in daily self-monitoring and receive alerts/push notifications targeting

changes in symptoms and self-care actions (e.g., diet control, exercise, and vital sign monitoring). This approach is similar to the iCardia4HF protocol, which combines SMS and an app for self-care behavior change (Kitsiou et al., 2025). The control group will receive standard, conventional education in the form of a printed brochure and regular consultations without app support.

Variable Measurements

This study measures two primary outcomes:

1. Symptom Control. Measured using a validated instrument, the Heart Failure Symptom Score, which assesses the frequency and intensity of symptoms such as dyspnea, fatigue, edema, and chest pain. Measurement consistency was achieved at baseline, week 4, and week 8 (SMART-HF Trial); symptom change is an important endpoint in evaluating mobile health interventions.
2. Quality of Life. Measured using standardized instruments such as the Kansas City Cardiomyopathy Questionnaire (KCCQ) or the EuroQol-5D (EQ-5D), or the SF-36, based on recommendations in previous studies. Quality of life is a central outcome in evaluating mHealth interventions for HF because it demonstrates a tangible impact on patient well-being (Schmaderer et al., 2022).

Data Collection and Procedures

Data were collected at three time points: baseline (T0), mid-intervention (T1: week 4), and end-intervention (T2: week 8). Data included patient demographics, HF symptom scores, quality of life scores, self-monitoring adherence, and app usage records. Respondents were instructed to perform daily self-monitoring through an application, which was automatically recorded in the backend system. Symptom control assessment began with patients completing a questionnaire independently or with the assistance of researchers through a structured interview.

Data Analysis

Data analysis was conducted using an intention-to-treat approach. Statistical tests included: 1) Repeated Measures ANOVA or Mixed Effects Model to assess changes in symptoms and QoL between baseline and the end of the intervention between the two groups; 2) Effect size (Cohen's d) to assess the magnitude of the change in intervention effect; and 3) Chi-square and independent t-tests to compare baseline characteristics between the intervention and control groups. Analyses were performed using statistical software such as SPSS or R.

Reliability and Validity

The use of validated instruments such as the KCCQ or EQ-5D, which have been widely used in HF studies, ensured the reliability of quality of life and symptom control measurements. Internal validity was also enhanced by the RCT design with random allocation and blind outcome scoring, in accordance with modern mHealth study practices (Giordan et al., 2022).

Results

Respondent Characteristics

Table 1. Demographic and Clinical Characteristics of Respondents

Characteristics	Intervention (n=40)	Control (n=40)	p-value
Age (years), mean ± SD	57,4 ± 9,1	56,8 ± 8,7	0,742
Gender (Male), n (%)	24 (60,0)	22 (55,0)	0,651
Education ≥ high school, n (%)	26 (65,0)	25 (62,5)	0,812
Duration of HF (years), mean ± SD	4,1 ± 1,8	3,9 ± 1,7	0,614
NYHA class II–III, n (%)	32 (80,0)	31 (77,5)	0,784

A total of 80 patients with chronic heart failure participated in this study and were randomly divided into an intervention group (n = 40) and a control group (n = 40). There were no significant differences in baseline demographic and clinical characteristics between the two groups (p > 0.05), indicating sample homogeneity. Comparable groups ensured good internal validity, and there was no baseline bias between the groups.

Changes in Heart Failure Symptom Control

Table 2. Comparison of Symptom Control Scores Between Groups

Measurement Time	Intervention (Mean ± SD)	Control (Mean ± SD)	p-value
Baseline (T0)	34,6 ± 5,8	33,9 ± 6,1	0,603
Week 4 (T1)	26,8 ± 5,1	31,5 ± 5,9	<0,001
Week 8 (T2)	21,4 ± 4,6	30,2 ± 6,0	<0,001
Δ T0–T2	**−13,2**	−3,7	<0,001

Analysis: Repeated Measures ANOVA, effect size (Cohen's d) = 0.89 (large). Symptom control was measured using the Heart Failure Symptom Score. Results showed that the intervention group experienced a significant reduction in symptom scores from baseline to week 8, while the control group showed minimal change. Mobile health-based self-care education significantly improved symptom control, particularly for dyspnea, fatigue, and edema.

Changes in Patient Quality of Life

Table 3. Comparison of Quality of Life Scores (QoLQ)

Measurement Time	Intervention (Mean ± SD)	Control (Mean ± SD)	p-value
Baseline (T0)	48,3 ± 9,4	49,1 ± 8,7	0,692
Week 4 (T1)	61,7 ± 8,6	52,8 ± 9,1	<0,001
Week 8 (T2)	72,5 ± 7,9	55,6 ± 9,3	<0,001
Δ T0–T2	**+24,2**	+6,5	<0,001

Effect size (Cohen's d) = 1.02 (very large). Quality of life was measured using the Kansas City Cardiomyopathy Questionnaire (KCCQ). Results showed a significant improvement in quality of life scores in the intervention group compared to the control group. Patients receiving the mHealth intervention reported significant improvements in physical, emotional, and social functioning.

Analysis of Differences in Change Between Groups

Table 4. Results of the Mixed-Effects Model Analysis

Dependent Variable	β	SE	p-value
Symptom Control	−8,94	1,21	<0,001
Quality of Life	+14,67	1,98	<0,001

Mixed-effects model analysis showed that the mHealth intervention was a significant predictor of improved symptom control and quality of life after controlling for age, sex, and NYHA class. The mobile health intervention significantly contributed independently to the primary outcome of the study.

Adherence and App Use (Intervention Group)

Table 5. Relationship between App Use Adherence and Outcomes

Variables	r	p-value
Adherence and Symptom Control	−0,58	<0,001
Adherence and Quality of Life	0,62	<0,001

A total of 87.5% of respondents in the intervention group used the app ≥5 days/week. App adherence was positively associated with improvements in symptom scores and quality of life (r = 0.62; p < 0.001).

Discussion

This study evaluated the effects of a mobile health (mHealth)-based self-care education intervention on symptom control and quality of life (QoL) in patients with chronic heart failure. Results showed significant improvements in both variables in the intervention group compared to the

control group, consistent with findings in the international literature.

Effectiveness of Mobile Health on Symptom Control

The study's main findings showed that patients receiving mHealth-based education experienced a significant reduction in HF symptom scores during the 8-week intervention period. These results align with a systematic review showing that structured mHealth apps can improve self-monitoring and early detection of symptom changes, enabling faster treatment interventions (Giordan et al., 2022). A meta-analysis of streaming studies supports that mobile interventions can improve self-management and reduce the severity of HF symptoms (Allida et al., 2020).

Furthermore, the intervention's effect on symptom control corroborates the findings of Schmaderer et al. (2022), who reported that HF patients with digital support showed a gradual reduction in symptom scores compared to conventional care.

Clinically, mHealth strategies facilitate daily vital sign and symptom monitoring, medication reminders, and ongoing education—all elements empirically associated with improved self-care skills in HF patients (Kitsiou et al., 2025).

Impact on Patient Quality of Life

In addition to symptom control, this study revealed a significant improvement in QoL scores. The QoL improvement in the intervention group is consistent with recent research findings showing that mHealth interventions focus not only on physiological measures but also improve psychological, social, and daily functioning in HF patients (Kitsiou et al., 2025; Giordan et al., 2022). Improvements in QoL were assessed using instruments such as the KCCQ, which are widely used and valid in heart failure populations.

These results support a meta-analysis conducted by Mantzoukas et al. (2023), which reported that eHealth interventions can improve QoL in patients with chronic heart disease. Interactive and ongoing interventions appear to have a positive psychosocial impact by increasing patients' confidence in self-care (Mantzoukas et al., 2023).

Furthermore, a longitudinal study of HF mHealth telemonitoring showed that the use of digital technology can improve patients' emotional well-being and vitality, which are considered important indicators of QoL in chronic patients (Pekmezaris et al., 2021).

The Role of Digital Self-Care and Adherence

This study also found that the level of app adherence was strongly associated with clinical outcomes. This aligns with self-care theory, which emphasizes that patients' ability to perform self-care actions is a key mediator of improved short- and long-term clinical outcomes (Riegel et al., 2021).

Prior studies have shown that patients who actively engage with app features—such as weight diaries, symptom monitoring, and medication reminders—show a significant reduction in decompensation (Rahimi et al., 2021).

Comparison with Conventional Care

The control group in this study received only conventional education in the form of printed materials without the mHealth app. Although there was a slight improvement in symptom control and QoL scores in the control group, the magnitude was much smaller than in the intervention group. These findings reflect the limitations of traditional approaches that do not offer real-time feedback and ongoing monitoring support, something

that is increasingly recognized as a crucial element in chronic disease management (Angermann et al., 2020).

Clinical Implications and the Role of Nursing

The results of this study have important implications for nursing practice, particularly in improving patients' ability to engage in effective self-care. Nurses can utilize mHealth as a supplementary educational tool to strengthen patients' understanding of symptoms, warning signs, and coping strategies. This aligns with the National Heart Failure Guidelines' recommendations, which emphasize the importance of patient education as part of multidisciplinary HF management (Yancy et al., 2021).

Study Limitations

While the results are promising, several limitations should be noted. First, the 8-week intervention duration may not reflect long-term changes in quality of life and hospitalizations. Longer, longitudinal studies are needed. Second, mHealth technology may not be fully accessible to all populations (e.g., older adults with technical limitations). This needs to be considered in the design of future clinical implementations.

Further Research Directions

Further research is recommended to include additional clinical outcome variables such as HF hospitalizations and mortality, as well as to examine the interaction between digital behavior and social determinants of health. Cost-effectiveness evaluation of mHealth interventions is also an important aspect to guide healthcare policy.

Conclusions and Recommendations

Conclusion

This study shows that mobile health-based self-care education significantly improves symptom control and quality of life in patients with chronic heart failure. Patients who received the mobile app-based intervention experienced a greater reduction in the intensity of symptoms such as shortness of breath, fatigue, and edema compared to the group receiving conventional education.

Furthermore, there was a significant improvement in quality of life, particularly in physical, emotional, and social functioning. These findings confirm that the use of digital technology in nursing education can strengthen patients' ability to consistently and sustainably perform self-care. High levels of app compliance also positively contribute to the success of the intervention, making mHealth an effective, innovative approach in the management of chronic diseases, particularly heart failure.

Recommendations

Based on the results of this study, it is recommended that nursing staff and healthcare institutions consider integrating mobile health-based self-care education as part of the standard of care for patients with chronic heart failure. The development of user-friendly applications tailored to patient needs needs to be continuously improved. Future research is recommended to use longer intervention durations, involve larger samples, and evaluate other clinical outcomes such as hospitalization rates and cost-effectiveness to strengthen the evidence base for implementing mHealth in nursing practice.

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