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ORIGINAL RESEARCH

Patient activation improves with a multi-component personalized mHealth intervention in older patients at risk of cardiovascular disease: a pilot randomized controlled trial

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Aims This study aimed to determine the effect of a multi-component mHealth intervention on patient activation and examine its predictors among older adults at risk of cardiovascular disease (CVD).

Methods and results This pilot randomized controlled trial compared two groups: *Get FIT* (control), who received healthy lifestyle counselling from a licensed health coach, a mHealth app (*MyFitnessPal*) with push alerts, and an activity tracker, and *Get FIT* + (intervention), who received the same interventions and had personalized text messages with 3- and 6-month follow-up periods. Patient activation was measured using the 13-item Patient Activation Measure; higher scores indicated better activation. Linear mixed-effects models were used to investigate between-group changes in outcomes across time. The participants' ($n = 54$) mean age was 65.4 ± 6.0 years; 61% were female; and 61% were married. Baseline characteristics were comparable between groups. Significant improvements in mean patient activation scores were observed in the *Get FIT* + group at 3 months [mean 3.53 points, 95% confidence interval (CI) 0.11, 6.96; $P = 0.043$] and 6 months (mean 4.37 points, 95% CI 0.91, 7.83; $P = 0.014$), whereas improvements in the *Get FIT* group were non-significant. Adjusting for age, gender, education, employment, marital status, social support, smartphone confidence, and self-perceived health, we found that only social support was associated with higher patient activation overall ($B = 5.14$, 95% CI 1.00, 9.27; $P = 0.015$).

Conclusion The findings indicate that personalized text messaging can improve the self-care of older adults at risk of CVD. Findings also emphasize the importance of social support in the success of mHealth interventions for older adults.

Registration The study is registered in ClinicalTrials.gov (NCT03720327).

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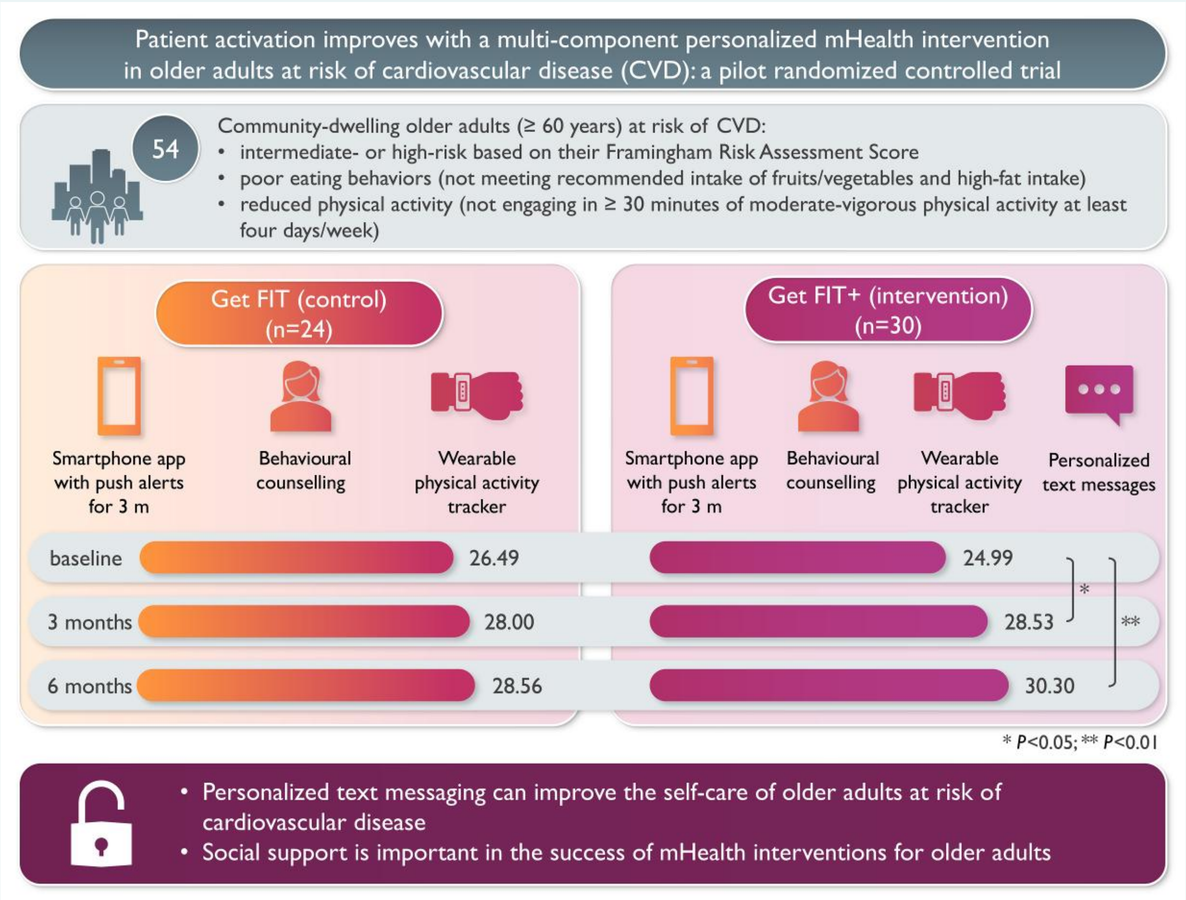
Graphical Abstract



Keywords Cardiovascular disease • Digital health • mHealth • Older adults • Patient activation • Pilot randomized controlled trial

Novelty

- Adding personalized text messaging to mHealth interventions can significantly increase patient activation.
- Social support is critical in maximizing the benefits of mHealth interventions for improving patient activation among older adults at risk of cardiovascular diseases (CVDs).
- Combining personalized text messaging with strategies to strengthen social support systems could be a novel approach to improving self-management and prevention of CVDs.

Introduction

Cardiovascular disease (CVD) remains the leading cause of death and disability globally.[1] While medical management of CVD, including diagnostics and therapeutics, continues to progress, innovative solutions focused on disease prevention are also vital in reducing the global burden of CVD. Integrating digital health tools such as mobile phones and applications (apps), telehealth, wearable devices, remote monitoring platforms, and artificial intelligence has an immense potential to empower individuals to manage their health and reduce the risk or burden of CVD.[2]

Worldwide, smartphone users are estimated to reach 7.1 billion in 2024.[3] These data show increasing opportunities for digital healthcare delivery for individuals with multiple risk factors for developing CVD.[4] The 2023 World Heart Federation Roadmap for Digital Health in Cardiology recognizes digital health technologies as a viable solution for universal health coverage and sustainable health development.[5] Older adults are also increasingly embracing technology for health management, with a recent study reporting high adherence to using a wearable watch and reporting minimal to no difficulty.[6] Research also indicates that older adults actively use health information websites and smartphone apps to learn about health conditions, track their progress, and connect with online support groups.[7] These examples demonstrate that older adults can use technology for health purposes and find it beneficial in managing their health.

The coronavirus disease 2019 (COVID-19) pandemic has triggered the increased uptake and implementation of digital health technologies.[8] Studies showed a significant rise in older adults embracing virtual consultations with doctors.[9] Telehealth provided continued access to essential medical care, reduced travel risks, and improved access to specialists, especially in remote areas. This acceleration in health technology adoption was primarily driven by necessity and therefore is a priority of the American Heart Association's Network for Health Technology and Innovation Health.[10]

Leveraging digital technology for health does not need to be complex or costly. Mobile health (mHealth) interventions, specifically text messaging, are a simple and cost-effective strategy to send electronic lifestyle-focused health information and reminders and promote behaviour change. This strategy was most valuable and relevant for end-users when personalized and tailored to them.[11] However, a recent Cochrane review of 18 randomized controlled trials (8136 total participants) found limited evidence on the effectiveness of text messaging in improving medication adherence and reducing cardiovascular events in people with CVD compared with usual care.[12] Therefore, more evidence from high-quality randomized trials investigating clinical outcomes and psychosocial constructs is needed to understand effectiveness fully.

Patient activation, defined as having the knowledge, skills, and confidence to manage one's health,[13] is a fundamental goal of CVD interventions. Patient activation is crucial in effective self-management. Patients who are activated are more empowered to engage in healthy behaviours that are crucial in reducing CVD risk, such as diet, exercise, physical activity, and medication adherence. Current evidence also shows a strong link between patient activation and positive health outcomes and care experiences.[14] However, the determinants of patient activation in terms of patient characteristics, current confidence with technology, and health status should also be investigated to identify areas amenable to change and maximize the effect of CVD interventions.

This study aimed to (1) determine the effect of a multi-component mHealth intervention on patient activation and (2) examine the predictors of patient activation among older adults at risk of CVD.

Methods

This study is a secondary data analysis from a two-arm repeated-measures pilot randomized controlled trial. For this study, patient activation outcomes and their predictors were analysed. The reporting of this study adhered to the Consolidated Standards of Reporting Trials (CONSORT) extension for pilot or feasibility trials.[15] Ethical approval was granted by the University of California, Irvine Institutional Review Board (#2016-2713). The study is registered in ClinicalTrials.gov (NCT03720327) and was conducted from June 2019 to December 2022.

Participants

We enrolled 54 community-dwelling older adults (≥60 years) from a primarily low-income, ethnic minority region in Southern California at risk of CVD (defined as intermediate or high risk based on their Framingham Risk Assessment Score) and who demonstrated (i) poor eating behaviours (defined as not meeting the required intake of fruits and vegetables and high-fat intake) and (ii) reduced physical activity [defined as lack of an exercise regimen and sedentary lifestyle (i.e. does not engage ≥ 30 min of moderate physically demanding activity that produces sustained aerobic exercise) at least 4 days per week]. Diet and physical activity patterns were established using the Eating Habits Checklist and the Modifiable Activity Questionnaire (pre-screening tools). Older adults were eligible to participate in the study; all materials were available in English and Spanish. The exclusion criteria included the following: (i) cognitive impairment that precludes an individual from understanding the consent process, completing surveys or using *Get FIT* and *Get FIT* + tools; (ii) chronic drug abuse; (iii) end-stage renal, liver, or pulmonary disease; (iv) current active cancer (i.e. undergoing active cancer treatment) other than isolated skin cancer treatable by simple excision; or (v) gastrointestinal disease that requires special diets (e.g. Crohn's disease; celiac disease).

Recruitment

Participants were recruited through provider referrals and face-to-face contact at senior centres and clinics. Research staff contacted all potentially eligible individuals referred by primary care providers and staff to determine their interest, availability, and eligibility for participation using the pre-screening tools. The study was explained to potential participants using a script and consent forms in English and Spanish. Once potential participants were recruited, a research staff member obtained written informed consent. Recruitment for the study was based on the high number of older adults seen at our primary care clinics and senior centres and previous collaborations with community partners. The accessible population formed a broad range of subjects with multiple racial/ethnic backgrounds that characterize the general Southern California population.

Measures

Sociodemographic characteristics were collected during the baseline survey, including age (years), gender (male/female), race/ethnicity (Hispanic, non-Hispanic, White, other), marital status (single, partnered, married, widow/widower), level of education (≤high school graduate, some college, ≥ college graduate), and employment status (employed, not employed, retired). A single yes/no question on social support, 'Do you have someone in your life to confide in?' was asked. The question 'If you have a smartphone, how confident are you when using it to access the internet?' was used to assess smartphone confidence, answerable by 'not being at all confident' or 'somewhat/very confident.' Self-perceived health was assessed using the question, 'In general, what would you say your health is?' answerable by excellent, very good, good, and poor. These questionnaires were translated from English to Spanish and back-translated from Spanish to English.

Patient activation was assessed using the 13-item Patient Activation Measure (PAM-13) or its validated Spanish version.[16] This tool included questions on self-management, including knowledge, skills, and confidence in managing their health or illness.[13] A four-point Likert scale that ranges from 1 (strongly agree) to 4 (strongly disagree) was used for each item, and scores were added to derive a single score previously shown to be reliable and valid.[13] Higher scores were positively associated with chronic disease self-management and correlated with greater adoption of and engagement in healthy behaviours.[17]

Randomization and data collection

Participants completed the baseline study questionnaires with assistance from a research team member, blinded to the participant's group assignment, if needed. Self-report data were collected using iPads and entered into the Research Electronic Data Capture (REDCap) platform, a secure web-based application.[18] All participants could use the iPad and complete the forms without complications.[16,19] REDCap offers a streamlined process for building databases, an interface for data collection and validation, and automated export procedures for downloading to statistical packages.[18]

During the baseline visit, project staff re-evaluated participants' eligibility and established baseline clinical and risk factor analysis. After completing all baseline data collection, participants were randomized 1:1 to *Get FIT* vs. *Get FIT* + using a computer sequence generator and stratified by ethnicity and gender to ensure adequate numbers of women and minorities in the two arms. The research team members were blinded to the randomization sequence. After 3 months (at the end of the intervention period), all participants were referred to a healthcare provider for risk reduction follow-up. Follow-up data were collected at 3 and 6 months using the same measures.

Control group (*get FIT*)

The *Get FIT* programme includes (i) a free, commercially available smartphone app for three months, (ii) a wearable physical activity tracker to monitor physical activity, and (iii) one 45-min behavioural counselling session focused on healthy eating and exercise.

The commercially available smartphone app is *MyFitnessPal* (premium version).[20] This programme is available on iPhone and Android devices (mobile phones and tablets). *MyFitnessPal* is a digital health and fitness platform focused on calorie tracking, community support, goal setting, and fitness tracking. The premium version contains monitoring for multiple health

Table 1 Sample baseline characteristics ($n = 54$)

Characteristic	Total	Get Fit ($n = 24$)	Get Fit + ($n = 30$)
	n (%)	*n* (%)	*n* (%)
Age, years (mean ± SD)	65.4 ± 6.0	66.5 ± 7.1	64.7 ± 4.6
Female	33 (61.1)	11 (45.8)	22 (73.3)
Hispanic	36 (66.7)	13 (54.2)	23 (76.7)
Partnered/married	33 (61.1)	13 (54.2)	20 (66.7)
Social support: yes	50 (92.6)	22 (91.7)	28 (93.3)
Education			
≤High school graduate	28 (51.9)	11 (45.8)	17 (56.7)
Some college	6 (11.1)	3 (12.5)	3 (10.0)
≥College graduate	20 (37.0)	10 (41.7)	10 (33.3)
Employed	20 (37.0)	10 (41.7)	10 (33.3)
CVD risk factors			
Weight (lbs)		180.9 ± 40.4	156.8 ± 26.8
LDL-C (mg/dL)		101.7 ± 34.3	99.5 ± 40.6
Total cholesterol (mg/dL)		177.8 ± 42.1	180.7 ± 47.5
Triglycerides (mg/dL)		131.5 ± 63.3	153.2 ± 76.8
Systolic blood pressure (mmHg)		136.7 ± 20.5	142.6 ± 21.8
HbA1C (%)		6.6 ± 2.0	6.5 ± 1.8

LDL-C, low density lipoprotein cholesterol; HbA1C, glycated haemoglobin.

and fitness components, specific nutrient monitoring, body measurements, and the ability to connect with friends, create groups, and join challenges. Participants were provided a smartphone with the installed *MyFitnessPal* app.[20] They were asked to self-monitor their dietary intake daily for 3 months. The application uses the Mifflin equation to compute a calorie budget for each participant that will change within the application as the participant's weight changes. The participants worked with a licensed health coach to select several pounds to lose weekly (0.5–2.0) and choose a weight loss goal. The participants were also asked to self-monitor their daily weight, and a standardized weighing scale was provided.

Each participant was given an activity tracker (Fitbit Charge)[21] and was asked to wear it daily for the study (3 months). The Fitbit Charge syncs automatically with the *MyFitnessPal* app and updates the participant's real-time physical activity log. The activity tracker did not require participants to carry their smartphones during activities.

Finally, the *Get FIT* participants had a one-on-one counselling session (∼45 min) with a licensed health coach. This counselling session took place at the baseline visit following randomization. The counselling focused on (i) basic nutrition principles, (ii) physical activity guidelines, (iii) motivators and outcome expectations for weight loss, and (iv) goal setting for diet and physical activity. The health coach assigned to each participant in the programme had electronic access to the participant's dietary and exercise log through the Ascend programme of the *MyFitnessPal* app. The Ascend programme provided the health coach with electronic, real-time data, including a participant's food diary, exercise diary, goal setting and progress towards goals, macro- and micronutrient consumption, weight, and challenges/motivators. The health-coaching role was to electronically monitor the daily progress of the participants and interact with them through push-only text messaging (i.e. no response from participants).

Intervention group (*Get FIT*+)

The *Get FIT* + group received the same interventions as the *Get FIT* group. However, *Get FIT* + participants received personalized text messages for 3 months.[22] Text messages directed at physical activity components were personalized by analysing activity trackers and food logs. The health coach also selected an area of focus (e.g. sodium content, calories, exercise minutes, etc.) based on the participant's daily electronic log and a text message to personalize based on their client's goals, progress, or numbers.

Sample size

For this pilot study, effect size estimation was based on feasibility (i.e. the number feasible to recruit within the timeframe) and widely used recommendations for the optimal sample size for pilot studies.[23] Starting with 50 participants allowed for a final sample size of 40 to complete the analysis, accounting for 20% attrition. This anticipated attrition rate is based on our data from previous longitudinal studies in patients with chronic illness.[24]

Data analysis

Data were entered, coded, and analysed using SPSS Statistics version 29 (IBM). Descriptive statistics were used to summarize patient characteristics through sample mean ± standard deviation, frequency, and percentage, and variables were compared using χ^2 test or *t*-test depending on the level of measurement. Linear mixed-effects models (LMM) that included a random intercept were used to account for the allocation to groups and repeated measurements. A primary LMM of the main outcome (patient activation) was used to analyse the differences in outcomes between the two groups over time. A secondary analysis that included all predictor variables (age, gender, education, employment, marital status, social support, smartphone confidence, and self-perceived health) was conducted to identify independent factors associated with patient activation scores over time. The least significant difference was used for pairwise comparison of variables with more than two categories. Statistical significance was set at $P < 0.05$.

Results

Sample characteristics

A total of 54 participants were included in the study. The mean age of participants was 65.4 ± 6.0 years; most were female (61%) and married (61%) (*Table 1*). Baseline sociodemographic characteristics were comparable across the two groups. There were also no significant differences in patient activation scores at baseline between *Get FIT* (mean 28.63, standard error [SE] 1.42) and *Get FIT* + (mean 27.63, SE 1.27). No adverse events were reported during the study duration.

Table 2 Patient activation score comparison by group and over time (unadjusted)

Groups	Baseline	3 months	6 months	Month 3 minus baseline		Month 6 minus baseline	
	Mean ± SE	Mean ± SE	Mean ± SE	Difference (95% CI)	P-value	Difference (95% CI)	P-value
Get Fit	28.63 ± 1.42	29.45 ± 1.45	30.45 ± 1.45	0.82 (−3.05, 4.70)	0.674	1.82 (−2.05, 5.70)	0.353
Get Fit+	27.63 ± 1.27	31.17 ± 1.27	32.00 ± 1.29	3.53 (0.11, 6.96)	0.043	4.37 (0.91, 7.83)	0.014
Difference (95% CI)	−0.99 (−4.76, 2.77)	1.72 (−2.09, 5.53)	1.55 (−2.29, 5.39)				

$P_{group} = 0.527$; $P_{time} = 0.056$; $P_{group \times time} = 0.509$

Table 3 Adjusted patient activation score comparison by group and over time

Groups	Baseline	3 months	6 months	Month 3 minus baseline		Month 6 minus baseline	
	Mean ± SE	Mean ± SE	Mean ± SE	Difference (95% CI)	P-value	Difference (95% CI)	P-value
Get Fit	26.49 ± 1.73	28.00 ± 1.78	28.56 ± 1.79	1.51 (−2.39, 5.41)	0.445	2.07 (−1.80, 5.94)	0.292
Get Fit+	24.99 ± 1.66	28.53 ± 1.73	30.30 ± 1.68	3.53 (0.05, 7.02)	0.047	5.30 (1.88, 8.72)	0.003
Difference (95% CI)	−1.50 (−5.15, 2.16)	0.53 (−3.26, 4.31)	1.73 (−2.18, 5.65)				

$P_{group} = 0.831$; $P_{time} = 0.018$; $P_{group \times time} = 0.452$
Adjusted for age, gender, education, employment, marital status, social support, smartphone confidence, self-perceived health

Patient activation

Differences between groups across the three-time points were not statistically significant. However, significant within-group improvements were observed in the *Get FIT* + group at 3 months (mean 3.53 points, 95% CI 0.11, 6.96; $P = 0.043$) and 6 months (mean 4.37 points, 95% CI 0.91, 7.83; $P = 0.014$), whereas improvements in the *Get FIT* group were non-significant (*Table 2*).

Adjusting for potential explanatory variables (age, gender, education, employment, marital status, social support, smartphone confidence, and self-perceived health) did not alter the interpretation of the results. At 3 months, patient activation in the *Get FIT* + group increased by 2.02 points (95% CI −3.03, 7.08) more than the *Get FIT* group, and at 6 months, the *Get FIT* + group increased by 3.23 points (95% CI −1.91, 8.37) more (*Table 3*). In the adjusted model, accounting for all other factors, only social support was associated with increased patient activation overall ($B = 5.14$, 95% CI 1.00, 9.27; $P = 0.015$) (*Table 4*).

Discussion

Our study shows that patient activation increased in people at risk of CVD following a multi-component digital intervention that included personalized text-based messages (*Get FIT+*). These results were robust and did not change when other variables (age, gender, education, employment, marital status, social support, smartphone confidence, and self-perceived health) were considered. When all other factors were included in the analyses, there were indications that having social support was associated with higher levels of patient activation.

Our finding that participants receiving personalized text-based messages had higher patient activation scores was unsurprising, as individualized text messages created a more personal experience. Personalized text messages offer targeted information and encouragement based on each person's progress and needs, which may be more effective than a one-size-fits-all approach in motivating patients to take an active role in their health.[25] Our findings are consistent with other studies showing that remote interventions improve activation.[26] Specifically, personalized text messages have been shown to improve patients' medication adherence and understanding of their disease and are used successfully to augment self-management.[27] Personalized messages used in this study may also have added effectiveness for patient activation because of the robust co-design process in developing the message bank.[22] Each text message used in this study was developed, reviewed, validated, and refined using iterative methods with patient partners, enhancing relevance from the patient's perspective.[22] However, the lack of significant effect between the intervention and control group reflects the complexity of the interventions compared. The control group also received a package of interventions but lacked the personalized text messages. This intervention package on its own may have been effective in improving activation. Further research is essential to understand the evolving trends and user experiences of technology use by older people, informing the development of inclusive and effective digital health solutions.

The findings from this study align with the principles of the Chronic Care Model (CCM),[28] which emphasizes patient-centred care and the importance of self-management support. The personalized text messages, co-designed with patient input, offered tailored information and encouragement, reflecting the CCM's focus on empowering patients to take an active role in managing their health.[28] By providing individualized feedback and support, these interventions promote better understanding of disease management, which is essential for improving patient activation and long-term outcomes.

Social support plays a crucial role in patient activation. As indicated in this study, people with social support or someone to confide to had increased patient activation overall when other variables (age, gender, education, employment, marital status, smartphone confidence, and self-perceived health) were considered. Social support provides access to social networks for people to feel less isolated and have a sense of belonging, knowing they have others to rely on, confide with, or seek advice.[29] These support networks offer emotional security, practical assistance, and encouragement that empowers people to take charge of their health. Solid social support also acts as a buffer against stress and isolation, bolstering people's resilience and the ability to cope with

Table 4 Independent predictors of patient activation

Variable	*n*	Mean ± SE	*B* (95% CI)	*P*-value
Group (at baseline)				
Get Fit+	30	25.00 ± 1.66	−1.50 (−5.15, 2.16)	0.419
Get Fit (ref)	24	26.49 ± 1.73		
Time (for control)				
3 months	54	28.00 ± 1.78	1.51 (−2.39, 5.41)	0.445
6 months	54	28.56 ± 1.79	2.07 (−1.80,5.94)	0.292
Baseline (ref)	54	26.49 ± 1.73		
Age	54	—	0.04 (−0.16, 0.23)	0.712
Gender				
Male	21	26.78 ± 1.40	−2.07 (−4.48, 0.34)	0.091
Female (ref)	33	28.85 ± 1.31		
Education				
≤High school graduate	28	27.19 ± 1.24	−0.98 (−3.34, 1.38)	0.415
Some college	6	28.09 ± 1.99	−0.08 (−3.97, 3.81)	0.968
≥College graduate (ref)	20	28.17 ± 1.37		
Employment				
Employed	20	27.35 ± 1.36	−0.92 (−3.34, 1.50)	0.453
Unemployed (ref)	34	28.28 ± 1.35		
Marital status				
Single, separated/divorced, widowed	21	27.03 ± 1.32	−1.54 (−3.86, 0.72)	0.176
Partnered/married (ref)	33	28.60 ± 1.36		
Social support				
No	4	25.25 ± 2.08	−5.14 (−9.27, −1.00)	0.015
Yes (ref)	50	30.38 ± 0.88		
Smartphone confidence				
No	13	27.99 ± 1.51	0.35 (−2.21, 2.91)	0.787
Yes (ref)	41	27.64 ± 1.21		
Self-perceived health				
Excellent–very good	12	28.22 ± 1.55	0.80 (−1.87, 3.48)	0.553
Good–poor (ref)	41	27.41 ± 1.98		

challenges.[29] Similar to our study, other studies have found that social support positively affected patient activation, although this effect was mediated by having higher self-efficacy.[30] Therefore, the availability of social support should be assessed and addressed when implementing interventions aimed at reducing people's CVD risk.

Understanding patient activation for older people at risk of CVD is essential in designing risk reduction interventions. Some older adults still face challenges, such as a lack of familiarity or confidence to use technology, while others may have physical limitations that make using technology difficult. Therefore, healthcare professionals and technology developers must prioritize user-centred design and consider older adults' unique needs and preferences when creating health technology solutions. Our study has demonstrated that text messaging is a viable option for delivering health information to people to enhance their empowerment and help them manage their health. These interventions are most effective when personalized and tailored to individual needs, preferences, and progress. Co-design is, therefore, a crucial consideration in ensuring that interventions for patients are relevant to them. Future research should focus on testing these interventions in a larger sample and diverse populations to enhance generalizability.

The COVID-19 pandemic-related distancing restrictions and isolation posed unique challenges for older adults, particularly regarding healthcare access. This unprecedented situation made it crucial for older adults to take a more active role in managing their health at home. The pandemic also significantly heightened feelings of isolation and loneliness among older adults, a group already at risk.[31] However, these feelings may have also catalysed increased technology adoption among this vulnerable population.[32] Given that data collection for this study occurred during the height of the pandemic, personalized text messaging likely impacted patient activation when isolation and loneliness were more pronounced in older adults.[31] By providing timely and personalized reminders, targeted health information, and a sense of connection, personalized text messaging could have contributed to older adults being engaged in their health management during isolation and limited in-person interaction.

Limitations

The randomized controlled design of this study allowed for causal inference so that observed effects are attributable to the intervention.

However, several limitations should be considered. We used a single-item question to measure perceived social support (someone to confide in) at baseline and did not measure this construct over time. Since the study participants were older adults, we opted to use a single-measure item over validated tools that were longer and could increase the subject burden. A single-item tool to represent social support has been used previously in a study with a larger sample size.[33] Caution should also be taken in interpreting and generalizing the exploratory analysis result that social support predicts better patient activation because of the small sample size. This pilot study's relatively small sample size makes detecting between-group differences more challenging. However, given that the difference in the magnitude of within-group improvements was significantly greater in the *Get FIT+* group, the between-group findings may have been underestimated. Replicating this study with a larger sample size is needed to confirm the effect of the intervention. Future studies should also focus on covering the different types of social support (emotional, instrumental, informational) and using more comprehensive measurement tools.

Conclusions

The findings from this study indicate that older people at risk of CVD can improve their self-management abilities, knowledge, and confidence through personalized text messaging as a mHealth intervention. Having social support is influential in maximizing the benefits of mHealth interventions. Therefore, one approach to CVD prevention might involve combining personalized text messaging with strategies to strengthen social support systems. Such a combined approach could include connecting participants with support groups, providing resources for building a strong support network, or incorporating features within the mHealth programme that allow peer-to-peer communication. This study highlights the potential of mHealth interventions, particularly when combined with social support, to empower individuals at risk of CVD to take charge of their health and improve their overall well-being.

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Conflict of interest: none declared.

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Data availability

The data generated and/or analysed for this study are not publicly available but are available from the corresponding author upon reasonable request.

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