Effectiveness of Theory-Based Health Information Technology Interventions on Coronary Artery Disease Self-Management Behavior: A Clinical Randomized Waitlist-Controlled Trial

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Abstract

Purpose: Secondary prevention of coronary artery disease, self-management behavior, and blood pressure control are important to cardiovascular event prevention and promotion of quality of life (QOL), but they are underutilized. The purpose of this study was to investigate the effects of a self-efficacy theory–based health information technology intervention implemented through blood control and patient self-management.

Design: A clinical randomized waitlist-controlled trial.

Methods: The study was conducted at a medical center in Taipei, Taiwan. A total of 60 subjects were randomly assigned to either the immediate intervention (experimental) group or the waitlist control group. The primary endpoint was systolic blood pressure at 3 months; secondary end points included self-management behavior and QOL. Treatment for the immediate intervention group lasted 3 months, while the waitlist control group received routine care for the first 3 months, at which point they crossed over to the intervention arm and received the same intervention as the experimental group for another 3 months. Both groups were evaluated by questionnaires and physiological measurements at both 3 and 6 months postadmission. The results were analyzed using generalized estimating equations.

Results: Systolic blood pressure significantly improved for the intervention group participants at 3 months, when there was also significant improvement in self-management behavior and QOL. There was no significant or appreciable effect of time spent in the waitlist condition, with treatments in the two conditions being similarly effective.

Conclusion: The use of a theory-based health information technology treatment compared with usual care resulted in a significant improvement in systolic blood pressure, self-management behavior, and QOL in patients with coronary artery disease.

Clinical Relevance: This treatment would be a useful strategy for clinical care of cardiovascular disease patients, improving their disease self-management. It also may help guide further digital health care strategies during the COVID-19 pandemic.

Cardiovascular disease, including coronary artery disease (CAD), is the leading cause of death and disease in the world population, and it affects the majority of adults in the United States (Benjamin et al., 2019). Consequently, the World Health Organization proclaimed a goal to reduce CAD deaths and revised a

risk prediction model for fatal cardiovascular disease; age, smoking status, systolic blood pressure (SBP), history of diabetes, and total cholesterol are variables included in the model (Kaptoge et al., 2019). Interventions and practices that modify lifestyle factors, including blood pressure control and self-management behavior, are among the most effective. Secondary prevention strategies, such as comprehensive education about regular exercise, monitoring blood pressure, risk factor control, and patient support, are effective ways to reduce the burden of cardiovascular disease and promote a good quality of life (QOL; Jin et al., 2019).

Great advances have been achieved in the secondary prevention of CAD. They include a change from a physician-centered to a patient-centered self-management model, which not only supports comprehensive education but also improves patients' QOL (Rixon et al., 2017; Van Der Eijk, Nijhuis, Faber, & Bloem, 2013). Self-management plays an important role in disease prevention and health care in chronic disease management. There are extensive and clear data that lifestyle changes and effective reduction of the fatal cardiovascular risk factors can improve long-term outcomes. In a systematic review of seven randomized control trials of 1,321 patients with CAD, Internet-delivered self-management support interventions showed significant positive effects, in particular for lifestyle-related outcomes (Palacios et al., 2017), although more theoretically based strategies and evidence-based behavior change interventions are required.

Technology employed to support precision health should become more user friendly, desirable, feasible, and viable (Starkweather et al., 2019). There is evidence that tele-based, web-based, or a combination of tele-based and web-based technology interventions are emerging as an effective alternative model for improving secondary prevention of CAD (Brørs et al., 2019). Health information technology (IT) includes various technologies that support a wide range of strategies from simple use of healthcare information to more advanced decision support, as well as integration with medical technologies (Alotaibi & Federico, 2017). In a systematic review of 69 studies evaluating the effects of Health IT on patient outcomes, 36 were found to demonstrate significant direct positive effects of Health IT on patient safety outcome measures, but the majority of studies had nonsignificant or mixed findings (Brenner et al., 2016). Use of Health IT systems to deliver and evaluate lifestyle outcomes is beneficial for promoting risk reduction in CAD.

Nurse-led telehealth interventions were significantly more efficient than traditional education intervention at improving CAD risk reduction (Huber, Henriksson, Jakobsson, & Mooe, 2017). Tele-based educational intervention is preferred even though face-to-face education is more practical. Based on a meta-analysis of 30 randomized trials of 7,283 patients with CAD, Jin et al. (2019) concluded that telehealth, as an adjunct to cardiac rehabilitation, can be an innovative way to overcome the barriers to secondary prevention. Tele-based nurse education aimed at reminding, encouraging, and motivating patients might be useful in this regard, but there have been few robust scientific evaluations of these interventions. In a systematic review of 17 randomized controlled trials of 5,780 patients with cardiovascular disease, an organized theoretical framework of behavior change via Internet- or mobile-based digital interventions showed a significant treatment effect of SBP control (Stogios, Kaur, Huszti, Vasanthan, & Nolan, 2020). Application of teleweb-based Health IT interventions is a low-cost and widely available alternative for self-management in patients with CAD at highest risk for cardiovascular events. Moreover, theory-based self-management educational intervention has an important role to play in effective secondary prevention and QOL promotion in patients with chronic disease (Zhao, Suhonen, Koskinen, & Leino-Kilpi, 2017), but there have been few robust scientific evaluations of these theory-based interventions on patients with CAD.

Health IT, a smart case management tracking system used in this study, is a teleweb health system that aims to improve self-management behavior and lifestyle but lacks evidence of therapeutic benefit. Currently, there are large gaps in utilization of web-based, telehealth, and self-efficacy theory-based nursing interventions aimed at controlling blood pressure. The purpose of this study was to investigate the effects of self-efficacy theory–based Health IT intervention on the control of blood pressure, self-management behavior, and QOL.

Methods

Study Design

A parallel-design, randomized waitlist-controlled clinical trial comprising 60 patients with CAD was conducted at a medical center in northern Taiwan. Recruitment took place between October 2019 and January 2020, and final 6-month follow-ups were conducted between April and July 2020 (Figure S1). Subjects were randomly assigned to either the immediate intervention group or the waitlist control group. The primary endpoint was SBP at 3 months after

admission. The secondary endpoints were self-management behavior, QOL, and diastolic blood pressure (DBP).

Participants

Patients were eligible if they were older than 20 years, had documented CAD, and were able to provide informed consent. CAD was defined as prior myocardial infarction, coronary artery bypass graft surgery, percutaneous coronary intervention, or 50% or greater stenosis in at least one major epicardial vessel detected by coronary angiography (Chow et al., 2015). Patients were excluded if they did not have a landline or sufficient language proficiency with Mandarin Chinese or Taiwanese to communicate. The landline was used to upload their health records to the cloud and was also dedicated for nursing consultation and care. Potential participants were identified by daily cardiology outpatient clinic lists.

It was estimated that 52 participants for the two groups combined would be required to detect a clinically meaningful effect defined by the within–between interaction between group and follow-up time on SBP (Cramer's phi of .2; Kao et al., 2019), allowing for an intercluster correlation coefficient of .5, power of .8, and alpha of .05. The total sample size was increased to 60 participants to allow for a 15% drop-out rate. A total of 60 patients with CAD were recruited for this study.

Procedure

Patients with CAD were recruited at a large medical center and university teaching hospital in Taipei, Taiwan. Randomization occurred via an Internet-based randomization program (www.thesealedenvelop.com). The random allocation sequence was in a uniform 1:1 allocation ratio with a block size of four and was concealed from study personnel. The Internet-based randomization program interfaced with the waitlist control group design such that patients were assigned randomly to the immediate intervention or waitlist control group. All patients were informed that they would receive treatment interventions, but that they needed to wait for notification to install the equipment of the Health IT system at their home through their landline. Prior to their follow-up appointment, patients received a phone call asking them not to reveal their allocation status to clinicians in follow-up visits. Immediate intervention participants received, in addition to usual care, the 3-month Health IT program and a health education telephone call every 2 weeks.

Waitlist control participants received usual care, which generally included community follow-up, with the majority referred to the outpatient cardiac department, as determined by their usual physician. Both groups received three study management phone calls providing them with their Health IT equipment, study contact details, and a reminder prior to the follow-up appointment. The immediate intervention group received the Health IT intervention for 3 months, while the waitlist control group received routine care for the first 3 months, at which point they were crossed over to the intervention arm and received the Health IT intervention for 3 months (see Figure S1). Both groups were evaluated by questionnaires and physiological measurements at both 3 and 6 months.

Instruments

Objective measures of cardiovascular risk factors (SBP and DBP) were obtained at admission (baseline) and at 3 and 6 months. Demographic information (age, gender, marital status, and education) was obtained at baseline. Both subjective and objective measures of CAD self-management were obtained. Continual self-management and QOL were measured using the Partners in Health (PIH) scale and the Taiwan version of the brief form of the World Health Organization Quality of Life (WHOQOL-BREF) scale.

The PIH scale, a generic 12-item self-rating scale, was used to measure self-management knowledge and behavior. Total scores can range from 0 to 96 (Battersby, Ask, Reece, Markwick, & Collins, 2003; Petkov, Harvey, & Battersby, 2010). The four factors of the PIH scale are purported to be knowledge of illness and treatment, patient–health professional partnership, recognition and management of symptoms, and coping with chronic illness (Smith, Harvey, Lawn, Harris, & Battersby, 2017). Higher scores indicate better self-management behavior (Petkov et al., 2010). The PIH scale is a reliable and validated instrument for measuring self-management of chronic conditions (Battersby et al., 2003; Smith et al., 2017; Veldman, Reijneveld, Lahr, Uittenbroek, & Wynia, 2017), including for patients with chronic cardiovascular disease in Taiwan (Tung et al., 2014). In the present study, Cronbach's alpha for the PIH scale was .88.

QOL was measured using the Taiwan version of the WHOQOL-BREF scale. The first 26 items are the same as the standard long WHOQOL scale, which was developed from global studies; we used the first 26 items to assess QOL (see Yao, Chung, Yu, & Wang, 2002). The Taiwan WHOQOL-BREF scale assesses four domains (physical, psychological, social,

and environmental), with higher scores on the corresponding subscales indicating a better QOL (Yao et al., 2002). The Taiwan WHOQOL-BREF scale is a sound, cross-culturally validated assessment of QOL and has excellent reliability and validity (Skevington, Lotfy, & O'Connell, 2004; Wong, Yang, Yuen, Chang, & Wong, 2018; Yao et al., 2002). Cronbach's alpha was .92 for the WHOQOL-BREF scale in the present study; for the physical, psychological, social relationships and environment subscales it was .71, .79, .59 and .87, respectively.

Blood pressure was measured using an automatic sphygmomanometer (BP 3MX1; WatchBP home, Microlife, Taipei, Taiwan). This device has been clinically validated according to the European Society of Hypertension International Protocol (Stergiou, Giovas, Gkinos, & Patouras, 2007). The participants needed to sit in a quiet and comfortable room for at least 5 min before checking their blood pressure at home.

Activity and fitness were monitored using a wristband-wearable device (The Xiaomi Mi Smart Band 4, Beijing, China), which can be used to track factors indicating users' health and fitness, such as sleep, calories burned, heart rate, and distance travelled in real time. In addition, ratings of perceived exercise and number of walking steps were recorded in the daily physical log. Data were collected from the device using theory-based strategies of self-monitoring and self-administered goal setting. This regimen also contributed to better self-management behavior.

Health IT Intervention Group

Based on the review of the literature on application of self-efficacy theory–based interventions (Rajati et al., 2014), the main strategies we used to improve patients' self-efficacy were performance accomplishments, vicarious experiences, verbal persuasion, and emotional arousal. Self-efficacy theory–based strategies were implemented to improve care of CAD participants in four areas: successful performance, vicarious experience, verbal persuasion, and emotional arousal (Table S1). The Health IT system (Chunghwa Telecom Personal Health Record, CHT PHR, Taipei, Taiwan) is a kind of teleweb health platform for blood pressure tracking in case management (Far East Medical Electronics Technology and Chunghwa Telecom). The Health IT interventions, combined with biweekly telephone interviews and education, were designed to assist patients in performing self-monitoring of blood pressure, blood pressure recording and uploading of these recordings to the cloud, an abnormal data alarm, telephone interviews by health professionals, patient education about hypertension, CAD risk factor consultations or emergency interventions based on the telephone instructions by the health professionals and the Health IT system, verbal persuasion, an exercise log, and problem solving and health education through telephone interviews.

Blood pressure of participants was measured and recorded through the Web. An alarm and reminder system were activated and set up to help patients better understand the meaning of their current blood pressure readings and how to deal with them. Reminders popped up on the website for blood pressure readings over 160/110 mmHg or less than 80/60 mmHg. These blood pressure data were displayed to patients as curve diagrams showing the 1-month or 3-month trends. The data log could be tracked by mobile phone apps. Health IT system apps are often used by loved ones or family members. Therefore, patients and their caregivers could read the blood pressure data on the platform every day. If the blood pressure reading was abnormal, an alert to the system was automatically triggered for a member of the study team to contact the patient. These health professional contact persons worked from 8:30 a.m. to 10 p.m., Monday through Friday. Patients alone could review the data daily and get a consultation through a phone call or website platform as needed. In addition, healthcare providers could provide healthcare instructions to patients based on the self-monitoring data through the website platform. Finally, patients were able to learn how to modify their diet and exercise, and manage lifestyle and blood pressure, by visiting the website regularly.

Waitlist Control Group

The participants in the control group received routine nursing care, including health education, monitoring of vital signs, and a reminder prior to the follow-up appointment. To avoid bias, the participants in the control group were not provided any intervention information during the trial.

Ethical Considerations

In agreement with the ethical requirements, it was emphasized to participants that their cooperation was voluntary and that their answers were confidential and would be used only for the purpose of this study. All participants provided their written informed consent. Permission was obtained to use the questionnaires. A hospital ethics committee approved this study (Approval

No. 2-108-05-132; Clinical Trial Registration ID: NCT 04146766).

Statistical Analyses

Data were analyzed using IBM SPSS version 25.0 (IBM Corp., Armonk, NY, USA) using intention-to-treat analysis. The demographic and clinical characteristics were summarized using frequencies, percentages, means, and standard deviations. Independent t tests and chi-square tests were carried out to examine the homogeneity of characteristics between the two groups. If the tests showed adequate homogeneity, group differences in changes on various measures from baseline to 3 months and 3 months to 6 months were tested using the generalized estimating equation (GEE). Paired t-tests were used to compare differences between the two groups (planned comparisons) if the interaction was $p < .10$. The tests were two tailed, with the alpha criterion for significance set at $p < .05$.

Results

Sample Characteristics

Table S2 presents the sample characteristics. Most participants were male ($n = 43$, 71.7%) and were married ($n = 54$, 90%). Most had a junior college degree ($n = 25$, 41.7%), and the age ranges was 41 to 60 years ($n = 24$, 40%) and 61 to 70 years ($n = 27$, 45%). About half ($n = 31$, 51.7%) identified themselves as retired in their employment statement.

Effectiveness of the Health IT Intervention on Self-Management Behavior

As shown in Table S3 and Figure S2 (A), the GEE analysis for self-management behavior revealed that the intervention group had significantly different change scores on the PIH scale than the waitlist control group from baseline to 3 months ($\chi^2 = 8.29$, $p = .004$). Planned comparison analyses revealed that the scores improved significantly for the intervention group ($M_{baseline} = 81.00 \pm 9.43$, $M_{3\ months} = 88.47 \pm 7.98$; $t = 4.60$, $p < .001$) but only slightly and nonsignificantly for the waitlist control group ($M_{baseline} = 80.13 \pm 8.94$, $M_{3\ months} = 81.87 \pm 8.08$; $t = 1.19$.) There was no significant interaction between group and 3 months to 6 months, but there was a significant main effect for 3 months to 6 months for the two groups combined ($\chi^2 = 15.11$, $p = .001$),

with higher PIH scores at 6 months ($M = 87.70 \pm 5.76$) than at 3 months ($M = 85.17 \pm 8.63$)

Effectiveness of the Health IT Intervention on Quality of Life

As shown in Table S3 and Figure S2 (B), for QOL the intervention group had significantly different total change scores on the WHOQOL-BREF than the waitlist control group from baseline to 3 months ($\chi^2 = 8.80$, $p = .03$). The scores improved significantly for the intervention group ($M_{baseline} = 57.43 \pm 5.70$, $M_{3\ months} = 60.67 \pm 5.89$; $t = -2.92$, $p < .05$) but improved nonsignificantly for the waitlist control group ($M_{baseline} = 54.47 \pm 7.92$, $M_{3\ months} = 55.47 \pm 7.16$; $t = -1.29$). The interaction between group and 3 months to 6 months was suggestive ($\chi^2 = 2.91$, $p = .09$). There was a nonsignificant worsening of scores in the intervention group ($M_{3\ months} = 60.67 \pm 5.89$, $M_{6\ months} = 58.77 \pm 3.81$; $t = 1.38$), but there was significant improvement in the scores of the waitlist control group ($M_{3\ months}$ 55.47 $\pm$ 7.16, $M_{6\ months} = 58.47 \pm 6.04$; $t = -3.34$, $p < .01$). As the interaction was only suggestive, it should be noted that there was a significant main effect for the baseline to 3-month interval for the two groups combined ($\chi^2 = 8.80$, $p = .03$), with a lower mean at baseline ($M = 55.95 \pm 7.01$) than at 3 months ($M = 58.07 \pm 7.01$).

We further examined the effectiveness of the intervention on the WHOQOL-BREF subscales (physical, psychological, social relationships, and environment). The results for the baseline to 3-month interval are shown in Table S4, and the results for the 3-month to 6-month interval are shown in Table S5. There are different baseline groups for the two separated tables. On the physical subscale, the intervention group had significantly different change scores than the waitlist control group from 3 months to 6 months ($\chi^2 = 6.00$, $p = .01$). The scores worsened nonsignificantly for the intervention group ($M_{3\ months} = 15.07 \pm 1.82$, $M_{6\ months} = 14.50 \pm 1.01$; $t = .35$) and improved significantly for the waitlist control group ($M_{3\ months} = 13.97 \pm 2.19$, $M_{6\ months} = 14.63 \pm 1.94$; $t = -2.68$).

On the psychological subscale, the intervention group produced significantly different change scores than the waitlist control group from baseline to 3 months ($\chi^2 = 4.91$, $p = .03$). The scores improved significantly for the intervention group ($M_{baseline} = 13.87 \pm 2.03$, $M_{3\ months} = 15.03 \pm 1.32$; $t = -2.39$, $p = .023$) but only slightly and nonsignificantly for the waitlist control group ($M_{baseline} = 13.07 \pm 2.55$, $M_{3\ months} = 13.30 \pm 2.40$; $t = -.72$.) The intervention group had significantly different change scores than the waitlist control

group from 3 months to 6 months (χ^2 = 8.68, p = .003). The scores worsened nonsignificantly for the intervention group ($M_{3\ months}$ = 15.03 ± 1.32, $M_{6\ months}$ = 14.77 ± 1.04; t = .75) but improved significantly for the waitlist control group ($M_{3\ months}$ = 13.30 ± 2.40, $M_{6\ months}$ = 14.43 ± 2.05, t = -3.46, p = .002).

For the social relations subscale, the intervention group had significantly different change scores than the waitlist control group from 3 months to 6 months (χ^2 = 5.00, p = .03). The scores worsened nonsignificantly for the intervention group ($M_{3\ months}$ = 15.33 ± 1.63, $M_{6\ months}$ = 14.50 ± 1.01; t = 1.12) and improved significantly for the waitlist control group ($M_{3\ months}$ = 13.57 ± 2.01, $M_{6\ months}$ = 14.63 ± 1.94; t = -2.13.)

On the environment subscale, the intervention group had significantly different change scores than the waitlist control group from 3 months to 6 months (χ^2 = 4.65, p = .03). The scores worsened nonsignificantly for the intervention group ($M_{3\ months}$ = 15.23 ± 1.43, $M_{6\ months}$ = 14.70 ± 1.49; t = 1.52) and improved nonsignificantly for the waitlist control group ($M_{3\ months}$ =14.63 ± 2.03, $M_{6\ months}$ = 15.03 ± 1.54; t = -1.51.)

Effectiveness of the Health IT Intervention on Blood Pressure Control

The effects of the Health IT interventions on the control of SBP and DBP were also examined. After adjusting for the baseline group difference, the GEE model showed a significant interaction between groups and the baseline to 3-month interval (χ^2 = 5.89, p = .02), as shown in Table S3 and Figure S2 (C). SBP decreased significantly for the intervention group ($M_{baseline}$ = 137.73 ± 18.23, $M_{3\ months}$ = 130.47 ± 13.67; t = 2.73, p < .05) but increased nonsignificantly for the waitlist control group ($M_{baseline}$ = 126.23 ± 14.01, $M_{3\ months}$ = 127.43 ± 9.77; t = -0.51). There was a significant main effect for the 3-month to 6-month interval for both groups combined (χ^2 = 9.93, p = .002), with lower SBP readings at 6 months ($M_{6\ months}$ = 126.02 ± 12.62) than at 3 months ($M_{3\ months}$ = 128.95 ± 11.88).

As shown in Table S3 and Figure S2 (D), for DBP there was also a significant main effect for the 3-month to 6-month interval for both groups combined (χ^2 = 5.98, p = .01), with lower DBP readings at 6 months ($M_{6\ months}$ = 70.23 ± 9.68) than at 3 months ($M_{3\ months}$ = 71.37 ± 9.39).

Discussion

This randomized waitlist-controlled trial examined the effects of a self-efficacy theory–based Health IT

intervention on the control of blood pressure, self-management behavior, and QOL in patients with CAD. Its effectiveness for control of SBP is consistent with findings of a previous study (Stogios et al., 2020). Moreover, participants' self-management behavior and QOL were improved significantly. There was no major effect of the time spent waiting in the waitlist condition, because the treatment was similarly effective when given immediately and after the 3-month wait period.

In line with previous studies, results from this study suggest that digitally controlled health interventions, such as electronic-health, telehealth, mobile-health, and Health IT, are practical home-based blood pressure control strategies for patients with CAD (Brørs et al., 2019). Although the potentially positive effect of such technology-based interventions on blood pressure control in patients with CAD has been described in the literature, few studies have directly applied a combined self-efficacy theory–based strategy with telehealth using the Health IT system to control blood pressure in patients with CAD. In addition, the results of our randomized waitlist-controlled trial result show similar treatment effects in both the immediate intervention group and the waitlist control group, for which the intervention occurred after the 3-month wait period.

This study incorporated a comprehensive self-efficacy theory–based strategy of successful performance, vicarious experience, verbal persuasion, and emotional arousal. The results demonstrate that it is feasible to perform regular blood pressure monitoring and a walking exercise using home-based, wearable equipment. Besides this, the results show that the Health IT system is viable in that it led participants to self-monitor their blood pressure more regularly and empowered them to self-manage their lifestyle and secondary prevention behavior. Moreover, the positive feedback from the verbal persuasion and emotional arousal delivered through the telephone interviews shows that Health IT is a desirable strategy in that it greatly empowers blood pressure control as a means of reducing cardiovascular risk. Positive support of, information about, and development of skills for symptom management and blood pressure control were offered through an educational telehealth interview. The core concept of such interventions is in line with a previous study supporting the use of technology-based precision health measures in nursing science (Starkweather et al., 2019). Future trials focusing on digital health or the use of Health IT interventions should utilize an organized theory-based framework of behavior change strategies, minimal

entry criteria, and patient-centered efforts tailored to patients with CAD.

In contrast, our results on the control of DBP are inconsistent with previous studies in which significant control of DBP was found (Huber et al., 2017; Kao et al., 2019). However, other studies found that a telehealth-based lifestyle-focused intervention significantly decreased SBP but not DBP (Chow et al., 2015). This inconsistency might be explained by a previous systematic review of 24 studies comprising 6,773 participants with CAD that evaluated the effects of telehealth interventions on patient outcomes. The results showed small significant reductions in both SBP and DBP (Turan Kavradim, Özer, & Boz, 2020). Specifically, the baseline DBP in both the immediate intervention and waitlist control groups were below the home DBP threshold of 80 mmHg (Vongpatanasin et al., 2018). This may explain the non-significant effect on the control of DBP in our study.

With regard to secondary outcomes of self-management behavior, a significant increase in PIH scale scores was found for the immediate intervention group at both 3 and 6 months. In addition, there were similar treatment effects in the group that received the intervention immediately and the waitlist control group that received it after the 3-month wait period. That our Health IT intervention optimized the efficacy of self-management for our patients with CAD might be explained by a previous finding that self-efficacy was highly correlated with self-management (Tung et al., 2014). In our study, a vicarious experience was created through recordings of good control of blood pressure and increased number of walking steps on a web-based, wearable device. Moreover, patients could initiate a consultation through a phone call or website platform as needed. The client-centered counseling and the positive modification education through the tele-health interview helped patients build a sense of self-efficacy by exploiting the principle of verbal persuasion. Participants had a good experience with problem solving and role modeling through this self-monitoring, and with the nursing education and counseling provided through the telephone interview. These results help to explicate the effects of Health IT on self-management behavior and may assist in guiding further home-based self-management education strategies.

Telephone counseling/education is a suitable technique for self-management of chronic disease. The telephone interview is a directive, client-centered counseling style that causes behavioral change and lifestyle change by helping clients explore and resolve ambivalence through patient education, risk reduction intervention, nonspecific counseling, and treatment contracts (Nasiriani, Motevasselian, Farnia, Shiryazdi, & Khodayarian, 2017).

The motivational counseling incorporated the principles of verbal persuasion and positive modification education and included information about the basics of blood pressure monitoring and disease control. The method takes into account individual demographics, cultural backgrounds, and personal expectations. The telephone interview and the motivational counseling considerably improved QOL and, along with support from their partners, improved performance in blood pressure control through a client-centered approach.

A previous study supports the conclusion that a home-based and technologically sophisticated blood control program promotes a good QOL (Kao et al., 2019), an outcome consistent with our study results. We found significant positive effects of the Health IT intervention on total WHOQOL-BREF scale scores and its psychological subscale scores from baseline to the 3-month follow-up, but significant negative effects on the physical, psychological, and social relations subscale scores from 3 months to 6 months. We believe this reversal for the 3- to 6-month interval occurred because this period coincided with the COVID-19 pandemic outbreak, which worsened QOL through home quarantine (Wang, Ng, & Brook, 2020). It is noteworthy that this study was conducted during the pandemic. Throughout the COVID-19 pandemic outbreak, daily activity, shopping, work, daily recreation, access of medical service, free transportation, and safety environments were limited by home quarantine, which resulted in declines on the physical, psychological, social relationships, and environment subscale scores on the WHOQOL-BREF. Previous literature suggests that the COVID-19 epidemic has affected not only people suspected of having COVID-19 symptoms, but also individuals not infected with COVID-19 (Nguyen et al., 2020; Samlani, Lemfadli, Ait Errami, Oubaha, & Krati, 2020). Thus, the pandemic explains why the QOL in the immediate intervention group was modestly disrupted during the follow-up period.

Limitations

Although these findings are notable, several limitations should be taken into account. It is noteworthy that the study was designed as a randomized waitlist-controlled trial, which means that we could not detect the long-term consequences of the interventions on cardiovascular events, whether they were applied immediately or after 3 months. Further randomized control trial studies with longitudinal follow-ups are recommended. Moreover, because the Health IT system equipment is landline based, only patients with a landline phone were recruited, which limits the generalizability of the findings. That

a landline phone is necessary for Health IT suggests that more advanced multidigital technology equipment may have a potential role in self-management for patients with CAD, and many more studies are needed in this regard. Finally, the generalizability of these findings is also limited because the participants were recruited mainly from one medical center.

Conclusions

The self-efficacy theory–based Health IT intervention, a smart teleweb health case management tracking system, is an innovative nurse-led intervention for the control of blood pressure and self-management behavior in patients with CAD. The use of digital methods not only helps the symptom management of physical health, but also QOL with regard to psychosocial health. Moreover, our results show that the intervention promoted good self-management behavior and QOL in patients with CAD even during the COVID-19 outbreak. Thus, they may help guide further digital healthcare strategies during the pandemic.

Acknowledgement

Clinical Resources

- Centers for Disease Control and Prevention. Heart disease facts. https://www.cdc.gov/heartdisease/facts.htm
- CISION PR Newswire. COVID-19 impact on healthcare information technology market-exclusive report by MarketsandMarkets™. https://www.prnewswire.com/news-releases/covid-19-impact-on-healthcare-information-technology-market--exclusive-report-by-marketsandmarkets-301065855.html
- Office of the National Coordinator for Health Information Technology. Advancing America's health care. https://www.healthit.gov/sites/default/files/pdf/health-information-technology-fact-sheet.pdf

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Supporting Information

Additional supporting information may be found in the online version of this article at the publisher's web site:

Figure S1. Flowchart of the study participants' recruitment.

Figure S2. Effect of Health IT intervention on self-management behavior, quality of life, systolic blood pressure (SBP) and diastolic blood pressure (DBP) in CAD patients.

Table S1. Theory-Based Self Efficacy Interventions on Self-Management Behavior.

Table S2. Characteristics of Coronary Artery Disease Patients.

Table S3. Mean Changes in Measures of Self-Management Behavior, Quality of Life, and Blood Pressure Following Health IT Intervention.

Table S4. Mean Changes on Subscales of WHOQOL-BREF from Baseline to 3 Months Following Health IT Intervention.

Table S5. Mean Changes on Subscales of WHOQOL-BREF from 3 Months to 6 Months Following Health IT Intervention.