Journal of the American Society of Hypertension ■(■) (2018) 1–8

Research Article

Digital health intervention as an adjunct to a workplace health program in hypertension

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Manuscript received February 21, 2018 and accepted May 18, 2018

Abstract

Background: Hypertension is a common and difficult-to-treat condition; digital health tools may serve as adjuncts to traditional pharmaceutical and lifestyle-based interventions. Using a retrospective observational study we sought to evaluate the effect of a desktop and mobile digital health intervention (DHI) as an adjunct to a workplace health program in those previously diagnosed with hypertension.

Methods: As part of a workplace health program, 3330 patients were identified as previously diagnosed with hypertension. A DHI was made available to participants providing motivational and educational materials assisting in the management of hypertension. We evaluated changes in blood pressure, weight, and body mass index (BMI) between users and nonusers based on login frequency to the DHI using multivariate regression through the five visits over the course of 1 year.

Results: One thousand six hundred twenty-two (49%) participants logged into the application at least once. DHI users had significant greater improvements in systolic blood pressure (SBP; −2.79 mm Hg), diastolic blood pressure (−2.12 mm Hg), and BMI (−0.23 kg/m^2) at 1 year. Increased login frequency was significantly correlated with reductions in SBP, diastolic blood pressure, weight, and BMI ($P \leq .014$).

Discussion: This large, observational study provides evidence that a DHI as an adjunct to a workplace health program is associated with greater improvement in blood pressure and BMI at 1 year. This study adds to the growing body of evidence that DHIs may be useful in augmenting the treatment of hypertension in addition to traditional management with pharmaceuticals and lifestyle changes. J Am Soc Hypertens 2018;■(■):1–8.

Keywords: Digital health; mobile application; non-pharmacological interventions; workplace health.

Introduction

Hypertension is a well-known risk factor for myocardial infarction, heart failure, renal disease, and stroke.[1] It is estimated that 33% of American adults over the age of 20 years have hypertension, a population of 80 million people. Of those, 45.9% are above blood pressure goal (140/90 mm Hg), despite 76.5% of those currently receiving some pharmacological treatment for hypertension.[2] This is notable in that poorly controlled hypertension is associated with worse cardiovascular outcomes, increased risk of stroke and increases in health care expenditures.[3,4]

Treatment of hypertension has been shown to effectively reduce the risk of heart failure, myocardial infarction and stroke.[5] Reductions as small as 2 mm Hg in systolic blood pressure (SBP) have been shown to reduce the risk of stroke (10%) and heart disease (7%).[6] Lifestyle interventions such as weight loss,[7,8] exercise,[9,10] dietary salt restriction,[11,12] and limiting alcohol intake[13,14] have been shown to be effective antihypertensive strategies. Community programs, such as workplace health programs[15–17] and community

Conflict of interest: The authors certify that they have no affiliations with or involvement in any organization or entity with any financial interest or nonfinancial interest in the subject matter or materials discussed in this article.

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1933-1711/$ - see front matter
https://doi.org/10.1016/j.jash.2018.05.006

education[18] have also been found to have small, but significant effects on blood pressure control.

The use of online and mobile interventions, termed digital health interventions (DHIs), to help optimize lifestyle factors for hypertension has become increasingly prevalent.[19] Increasing online access via home broadband and mobile phones[20] has allowed for the proliferation of digital tools that can provide education and behavior modifications at the patient's discretion. In patients previously diagnosed with hypertension DHIs have been used in multiple formats including e-counseling,[21] mobile applications,[22,23] and online platforms[24,25] with varying effect. A systematic review of randomized control trials including 1287 patients found small reductions in SBP and diastolic blood pressure (DBP) compared with controls or usual care.[26] However, the definition of hypertension and initial blood pressure readings varied widely. Only a single study was longer than 1 year and many studies were less than 6 months. In general, these interventions have shown promise, but lack large patient samples and extended duration given hypertension as a chronic condition.[27]

With this study, we sought to examine the effect of a DHI in patients with previously diagnosed hypertension as part of a workplace health intervention over 1 year. Our hypothesis was DHI participation and frequency of use would be associated with blood pressure control and secondary outcomes of weight and body mass index (BMI) in a large retrospective observational analysis.

Methods

Employee Recruitment and Study Parameter

Between 2011 and 2014 CareHere, LLC (Nashville, TN) created and implemented an incentive plan for employees to improve health across 81 employers in 42 states encompassing 30,974 employees in a variety of occupations. CareHere, LLC's onsite clinic vendor managed the individual programs and tracked results both manually and with the Online CareHere Connect Personal Health Assistant designed and produced by Healarium, Inc (Dallas, TX). As described previously,[16,28] all employees enrolled in the employer-sponsored health insurance program were offered the opportunity to complete biometric screening with no forced entry into the program or study. The DHI software implementations were branded to each employer but were similar in that they covered basics of CVD prevention, as well as conceived and designed by CareHere. Delivery methods and interventions did not vary by employer. Employees were given the option to "opt out" of the digital health component of the program on the initial intake but were not consented at the time of entry, as deidentified data were to be used in the analyses. Race was included as a self-identified attribute at the initial visit. The study and consent process were approved by the IRB of Mayo Clinic.

The patients' primary health care providers assessed blood pressure, height, and weight every 90 days in an outpatient examination. Blood pressure measurements were taken in a clinical setting by trained health care professionals and documented in the EMR. Employees were asked to follow-up with their health care provider every 90 days for the duration of the program (at least 1 year). Of the participating employees, 9741 had a previous diagnosis of hypertension based on ICD9 codes available electronic medical records. At the initial visit, 3330 participants were found to have poorly controlled hypertension, with an SBP above 140 mm Hg or a DBP above 90 mm Hg, and were included in the analysis.

Digital Health Intervention

The DHI studied here has been described previously[16,28] and the login screen is visualized in Figure 1. In brief, it is a platform accessible online through a desktop and smartphone-based portal that provides educational materials and concrete health improvement tasks while tracking and logging user data. On enrollment, participants upload baseline data, and additional data is compiled as they progress through the program. Participants are asked to log in on a regular basis in between each quarterly visit. The platform provides individualized care plans based on medical comorbidities, including health status information tasks, targets, and plans that encourage the adoption and maintenance of a healthier lifestyle for improved wellness without physician intervention. Communication occurs in an HIPAA compliant fashion directly in the application as well as through email and short message serve text messaging, dependent on user preference. The software directly communicates with an electronic health record that captures ICD codes, medical diagnoses, medical information, demographic information, and lab and vital sign values. An application user was defined as any individual with a minimum of one login to the digital health application during the 1-year study interval. Frequency of use was determined by the annual number of user login cumulatively between desktop and mobile applications; it does not include the number of message sent from the DHI to the user. No measure of email readership or short message serve text readership was available.

Statistical Analysis

Baseline user characteristics were aggregated, for binary data percentages were computed and chi-square tests were used to evaluate differences. Continuous variables that had a normal distribution are shown with means and standard deviations. To evaluate the effect of DHI use on SBP, DBP, weight, and BMI differences, a multiple linear