Research Article
Open Access
CrossMark

An analysis of factors influencing the popularity and user satisfaction of hypertension self-management applications: a cross-sectional study in China

Abstract

Background: As the largest developing country in the world, China lacks data on the content and popularity of smartphone self-management apps for HTN. The major functional characteristics and consumer interaction metrics of smartphone apps are unknown. This is the first study to provide an evaluation of Chinese smartphone-based self-management apps for hypertension in user angle. We analyzed the Chinese Android and iPhone markets using the search terms ''hypertension'' and "high blood pressure'' in July 2018. All search items were screened according to inclusion and exclusion criteria. Fifty-six of the apps included (47.9%) were designed for the Apple iPhone, and 61 (52.1%) were designed for Android devices. Moreover, 93.2% were used for blood pressure (BP) self-monitoring, 17.1% were used for diet self-monitoring, and 48.7% were used for physical activity self-monitoring. Similarly, 58.1% were capable of tracking other health data, and 49.6% had the ability to enhance medication adherence. Only 3.4% could transform the smartphone into a medical device for the measurement of BP. There were no differences in app features between the two smartphone platforms. Android apps, which were capable of both physical activity self-monitoring (odds ratio, 6.31; P <. 001) and diet self-monitoring (odds ratio, 3.18; P <. 001), had high popularity. There was no significant correlation between the major functional characteristics of all apps with high user satisfaction. Future work will propose a new methodology for evaluating the quality and reliability of smartphone apps for HTN self-management from the perspective of healthcare professionals (HCPs).

Keywords: Hypertension, mobile health, applications, self-management, China

Volume 8 Issue 2 - 2019

Tingwei Ren, Ye He, Yong Zhang
Chongqing Medical University, China

Correspondence: Yong Zhang, School of Public Health and Management, Chongqing Medical University, Chongqing 400016, China, Tel +86-135-9408-4999, Email zhangyogcq@live.cn

Received: March 20, 2019 | **Published:** March 25, 2019

Introduction

Hypertension (HTN) is a leading cause of the global epidemic of cardiovascular diseases.[1,2] It can lead to myocardial infarction, cerebral infarction, and heart failure.[3] One national survey revealed that the prevalence of HTN was high in China; the current prevalence of HTN in Chinese adults is 29.6%, which corresponds to 325 million patients. However, disease awareness, treatment, and control rates do not match the rate of economic development.[4] In addition to medication, lifestyle treatments have the potential to improve blood pressure (BP) control and even reduce medication needs.[5,6] Home self-monitoring of blood pressure (SMBP), which is similar to 24-hour ambulatory monitoring,[7] can be an effective means to replace traditional office BP measurements for the prediction of cardiovascular events. Mobile health technologies can provide a similar type of support in promoting HTN self-management.[8] Mobile health (m-health) is defined as the "medical and public health practice supported by mobile devices such as mobile phones, patient monitoring devices, personal digital assistants (PDAs), and other wireless devices"[9] Media Research showed that the number of mobile phone users in China reached 668 million by the end of 2017, at which time around 768 million people surfed the Internet.[10] The popularity of smartphones and the Internet has greatly increased the number of mobile medical applications (apps).[11] Today, about 8% of apps are aimed at heart and circulation diseases.[12] As the largest developing country in the world, China lacks data on the content and popularity of smartphone self-management apps for HTN. The major functional characteristics and consumer interaction metrics of smartphone apps are unknown. To date, there has been no study of these apps in Chinese markets from the perspective of users.

The purpose of this cross-sectional study was to review the general situations, major features, and consumer interaction metrics of smartphone self-management apps for HTN. The findings of this study could reveal the factors that influence the popularity and favorable ratings of Chinese self-management apps for HTN, which could, in turn, aid consumers in the selection of apps based on their specific needs. It could also provide mobile app developers guidance in the development of apps.

Methods

Search strategy

We began to screen self-management apps for HTN on the Android and iPhone platforms in July 2018. Search terms, including "hypertension" and "high blood pressure," were used to search both the Android app markets and Apple iTunes. The app market changes quickly; several new apps are published or updated every day. We only searched apps in the first week (From July 1 to July 7). Apps were classified as either iOS- or Android-compatible. For the iPhone, we used Apple iTunes to gather an app list from China's market. For Android, Google Play store, the official software market, was not available in mainland China. Instead, we sampled apps from the five largest Android app stores in China, which were operated by Tencent's

store Myapp (Tencent Holdings Limited, Shenzhen, China), Baidu (Baidu, Inc, Beijing, China), 360 (Qihoo 360 Technology Co. Ltd, Beijing, China), Huawei (HUAWEI Technology Co. Ltd, Inc, Beijing, China), and the Xiaomi App Store (MI, Inc, Beijing, China). These five stores make up 76.4% of the Chinese Android market share.[13] Apps were included only once even if they were repeated in the search results for two keywords.

Screening of applications

To select appropriate target apps, the inclusion criteria were: (1) The apps had to target the HTN prevention and treatment business. (2) The app language had to be simplified Chinese for only mainland China (excluding Taiwan, Hong Kong, and Macau). (3) The target user had to be focused on hypertensive's. (4) App services had to pertain to the healthcare or medicine of HTN, but not general health. Exclusion criteria were: (1) The app associated with oscillometric devices, which are automated BP measuring devices. (2) The target users were healthcare professionals only (HCPs). Every app targeted for analysis had to meet all inclusion and exclusion criteria. According to the search items above, i.e., "hypertension" and "high blood pressure", two researchers initially screened apps by using the app description. Initially screened apps were downloaded and used on a trial basis one by one. The target apps were then screened based on inclusion and exclusion criteria. After app screening, two researchers audited the target apps and then extracted the app characteristics and consumer interaction metrics. The entire flowchart of app selection is illustrated in Figure 1.

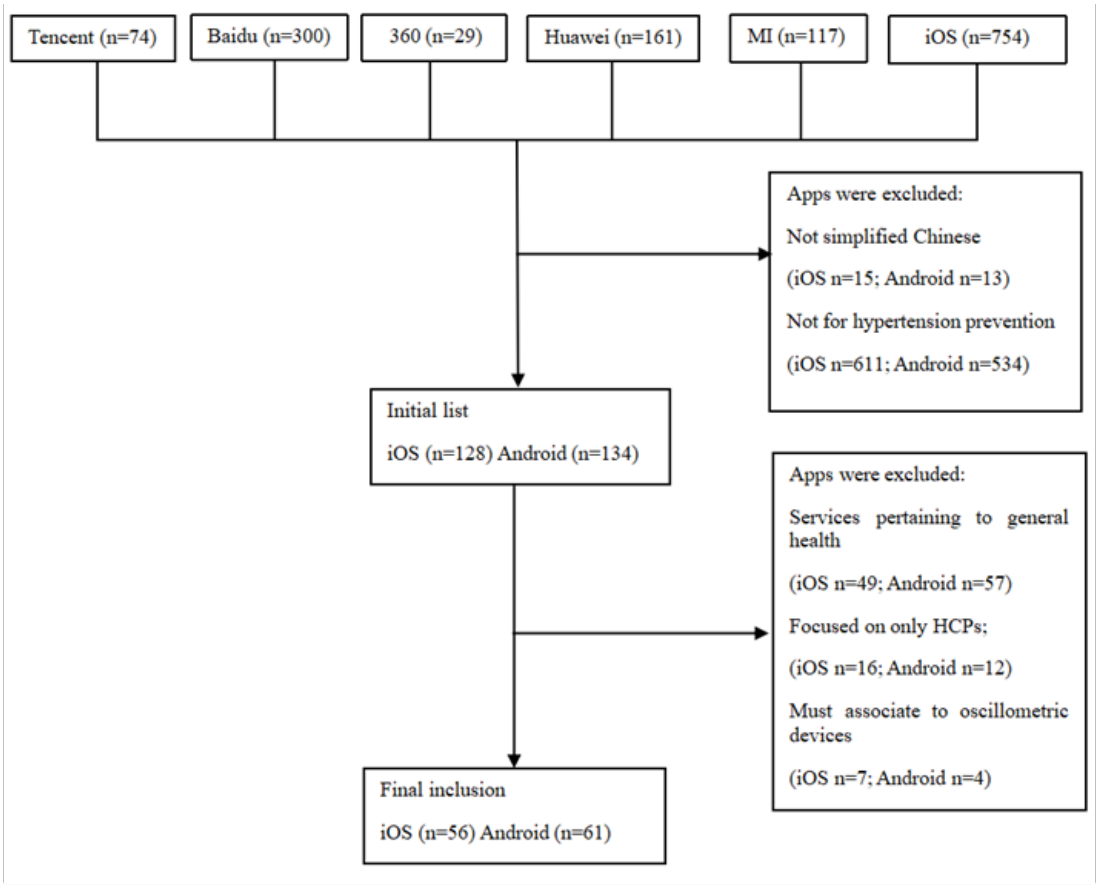

Figure 1 Flowchart of the section process for hypertension self-management applications.

Extraction of app characteristics and consumer interaction metrics

We extracted the number of positive ratings and total app ratings of Apple apps because Apple iTunes does not publish app download statistics. Both the Apple and Android app stores provided a wealth of information, including prices and customer ratings for apps.[15] For Android apps, data included the number of consumer downloads, the number of positive ratings, and total app ratings extracted from a third website called KuChuan (the largest Android application release and statistics platform in China, supporting 30 application markets). We extracted the following app data:

A. **Price:** This information indicated whether the app was free or had to be purchased, and if so, at what price.

B. **Size:** This information captured the mobile device storage space used by the app.

C. **Number of apps developed by a professional organization:** This information indicated whether the app was developed only by third parties. It also indicated whether scientific societies or healthcare or legal experts were involved in app development.

D. **Number of apps with strong safety protocols:** When users installed a smartphone app, the safety protocols claimed that the sensitive data of users would only be used for hypertension self-management and would not be sold to third parties (e.g., advertisers) or combined with data from other sources to obtain a more complete profile of their users.

E. App ratings: This information related to the rating of an app on a scale of one to five, with five being the best.

F. Number of ratings: This information recorded the number of ratings the apps had received.

G. Number of favorable ratings: We defined app ratings ≧4.5 as favorable and <4.5 as unfavorable. Our basis for choosing apps with user ratings of 4.5 and above was to hone in on apps with a high user satisfaction rate.[15]

H. Number of consumer downloads: This information recorded the number of times each app had been installed.

We sorted all the apps by the number of positive ratings and then selected the top five highest-rated apps to get the hypertension self-management apps with the highest user satisfaction rate. We then sorted the Android apps by the number of consumer downloads to get the most popular apps and the major features of these apps.

Categorization of app functional characteristics

We recorded all common features offered by the hypertension self-management apps. In this study, we adopted the categorization of app functions from previous reports,[16,17] and then we tailored it for the hypertension self-management apps in the Chinese market. The eight major app functions targeted for the analysis in this study were as follows:

I. BP self-monitoring,

II. Dietary self-management.

III. Physical activity self-management.

IV. Medication adherence tools.

V. Other health data tracking functions.

VI. Hypertension education.

VII. Cuff-less BP measurement.

VIII. Communication with healthcare providers (Table 1).

Each app could have one or more features. Two researchers recorded the app major functions independently. When the data were different, the two researchers attempted to reach an agreement through discussion.

Table 1 Previously reported categories and use in the categorization of HTN self-management apps

Previously published categories		Categories adapted for this study
Thangada et al.[16]	**Kumar et al.[17]**	
Measure BP	Tracking function	BP self-monitoring
Record BP data	Tools to enhance medication adherence	Dietary self-monitoring
Provide patient directed feedback	Transform phone into a medical device	Physical activity self-monitoring
Improve self-monitoring of BP	Hypertension education	Medication adherence tools
Improve medication adherence	Access to support groups	Other health data tracking functions
Facilitate communication with healthcare providers		Hypertension education
		Cuff-less BP measurement
		Communicate with healthcare providers

Statistical analysis

Characteristics of apps were expressed as categorical variables and continuous variables. The χ^2 test and rank-sum test were used to compare differences in proportions and the data of a non-normal distribution, respectively.

To predict which major app functional characteristics were preferred by users, we used an ordinal logistic regression model to test a large number of consumer downloads that were equipped with major features (data on the number of consumer downloads were only available for Android apps). The number of downloads was divided into five categories ranging from <10,000 to>1 million. In order to understand the major app features that were associated with the number of favorable ratings by users, we used an ordinal logistic regression model to predict apps with a higher number of favorable ratings (user ratings of 4.5 and above) with major app features for all apps. The number of favorable ratings was divided into three categories ranging from <10 to >1,000.The overall model fit was tested using the likelihood ratio c^2 test. *P*-values <0.05 were considered to be significant. All data analyses were performed using SAS version 9.4.

Results

Overall

We identified 754 hypertension self-management apps on Apple iTunes and 681 apps on Android markets. After screening and using the apps, we found that there were 143 smartphone apps eligible for the analysis—56 for the Apple iPhone and 61 for the Android platform (Figure 1).

Characteristics of HTN apps

Apps compatible with the two different operation systems had significantly different download sizes in megabytes. All apps on the Android markets were free. However, 53 (94.3%) apps on Apple iTunes were free, and the other 3 apps had a median purchase price in 2018 US dollars of 1.35 (with a range of 0.15-2.70). Only 4 (6.6%) Android apps and 7 (12.5%) iPhone apps had been developed by a professional organization. Moreover, 23 (41.1%) iPhone apps had been implemented with strong safety protocols, while there were only 13 (21.3%) Android apps with those safety protocols. A total of 44.4% of apps did not contain enough user ratings to indicate. The iOS apps' median user rating was 4.7 (IQR, 4.3-5.0), and the Android apps'

median user rating was 4.8 (IQR, 4.6-4.9). There was a significant difference between ratings on the two platforms (P<.001). The median number of raters for Android apps was 98 (IQR, 14-460), while the median for iPhone apps was 82 (IQR, 12-82). On the Android markets, 15 (24.6%) apps had less than 10,000 consumer downloads and 8 (13.1%) apps had over 1 million downloads. All apps on the Apple iTunes and Android Markets characteristics are summarized in Table 2.

Table 2 Characteristics of all apps on Apple iTunes and Android Markets

App characteristics	Apple (n=56)	Android (n=61)	P value
Size in megabytes, median (IQR)	35.5 (22.3-56.8)	26.6 (9.9-52.7)	0.011
Free apps, n (%)	53 (94.6%)	61 (100%)	0.067
Price in 2018 US dollars charged for the app, median (IQR)	1.35 (0.15-2.70)	NA	NA
Developed by a professional organization, n (%)	7 (12.5%)	4 (6.6%)	0.271
Strong safety protocols, n (%)	23 (41.1%)	13 (21.3%)	0.021
User interaction parameters			
App ratings, median (IQR)	4.7 (4.3-5.0)	4.8 (4.6-4.9)	0.207
Number of ratings, median (IQR)	82 (12-82)	98 (14-460)	0.019
App ratings of 4.5 and above, n (%)	18 (32.1%)	25 (41.0%)	0.322
Number of favorable ratings, n (%)			
>1K	2	3	0.719
100–1K	8	15	0.161
10-100	17	13	0.263
<10	32	32	0.611
Number of consumer downloads, n(%)			
>1 million	NA	8 (13.1%)	NA
500K–1 million	NA	5 (8.2%)	NA
100K–500K	NA	9 (14.8%)	NA
10K–100K	NA	24 (39.3%)	NA
<10K	NA	15 (24.6%)	NA

IQR, interquartile range; NA, not applicable

Overall Services provided by apps

Of all apps we tested, 93.2% (51 iPhone apps and 58 Android apps) were capable of providing BP self-monitoring, including a BP measurement reminder in 40.2% of apps, a BP tracker in 93.2% of apps, and the ability to analyze BP trends or give text-based feedback for high or low BP in 82.9% of apps. A total of 17.1% of all apps could be used for diet self-monitoring. Similarly, 15.4% of all apps could track food intake through features such as dietary or calorie logging, 9.4% could give dietary analysis feedback based on a dietary log, and 17.1% had a database that provided food information. A total of 48.7% of apps could be used for tracking physical activity through steps or calories. Of these, 16.2% could recommend an exercise regimen. A majority of apps (61.5%) contained general information on HTN (e.g., the definition of hypertension and prehypertension, treatment goals, and drug therapy), and 23.8% provided health education on the Dietary Approaches to Stop Hypertension (DASH) diet. Tools to enhance medication adherence such as medication alarm was found in 49.6% of apps, and a medication log was found in 30.8% of apps. A total of 58.1% of all apps were capable of tracking weight or BMI, and 52.1% were capable of tracking heart rate. Moreover, 3.4% of all apps (one iPhone app and three Android apps) could take a cuff-less BP measurement through the smartphone. Moreover, 38.4% could communicate with healthcare providers. There were no differences in the aforementioned functions between the two smartphone platforms (Table 3).

Table 3 Major functional characteristics of all apps on the Apple Store and Android markets

App functional characteristics	Apple ITunes (n=56)	Android markets (n=61)	P value
BP self-monitoring			
BP measurement reminder	21 (37.5%)	26 (42.6%)	0.572
BP tracker	51 (91.1%)	58 (95.1%)	0.251
Visual or text-based feedback on BP	46 (82.1%)	51 (83.1%)	0.834

Citation: Ren T, He Y, Zhang Y. An analysis of factors influencing the popularity and user satisfaction of hypertension self-management applications: a cross-sectional study in China. *MOJ Public Health.* 2019;8(2):65–72. DOI: 10.15406/mojph.2019.08.00287

Table Continued....

App functional characteristics	Apple ITunes (n=56)	Android markets (n=61)	P value
Diet self-monitoring			
Food intake tracker*	9 (16.1%)	9 (14.8%)	0.844
Dietary analysis	6 (10.7%)	5 (8.2%)	0.641
Food database	9 (16.1%)	11 (18.0%)	0.778
Physical activity self-monitoring			
Physical activity tracker**	27 (48.2%)	30 (49.2%)	0.917
Exercise prescription	11 (19.6%)	8 (13.1%)	0.339
Medication adherence tools			
Medication alert/notification/alarm	32 (57.1%)	26 (42.6%)	0.117
Medication log	20 (35.7%)	16 (26.2%)	0.611
Others health data tracking function			
Weight/BMI tracker	33 (58.9%)	35 (57.4%)	0.865
Heart rate tracker	29 (51.8%)	32(52.5%)	0.942
Hypertension education			
General information on HTN	31 (55.4%)	41 (67.2%)	0.188
DASH diet	12 (21.4%)	13 (21.3%)	0.988
Cuff-less BP measurement	1 (1.8%)	3 (4.9%)	0.352
Communicate with healthcare providers	21 (37.5%)	24 (39.3%)	0.838

BMI, body mass index; BP, blood pressure; DASH, Dietary Approaches to Stop Hypertension; HTN, hypertension; * Food intake tracker measures dietary or calorie intake; ** Physical activity tracker means calorie consumption or step recording.

Predictors of popularity and satisfaction

Android apps that had the "Diet self-monitoring" function (odds ratio [OR], 6.31; 95% CI, -15.698−8.249; P<. 001) had the highest predicted number of downloads. Another feature that was associated with more downloads was the "Physical activity self-monitoring" function (odds ratio [OR], 3.18; 95% CI, -28.57315.163; P<. 001; (Table 4). In another ordinal logistic regression model, results showed that there was no significant correlation between the number of positive ratings and the major functional characteristics of all apps (Table 5).

Most popular and user satisfaction rate apps

The highest number of downloads for Android and the highest number of favorable ratings for Apple are summarized in Table 6. An-Hao was the most popular self-management app on Apple iTunes. The functions and properties of An-Hao enabled it to offer tools to help hypertensive patients change their dietary and exercise habits, track their health data, and provide reminders, data feedback, and health education about HTN. In Android markets, Ti-Jian-Bao was the most popular app; it measured blood pressure and heart rate within ±10% via a press of the finger on the smartphone camera without any peripherals. The app also claimed to be the world's first pulse wave acquisition and analysis software.

Table 4 Results of ordinal logistic regression using a category of downloads as the outcome variable (ranging from >1 million to <10,000; five categories) and functional characteristics of the Android app as predictor variables

App functional characteristics	Android markets (n=61)
	Odds Ratio (95% CI)
BP self-monitoring	0.31 (-6.406-4.080)
Diet self-monitoring	6.31 (-15.698--8.249)
Physical activity self-monitoring	3.18 (-28.573--15.163)
Medication adherence tools	4.82 (-1.538-4.685)
Other healthy tracking functions	9.60 (-. 380-4.905)
Hypertension education	0.55 (-2.366-1.155)
Cuff-less BP measurement	0.20 (-4.983-1.810)
Communicate with healthcare providers	0.62 (-1.547-. 591)

BMI, body mass index; BP, blood pressure; DASH, Dietary Approaches to Stop Hypertension; HTN, hypertension

Table 5 Results of ordinal logistic regression using the number of positive ratings as outcome variable (ranging from >1,000 to <10; four categories) and functional characteristics of apps from the two platforms as predictor variables

App functional characteristics	Apple iTunes (n=56)	Android markets (n=61)
	Odds Ratio (95% CI)	Odds Ratio (95% CI)
BP self-monitoring	0.41 (-3.280-1.501)	1.96 (-2.118-3.468)
Diet self-monitoring	1.50 (-1.389-0.975)	0.52 (-1.977-. 657)

Citation: Ren T, He Y, Zhang Y. An analysis of factors influencing the popularity and user satisfaction of hypertension self-management applications: a cross-sectional study in China. *MOJ Public Health.* 2019;8(2):65–72. DOI: 10.15406/mojph.2019.08.00287

Table Continued....

App functional characteristics	Apple iTunes (n=56) Odds Ratio (95% CI)	Android markets (n=61) Odds Ratio (95% CI)
Physical activity self-monitoring	0.77 (-1.593-1.065)	1.02 (-1.213-1.257)
Medication adherence tools	0.81 (-1.389-0.975)	1.21 (-. 839-1.216)
Other healthy tracking function	0.71 (-1.663-0.966)	0.81 (-1.563-1.151)
Hypertension education	0.93 (-1.299-1.144)	0.75 (-1.478-. 892)
Cuff-less BP measurement	0.14 (-4.804-. 889)	0.31 (-3.542-3.468)
Communicate with healthcare providers	0.58 (-1.759-0.668)	0.63 (-. 623-1.539)

Table 6 Top five highest number of downloads and number of favorable rated apps on hypertension self-management for Apple and Android

Name of App	Number of Downloads	Number of favorable user ratings (≧4.5)	Average user Rating
iPhone			
An-Hao	NA	1228	5
Tai-Guan-Jia	NA	1095	5
Yi-Nuo-Yi-Sheng	NA	376	5
Kang-Mei-Xiao-Guan-Jia	NA	246	5
Guan-Xin-Tang	NA	134	5
Android			
Ti-Jian-Bao	49.9 million	536	4.8
Zhang-Kong-Tang-Niao-Bing	3.7 million	334	2.7
Xue-Ya-Guan-Jia	3.2 million	171	4.7
Yi-Nuo-Yi-Sheng	1.9 million	28	4.6
Nian-jia-jian-kang	1.3 million	4	4.5

BP, blood pressure; NA, not applicable;

Discussion

In this study, we analyzed 117 applications developed for HTN self-management on the Apple and Android smartphone-based platforms. These two platforms were the most popular in China, with a market share of 99.5%.[18] In the treatment of hypertension, a patient's ability to self-manage his condition is integral to intervention. It seemed to be well-represented in the Chinese m-health apps we studied for hypertension self-management. A majority of apps were designed to facilitate of patients' blood pressure control rate, medication adherence and self-management consciousness. The main functional characteristics of hypertension self-management apps in the App Store were BP self-monitoring and analytical tools; 80% of these apps could track blood pressure and analyze the BP input by users. As it relates to the BP tracking function, a previous randomized controlled trial that compared BP self-monitoring with traditional care showed that self-monitoring resulted in lower BP in hypertensive patients.[19] It reduced BP by 9.3mm Hg systolic and 3.2mm Hg diastolic at the 12-month follow-up period. Earlier, Tonya BS achieved the same results through a mate analysis.[20] In addition, nearly half of the apps were used to enhance hypertension medication adherence and change physical activity behavior. In Android markets, the results showed that users were more likely to choose apps with diet self-monitoring tools and physical activity self-monitoring. User orientation is basically the same as that of manufacturers and developers.

Ti-Jian-Bao, the app with the highest number of downloads on Android markets, was able to transform the smartphone into a BP measurement device (cuff-less BP measurement). Interestingly, in our regression models, apps with this function did not enjoy higher popularity or higher user satisfaction. However, for Google apps, Kumar found this feature to be highly predictive of a good app rating by users in America.[17] We thought that the reason for this might be that only a few apps (3.4%) can measure health data through the smartphone in the Chinese market. This situation highlights the popularity of these apps among consumers. The BP measurement method involves applying the subject's finger to the phone camera or to the touch screen. The function is extremely easy to use under any circumstances. The user does not have to be hypertensive; he could also be a healthy individual. Although these apps were popular, none of them have been scientifically validated or recommended by any Scientific Society for clinical use.[21] Their readings may be inaccurate. A recent study on these apps showed that their readings (within 15 mm Hg of brachial cuff) accurately measured systolic and 10 mm Hg diastolic blood pressure only 59% and 70% of the time, respectively.[22]

With the number of m-health apps doubling every two to three years, a growing number of patients with chronic diseases are turning to smartphone-based apps to manage their disease. This trend will give people the opportunity to steadily increase the quality of healthcare they receive. At the same time, this sector will be very profitable for manufacturers and developers because most app developers have already developed the BP measurement devices associated with these apps. Our analysis showed that most of the apps were developed by third-party health management companies. Very few app developers were healthcare agencies or professional organizations. Among the

policies and documents available in China, no direct laws governing medical apps have been found to date.[23] User ratings and the number of downloads are largely unregulated, and it is not possible to verify whether the number of downloads displayed came from real app users as opposed to the app developers or companies themselves. What is more, the usability and effectiveness of these health-related smartphones apps cannot be evaluated. Almost none of the studies conducted, thus far, have analyzed the apps from this perspective.[24] Even if different approaches were proposed,[25,26] none of them could be judged comprehensively or supported by enough sufficient evidence to make any recommendation for their clinical use.

Strengths and limitations

To our knowledge, this is the first study on Chinese smartphone-based self-management apps for HTN from the user angle. We analyzed apps on the Apple iTunes and Android markets, the two most popular platforms in Chinese markets. Although users are most likely to pursue the top search results, we screened all the search items for our analysis. We used regression modeling to predict app features that had high satisfaction among users. The results may be useful for content developers to design apps that are more engaging to users. This study also had several limitations. First, in the two months since we performed the analysis, several new self-management HTN apps became available. Second, Apple iTunes does not provide the number of consumer downloads for apps. As a result, we could not predict which major functional characteristics of Apple apps were preferred by users. Third, some apps for HTN self-management associate with oscillometric, automated BP measuring devices. These apps were not included in this study.

Conclusion

A large and growing number of smartphone-based self-management applications are currently available for patients with HTN in Chinese markets. Most apps currently focus on functions for tracking lifestyle behavior changes. The high rate of smartphone ownership and Internet coverage in China points to the need for more analysis to evaluate the pattern of health app use among Chinese users. Also, these HTN self-management apps require high-quality randomized controlled trials to evaluate their effectiveness in HTN intervention and clinical outcomes.

Funding details

This research was supported by a grant from the Chongqing Science and Technology Commission, project cstc2016jcyjA0127.

Acknowledgments

We thank LetPub (www.letpub.com) for its linguistic assistance during the preparation of this manuscript.

Conflicts of interest

There is no conflict of interest.

References

1. Daar AS, Singer PA, Persad DL, et al. Grand challenges in chronic non-communicable diseases. *Nature*. 2007;450(7169):494–496.
2. World Health Organization. *Cardiovascular Disease Prevention and Control*. 2011.
3. WHO. *Global action plan for the prevention and control of noncommunicable diseases 2013–2020*.
4. Wang J, Zhang L, Wang F, et al. Prevalence, Awareness, Treatment, and Control of Hypertension in China: Results From a National Survey. *American Journal of Hypertension*. 2014;27(11):1355.
5. Ashoorkhani M, Bozorgi A, Majdzadeh R, et al. Comparing the effectiveness of the BPMAP (Blood Pressure Management Application) and usual care in self-management of primary hypertension and adherence to treatment in patients aged 30–60 years: study protocol for a randomized controlled trial. *Trials*. 2016;17(1):511.
6. James P A, Oparil S, Carter B L, et al. Evidence-Based Guideline for the Management of High Blood Pressure in Adults: Report From the Panel Members Appointed to the Eighth Joint National Committee (JNC 8). *Jama*. 2014;311(5):507–520
7. Stergiou GS, Kollias A, Zeniodi M, et al. Home Blood Pressure Monitoring: Primary Role in Hypertension Management. *Current Hypertension Reports*. 2014;16(8):462.
8. Internet 50 Countries with Highest Penetration Rates-Internet World Stats.
9. World Health Organization. *mHealth: New horizons for health through mobile technologies*. Geneva, Switzerland; 2011.
10. iiMedia Research. 2018.
11. Fjeldsoe B, Marshall AL, Miller YD. Behavior change interventions delivered by mobile telephone short-message service. *American Journal of Preventive Medicine*. 2009;36(2):165–173.
12. Market Share of Mobile Health Market in China. Hamburg: Statista; 2018.
13. Yoo E. The Top Ten Android App Stores in China 2017: Technode. 2018.
14. World Organization Health. *Classifying Health Workers: Mapping Occupations to the International Standard Classification*. Geneva; 2010.
15. Harleigh S, Chioma A, Ashish J. Evaluating the Dietary and Nutritional Apps in the Google Play Store[J]. *Healthcare Informatics Research*. 2018;24(1):38–45.
16. Thangada ND, Neetika G, Ambarish P, et al. The Emerging Role of Mobile-Health Applications in the Management of Hypertension[J]. *Current Cardiology Reports*. 2018;20(9):78.
17. Kumar N, Khunger M, Gupta A, et al. A content analysis of smartphone-based applications for hypertension management. *Journal of the American Society of Hypertension Jash*. 2015;9(2):130–136.
18. Smartphone OS sales market share evolution. Kantar; 2018.
19. Mcmanus RJ, Mant J, Haque MS, et al. Effect of self-monitoring and medication self-titration on systolic blood pressure in hypertensive patients at high risk of cardiovascular disease: the TASMIN-SR randomized clinical trial. J*ournal of the American Medical Association*. 2014;312(8):799–808.
20. Tonya BS, Eric J, Lee V, et al. Does home blood pressure monitoring improve patient outcomes? A systematic review comparing home and ambulatory blood pressure monitoring on blood pressure control and patient outcomes. *Integrated Blood Pressure Control*. 2015:43–49.
21. Goldberg EM, Levy PD. New Approaches to Evaluating and Monitoring Blood Pressure. *Current Hypertension Reports*. 2016;18(6):1–7.
22. Omboni S, Caserini M, Coronetti C . Telemedicine and M-Health in Hypertension Management: Technologies, Applications and Clinical Evidence. *High Blood Pressure & Cardiovascular Prevention*. 2016;23(3):1–10.
23. Hsu J, Di L, Yu YM, et al. The Top Chinese Mobile Health Apps: A Systematic Investigation. *Journal of Medical Internet Research*. 2016;18(8):e222.

24. McKay FH, Cheng C, Wright A, et al. Evaluating mobile phone applications for health behaviour change: a systematic review. *Journal of telemedicine and telecare*. 2018;24(1):22–30.

25. Difilippo KN, Huang W, Chapman-Novakofski KM. A New Tool for Nutrition App Quality Evaluation (AQEL): Development, Validation, and Reliability Testing. *Jmir Mhealth & Uhealth*. 2017;5(10):e163.

26. Liang J, He X, Jia Y, et al. Chinese Mobile Health APPs for Hypertension Management: A Systematic Evaluation of Usefulness. *Journal of Healthcare Engineering*. 2018;9:1–14.

Citation: Ren T, He Y, Zhang Y. An analysis of factors influencing the popularity and user satisfaction of hypertension self-management applications: a cross-sectional study in China. *MOJ Public Health.* 2019;8(2):65–72. DOI: 10.15406/mojph.2019.08.00287