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Home-based blood pressure monitoring using the AHOMKA care model: a longitudinal single-group pilot study in Accra

Frank EDWIN [1,2], Mark TETTEY [3*], Evelyn K ANSAH [4], John TETTEH [5], Swithin M SWARAY [6], Edem S VIDZRO [4], Jacques KPODONU [7], John KPODONU [8], Alice TANG [9], Valencia KOOMSON [10]

[1] School of Medicine, University of Health and Allied Sciences, Ho, Ghana; [2] Cardiothoracic Centre, Ho Teaching Hospital, Ho, Ghana; [3] Department of Surgery, University of Ghana Medical School, College of Health Sciences, University of Ghana, Accra, Ghana; [4] Institute of Health Research, University of Health and Allied Sciences, Ho, Ghana; [5] Department of Community Health, University of Ghana Medical School, College of Health Sciences, University of Ghana, Accra, Ghana; [6]National Cardiothoracic Centre, Korle-Bu Teaching Hospital, Accra, Ghana; [7] Division of Cardiac Surgery, Department of Surgery, Beth Israel Deaconess Medical Centre, Boston, Massachusetts, USA; [8] Department of Medicine and Therapeutics, University of Ghana Medical School, College of Health Science, University of Ghana, Accra, Ghana; [9]Department of Public Health and Community Medicine, Tufts University School of Medicine, Boston, MA, USA; [10]Department of Electrical and Computer Engineering, Tufts University, Medford, MA, USA

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Abstract

Background: Hypertension is a major risk factor for cardiovascular disease and requires long-term health treatment and ongoing monitoring to the extent that traditional management approaches may be limited in providing. Adopting appropriate digital tools like mobile health technology (mHealth) could be an effective strategy for improving the control and management of this public health burden. This pilot study evaluated the feasibility of the AHOMKA care model at two tertiary hospitals in Ghana. Outcome measures were changes in systolic (SBP) and diastolic (DBP) blood pressure model acceptance by patients and health care providers.

Objective: This study sought to assess the overall pattern of home blood pressure self-monitoring among participants from two teaching hospitals in southern Ghana, using mHealth.

Methods: Participants attending two (2) cardiology clinics were recruited for this mixed-method pilot study over a period of eight (8) weeks. Following a longitudinal single-group approach, we conducted structured interviews at the baseline and end-line and used exports of the AHOMKA mHealth application, in-depth interviews and focus group discussions with patients and healthcare providers. Repeated measures analysis of variance was adopted to assess differences in SBP and DBP between baseline and end line.

Results: This pilot study involved 27 participants with a mean of 50.4 ± 11.0 years-approximately 1:1 male-female participation. Mean SBP decreased by 11.6 mm Hg (95% CI = 15.0 to -8.2), from an average of 138.6 mmHg at baseline to 126.2 mmHg at endline. Average DBP was also significantly reduced by 3.0 mmHg (95% CI = -5.5 to -0.5), from an average of 87.0 mmHg at baseline to 83.0 mmHg at endline. Patients and healthcare providers were satisfied and optimistic about the AHOMKA care model.

Conclusion: The encouraging trend in BP outcomes and high response rate from this pilot study provides evidence for further investigation involving the assessment of the effectiveness of the AHOMKA care model while culturally adapting the model to the Ghanaian context. In the spectrum of hypertension interventions, AHOMKA has the potential to ease the burden on the public health system.

Keywords: mHealth, mobile technology, systolic hypertension, diastolic hypertension, Ghana

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INTRODUCTION

Hypertension is a well-established risk factor for cardiovascular, cerebrovascular, and chronic kidney disease [1], which is known to affect an estimated 1.28 billion adults globally [2] and is highly prevalent in low and middle-income countries (LMIC) [2-4]. Africa reports one of the highest burdens in the world, with a 54% prevalence among adults [5]. Although it is considered the largest contributor to global disability-adjusted years (DALYS) and the highest-ranked risk factor for death from all causes [6], 46% of persons with hypertension on the

* *Corresponding author*
Email: mmtettey@ug.edu.gh

continent are unaware of their status, while merely 7% of diagnosed cases are under control [2,5]. Over the past three decades, Africans living with hypertension have steadily risen from 19.7% in the 1990s to about 30.8% in 2010. By 2030, persons living with hypertension in Africa are expected to reach 217 million [7]. In a systematic review, Atibila et al. (2021) identified factors such as population growth, increase in life expectancy, lifestyle choices and positive perception of obesity as fuelling the hypertension pandemic [8]. In Ghana, Bosu and Bosu (2021) [9] have recently observed an upward trend in hypertension prevalence from the northern belt to the south. The consistent increase in hypertension cases recorded over the past decade has had a significant influence on the morbidity and mortality rate of cardiovascular disease, especially in urban Ghana [8,11,12], with the situation being exacerbated by poor rates of hypertension knowledge, treatment, and control [10].

In resource-limited countries, including Ghana, the challenges of insufficient funding and inadequate healthcare delivery are major obstacles to the implementation of long-term management [11]. Patient-related barriers, medication non-adherence, and reluctance to make lifestyle changes have impeded hypertension management and control [12,13]. Further, long waiting times, unaffordable and poor accessibility of care at health facilities, as well as difficult-to-reach populations can compromise service delivery and adversely affect hypertension outcomes [14]. Effective management requires regular blood pressure monitoring, which has been traditionally approached using several scheduled in-person clinic visits throughout the year. However, the many limitations to accessible and quality health care are known to compromise compliance, ultimately undermining the effectiveness of this traditional approach to hypertension management and control in low-resource settings.

It is widely acknowledged that digital technology is changing the healthcare landscape [15-17]; hence, the need to harness the potential of mobile health technology (mHealth) to improve health and healthcare delivery [18]. It is relevant at a time when, in many countries, life expectancy is rising in tandem with chronic diseases, and people with chronic disorders have mostly been passively involved in managing their illnesses. mHealth interventions have the potential to improve hypertension outcomes by facilitating patient education, improving medication adherence, promoting patient empowerment, providing individualised self-care recommendations, and improving patient-healthcare provider communication and decision-making [19,20]. The World Health Organization (WHO) defines self-management as the ability of individuals, families and communities to promote and maintain their health, prevent diseases and cope with illness, with or without the support of healthcare providers [21]. The coverage of mHealth studies in Ghana, nevertheless, is limited. The AHOMKA project aims to enhance hypertension outcomes by integrating mHealth technology, utilising behavioural science principles, and empowering patients as advocates in self-management. This interactive bi-directional communication between patients and healthcare providers is hoped to improve hypertension outcomes and offer healthcare providers more insight and practical evaluation of daily patterns in patients' activities.

In this pilot study, we assessed the overall pattern of home blood pressure self-monitoring among participants from two teaching hospitals in southern Ghana using mHealth.

MATERIALS AND METHODS

The AHOMKA care model

The primary focus of the AHOMKA care model is to promote active self-care management among patients with hypertension. This system of self-management includes education of the patient, self-monitoring of clinical data, medication adherence and behavioural change (eating healthy and being physically active). The model provides bi-directional communication between the patient and healthcare provider, a key component of the model with complementary emails and text messaging, BP warnings, telephone calls and home visit interventions. Two tertiary facilities situated in the southern sector of Ghana with records of increased hypertension prevalence [22] were selected. The study team comprising physicians and nurses were trained in setting up and using the BP monitors for self-measuring, navigating the AHOMKA app and encouraging lifestyle modifications through reminders on medication adherence, healthy diet and regular physical activity.

Study participants

The requirements for eligibility include being over thirty years old, having a confirmed diagnosis of hypertension (SBP $\geq$ 140 mmHg and/or DBP $\geq$ 90 mmHg), being on prescribed anti-hypertensive medication, owning a smartphone with Android operating system and being able to communicate effectively enough to complete the study tasks. Patients were excluded if they had cognitive dysfunction, were found to be pregnant or were diagnosed with hypertension but with co-morbidities and cardiovascular complications. The AHOMKA initiative includes education of healthcare providers and participants, brief educational messages on diet and regular physical activity and questions seeking to promote medication adherence.

Recruitment

We consecutively recruited 32 participants living with hypertension (16 from each of the study sites) from the outpatient department (OPD) of the two facilities receiving care at the time of data collection. After data cleaning, 27 patients qualified at both sites to be included in the quantitative data analysis, giving a response rate of 84.4%. Hypertensive patients who provided informed consent to participate in the study were recruited to complete baseline measurements, including BP, height, weight, and a demographic survey. Upon receipt of the BP monitors, nurses engaged participants to set up the BP monitor and provide guidance on the accurate use of the equipment. These BP devices (Omron M2 Intelli IT, Japan) were calibrated by the Ghana Standards Board. The research coordinators at both sites downloaded and installed the AHOMKA Android application software onto participants' phones and oriented them on navigating the application. Participants were instructed to measure their BP three to seven times per week and enter the data using the AHOMKA app. The data was automatically available to the research team upon entry. The application included BP self-monitoring, questions on medication adherence and symptom-reporting features. Elevated BP (greater than 140/90 mm Hg) was flagged on the AHOMKA platform upon data entry. The patient was promptly contacted to evaluate the symptoms and severity of elevated BP, and a physician appointment was scheduled if indicated.

Before-after comparison of blood pressure using the baseline and endline measurements was used to calculate the differences in mean SBP and DBP at endline. Blood pressure was measured three times at one sitting on the upper left arm at heart level after at least 1 minute of rest in a sitting position using the validated blood pressure device. The average of these three readings was used for analysis.

Feasibility Study

Study design and data collection

This home BP self-monitoring model adopted a mixed-method approach to evaluate the feasibility of this pilot initiative. Participants were consecutively included over an 8-week follow-up period to avoid selection bias. Participants were required to participate in the baseline and endline interviews of this feasibility study. Research assistants from both sites collected data between August and November 2022 and were supervised by the principal investigators. Baseline interviews were conducted with patients after recruitment in this pilot study. The interview contained structured questions on patients' demographics and solicited feedback on capabilities, opportunities and motivation factors that could have influenced self-management efforts before the study. Endline interviews conducted during the exit consultation contained structured questions soliciting opinions on acceptance and expectations for the model. Digital patient records exported included blood pressure measurements recorded throughout the pilot phase and records on medication adherence as well as reported symptoms. Data was recorded from the commencement of the pilot phase for at least eight weeks per patient. Data was anonymised and prepared for analysis by creating a timeline of events for each patient. For outcomes related to satisfaction with the AHOMKA care model, we selected data on these themes obtained in the qualitative component of this pilot study. We used the following methods as applied by Cremers et al., 2019 [25]. In-depth interviews (IDIs) with 10 participants and healthcare providers were conducted after completing the pilot phase. One focus group discussion (FDG) was also conducted for healthcare providers at this time.

Outcome measure

The main outcome measure was systolic and diastolic BP. Research coordinators measured baseline BP during data collection. Patients were subsequently asked to take their own BP at home using the BP monitor provided. During each measurement, the AHOMKA application allowed for 3 BP readings with 1-minute intervals between readings. Patients were asked to take their BP every day, summing up to a maximum of 56 days. The model's acceptability was considered the outcome for the qualitative aspect. Several explanatory variables considered included sex, age, marital status, educational level, employment status, self-rated health, home BP (self-monitoring), body mass index, and medication adherence.

Data analysis

Data analysis required a minimum of 12 entries because patients were advised to enter BP at least 3 times a week. This analysis assumes a patient followed through for half of the study duration. Baseline sociodemographic characteristics were compared by study site using t-tests for continuous variables and chi-square tests for categorical variables. Inferential analysis included a t-test involving paired for within individuals and a two-sample t-test for between sites. Considering the panel nature of the data, mean changes in SBP and DBP pre- and post-AHOMKA access were assessed using paired t-tests. We adopted the Shapiro-Wilk test of normality to check the distribution of the outcomes. For relationships, we employed the generalised estimation equation with Gaussian identity to adjust for potential confounding variables. Analysis was performed using Stata 16.1 (StataCorp LLC, College Station, TX) and statistical significance set at $p < 0.05$. Research assistants transcribed IDIs and FGDs, and thematic content analysis was performed using NVivo Version 12.0. Data was blindly double-coded, and content was analysed for meaning and patterns using grounded theory

RESULTS

Participants' ages ranged from 32-74 years (mean of 50.4 ± 11.0 years), with approximately 1:1 male-female participation and the majority (96%) being married. Nearly three-quarters (74%) of participants were overweight or obese. Only medication adherence was significantly different by study site ($p = 0.01$), with higher adherence at Ho (86.7%) compared with Accra (41.7%) (Table 1). Systolic blood pressure (SBP) dropped from baseline to follow-up. A significant mean of SBP drop occurred on day 30 (Figure 1). The individual SBP patterns can be found in Supplementary Figure 1. Generally, the overall diastolic blood pressure (DBP) pattern showed a roller coaster trend from baseline. The rate of decrease was not significantly different (Figure 2). Individual DBP patterns can be found in Figure 2.

Table 1: Baseline socio-demographic and clinical characteristics among study participants

Variable	Pooled	Study site		
		Accra	Ho	
	N=27	n=12	n=15	p-value
	n (%)	n (%)	n(%)	
Sex				0.861
Female	13 (48.15)	6 (50.00)	7 (46.67)	
Male	14 (51.85)	6 (50.00)	8 (53.33)	
Age group				0.319
≤40	5 (19.23)	2 (16.67)	3 (21.43)	
41-45	4 (15.38)	2 (16.67)	2 (14.29)	
46-49	6 (23.08)	1 (8.33)	5 (35.71)	
50+	11 (42.31)	7 (58.33)	4 (28.57)	
Age, mean ± SD	50.37 ± 10.98	53.42 ± 10.82	47.93 ± 10.84	0.201
Marital status				0.354
Single	1 (3.85)	0 (0.00)	1 (7.14)	
Married	25 (96.15)	12 (100.00)	13 (92.86)	
Educational level				0.447
Primary School	4 (15.38)	1 (8.33)	3 (21.43)	
Secondary School	8 (30.77)	5 (41.67)	3 (21.43)	
Tertiary or Higher	14 (53.85)	6 (50.00)	8 (57.14)	
Employment status				0.765
Unemployed	10 (38.46)	5 (41.67)	5 (35.71)	
Currently Employed	16 (61.54)	7 (58.33)	9 (64.29)	
SRH				0.833
Good	20 (76.92)	9 (75.00)	11 (78.57)	
Very Good	6 (23.08)	3 (25.00)	3 (21.43)	
Home BP check				0.494
No	5 (19.23)	3 (25.00)	2 (14.29)	
Yes	21 (80.77)	9 (75.00)	12 (85.71)	
BMI				0.401
Normal	7 (25.93)	2 (16.67)	5 (33.33)	
Overweight	8 (29.63)	5 (41.67)	3 (20.00)	
Obese	12 (44.44)	5 (41.67)	7 (46.67)	
BMI, mean ± SD	30.19 ± 7.12	30.67 ± 7.58	29.81 ± 6.98	0.763
Medication adherence				0.014
Non-adherence	9 (33.33)	7 (58.33)	2 (13.33)	
Adherence	18 (66.67)	5 (41.67)	13 (86.67)	

NOTE: Abbreviation; SD = Standard deviation; SRH = Self-Rated-Health; BMI = Body Mass Index

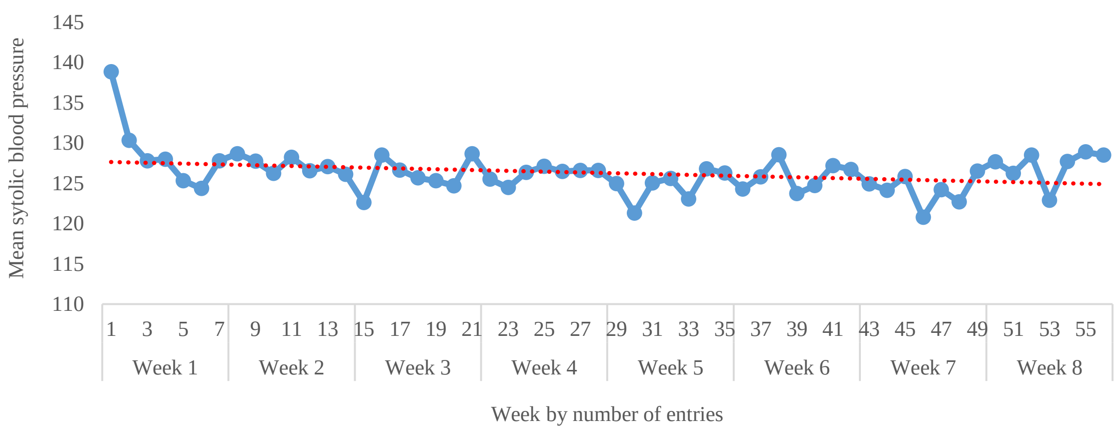

Figure 1. Overall patterns of systolic blood pressure among study participants at Accra and Ho

Table 2: Average mean systolic blood pressure (95% confidence interval) among participants by before and after the study

Study period	Pooled (N = 27)	Study site	
		Accra (n = 12)	Ho (n = 15)
Baseline	138.85 (132.84 to 144.86)	142.08 (132.50 to 151.66)	136.27 (128.58 to 143.95)
Endline	126.15 (125.23 to 127.06)	127.13 (125.56 to 128.71)	125.37 (124.31 to 126.43)
Difference	12.70 (6.97 to 18.44)***	14.95 (5.08 to 24.81)**	10.90 (4.21 to 17.58)***

Table 3. Average mean (95% confidence interval) diastolic blood pressure among participants by before and after the study

Study period	Pooled (N = 27)	Study site	
		Accra (n = 12)	Ho (n = 15)
Baseline	86.96 (82.85 to 91.07)	90.08 (83.44 to 96.72)	84.47 (79.45 to 89.48)
Endline	83.01 (82.39 to 83.63)	81.69 (80.54 to 82.84)	84.06 (83.32 to 84.79)
Difference	3.95 (0.1 to 7.88)*	8.39 (1.25 to 15.52)*	0.41 (-0.46 to 3.75)

Table 4. Impact of intervention on systolic blood pressure among participants

Study period	Pooled (N=27)	Study site	
		Accra (n = 12)	Ho (n = 15)
	β (95% CI)	β (95% CI)	β (95% CI)
Baseline	ref	ref	ref
Endline	-11.60 (-15.02 to -8.18)***	-15.53 (-20.84 to -10.22)***	-8.21 (-12.86 to -3.55)***

Table 5. Impact of intervention on diastolic blood pressure among participants

Study period	Pooled (N=27)	Study site	
		Accra (n =12)	Ho (n = 15)
	β (95% CI)	β (95% CI)	β (95% CI)
Baseline	ref	ref	ref
Endline	-2.96 (-5.50 to -0.48)*	-8.73 (-13.02 to -4.44)***	1.96 (-1.19 to 5.13)

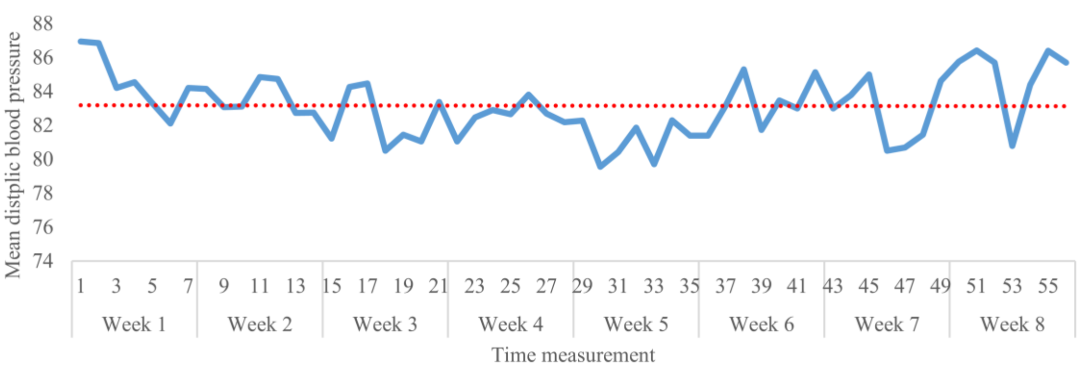

Figure 2. Overall patterns of diastolic blood pressure among study participants at Accra and Ho

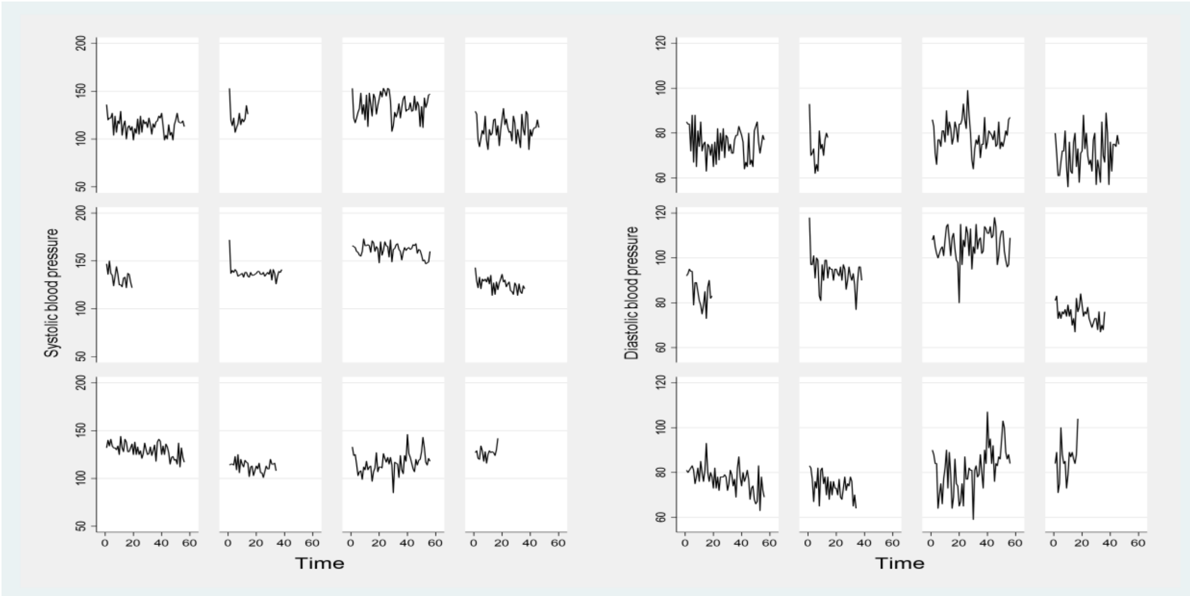

Figure 3. Systolic and diastolic patterns among study participants at Accra study site

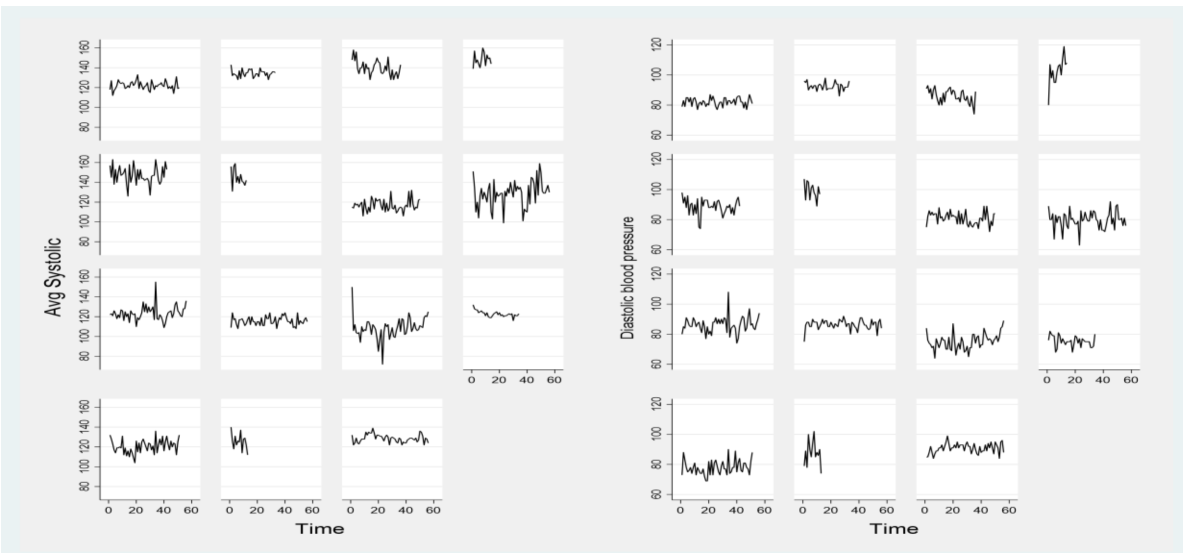

Figure 4. Systolic and diastolic patterns among study participants at Ho study site

Mean baseline SBP significantly decreased from 138.9 mm Hg (95% CI = 132.8 to 144.9) to 126.2 mm Hg (95% CI = 125.2 to 127.1) ($p < 0.001$). There was a significant decrease in average SBP across both sites ($p < 0.001$) (Table 2). Average baseline DBP generally decreased from 86.96 mm Hg (95% CI = 82.85 to 91.07) to 83.01 mm Hg (95% CI = 82.39 to 86.63) ($p < 0.05$). There was a significant reduction in average DBP at the Accra site (difference = 8.39 mm Hg, $p < 0.05$) but not at the Ho site (difference = 0.41 mm Hg, $p > 0.05$) (Table 3). Average baseline DBP generally decreased from 86.96 mm Hg (95% CI = 82.85 to 91.07) to 83.01 mm Hg (95% CI = 82.39 to 86.63) ($p < 0.05$). There was a significant reduction in average DBP at the Accra site (difference = 8.39 mm Hg, $p < 0.05$) but not at the Ho site (difference = 0.41 mm Hg, $p > 0.05$) (Table 3). After adjusting for potential confounding variables, the use of the AHOMKA care model for home self-BP monitoring saw a significantly lowered trend in average SBP by -11.60 mm Hg (95% CI = -15.02 to -8.18, $p < 0.001$). The outcome was significant at both sites; however, a larger difference was observed at the Accra site (Table 4). A similar trend was observed with DBP, with a significantly lower average DBP by -2.96 mm Hg (95% CI = -5.50 to -0.48, $p < 0.001$) observed. The trend was significant at the Accra site ($p < 0.001$ compared with the Ho site ($p > 0.05$) (Table 5).

Optimism for Ahomaka Care Model

Healthcare providers embraced the mHealth model and were eager to experience the implementation of the AHOMKA project: "As part of hypertension management, patients are encouraged to do their BP monitoring at home … so if this is being catered well for by an app, then it's in the best interest of the patient. So, this monitoring of blood pressure and caregivers having their input in the control of hypertension, I welcome it, and I think it's a good stride" (IDI physician). They were optimistic that patients would be excited about the AHOMKA care model as it would ease congestion at the clinics. One physician explained: "I think they'll be fascinated by it, embracing technology in managing hypertension. I think they will also be quite a relief because it will reduce the patient load in clinics. So, I think that overall, the attitude towards it will be positive" (IDI physician). I think with the way things are going, it might improve healthcare, especially for people coming from afar" (Nurse D). In the same vein, patients gave a positive appraisal of the AHOMKA app, confirming that anxiety dissipated after being introduced to the system: "The first time that I started using the app, I thought it'd be difficult, but with your training, education and guidance when I came home, it was fine (IDI patient).

Healthcare providers were also concerned about the illiteracy rate and language factor among patients from the surrounding villages, an insight which should be factored into the bigger project. "Most of our clients actually come from peripheries - villages and towns around. There is a high illiteracy rate accompanied by language barrier, so all these factors make it difficult to communicate with them" (FGD, healthcare providers). The common barriers reported included erratic internet connectivity, data cost and prolonged feedback time.

DISCUSSION

This pilot study evaluated the feasibility of the AHOMKA care model. Healthcare providers and patients alike were optimistic about the prospects of the model yet concerned about erratic internet connectivity and the coverage of the model in populations with high illiteracy rates. In its present state, technology favours the ability to read and operate a mobile phone. Quantitative analysis revealed a downward trend in mean systolic and diastolic blood pressures towards the endline. This could be attributed to the awareness created by the AHOMKA care model and the active involvement of participants in the management process. This outcome could have profound implications for hypertension management and probably cardiovascular disease management.

A key feature of the model was the brief messages and pictures encouraging lifestyle modifications through questions on medication adherence, education on a healthy diet and regular physical activity. Lv and colleagues reported that mHealth intervention significantly reduces SBP [32]. Their study found that when compared with the usual care, telemedicine and mHealth intervention decreased SBP by an average of 5.49 mmHg. Like AHOMKA, their intervention involved active remote engagement of participants and the promotion of good self-management. Gazit and colleagues also found mHealth BP self-management program to be effective in the long-term control of BP as well as in the detection of alarming blood pressures [33]. Even though our work was a comparatively short pilot study, implying less engagement time with participants, Gazit and colleagues highlighted mobile technology's clinical significance even in less engaged populations, as it was capable of detecting and improving high blood pressure, further demonstrating the potential of such models.

Variations could be observed in the BP trends; however, these would be better accounted for in larger studies in which concerns raised by healthcare providers and patients such as phone type (i.e., basic phone users), ease of app usage and language consideration would be taken into consideration.

Digital health intervention is transforming the behaviour of people with chronic conditions and promoting better self-management support [36,37]. Hessler et al. (2019) highlighted the effectiveness of digital systems in primary care in addressing patients' self-management issues, prioritising care, and facilitating structured action planning and follow-up. This aligns with the goal of the AHOMKA care model. Similar to the AHOMKA care model, X and Long (2020) highlight that smartphone apps can be effective tools for behavior change in hypertension management. These apps can facilitate lifestyle modifications, medication adherence, and self-monitoring of blood pressure, which are crucial for effective hypertension management. With the ubiquitous presence of mobile phones, mHealth technology could potentially be the game changer in addressing healthcare systems constraints in low-middle-income countries like Ghana.

Conclusion

Evidence from this pilot study indicates the AHOMKA care model is feasible in the study context. Evidence from this pilot study indicates the AHOMKA care model is feasible in the study context. Participants and healthcare providers were optimistic about the potential benefits, although they shared some concerns for consideration in future studies. In the spectrum of hypertension interventions, AHOMKA has the potential to ease the burden on the public by providing easy access to healthcare services and augmenting efforts to improve hypertension management and control. For further studies, recommendations should be implemented to improve the model.

The encouraging trend and high response rate from this pilot initiative support further development and testing in larger samples over a longer time frame to assess the impact of the AHOMKA initiative on BP outcomes.

DECLARATIONS

Ethical consideration

Ethical approval for this study was obtained from the Ethics and Protocol Review Committee of the School of Biomedical and Allied Health Sciences, University of Ghana (Ref Number: SBAHS/AAPT/10628546/2020-2021). All the methods were performed in accordance with the Declaration of Helsinki. The participants also gave their informed consent, having been briefed thoroughly about the purpose of the study and their expected roles.

Consent to publish

All authors agreed on the content of the final paper.

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Competing Interest

The authors declare that there is no conflict of interest regarding the publication of this article.

Author contributions

FE, MT, EKA, VK, and JK participated in the concept, design, and supervision. FE, MT, EKA, and VK participated in the methodology. JT participated in the analysis and interpretation of data. SMS, JT, ESV, FE, MT, and EKA participated in drafting the manuscript, and SMS, VK, MT, FE, EKA, JK, ESV, and AT reviewed and edited the final draft.

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Availability of data

Data is available upon request to the corresponding author.

REFERENCES

1. GHO W. Indicator Metadata Registry Details, https://www.who.int/data/gho/indicator-metadata-registry/imr-details/3155 (2023, accessed 28 August 2023).
2. WHO. Hypertension, https://www.who.int/news-room/fact-sheets/detail/hypertension (2023, accessed 12 August 2023).
3. Dai B, Addai-Dansoh S, Nutakor JA, Osei-Kwakye J, Larnyo E, Oppong S, Boahemaa PY, Arboh F (2022) The prevalence of hypertension and its associated risk factors among older adults in Ghana. Front Cardiovasc Med 9:.
4. Mills KT, Stefanescu A, He J (2020) The global epidemiology of hypertension. Nat Rev Nephrol 16:223–237.
5. Olowoyo P, Barango P, Moran A, Williams B, Whelton PK, Owolabi M, Olowoyo P, Barango P, Moran A, Dzudie A, Okekunle AP, Obiako R, Mocumbi A, Beheiry H, Parati G, Lackland DT, Sarfo FS, Odili A, Agyemang C, Campbell N, Kengne AP, Pellicori P, Ebenezer AA, Adebayo O, Olalusi O, Uvere E, Guzik TJ, Kokuro C, Bukachi F, Osi K, Ogah OS, Delles C, Maffia P, Akinyemi R, Ojji D, Williams B, Whelton PK, Owolabi M (2024) Priorities to reduce the burden of hypertension in Africa through ACHIEVE. Lancet Glob Health 12:e192–e193.
6. Mensah GA. Epidemiology and global burden of hypertension. In: Camm AJ, Lüscher TF, Maurer G, et al (eds) The ESC Textbook of Cardiovascular Medicine. Oxford University Press
7. Adeloye D, Basquill C (2014) Estimating the Prevalence and Awareness Rates of Hypertension in Africa: A Systematic Analysis. PLoS One 9:e104300.
8. Atibila F, Hoor G ten, Donkoh ET, Wahab AI, Kok G (2021) Prevalence of hypertension in Ghanaian society: a systematic review, meta-analysis, and GRADE assessment. Syst Rev 10:220.
9. Bosu WK, Bosu DK (2021) Prevalence, awareness and control of hypertension in Ghana: A systematic review and meta-analysis. PLoS One 16:e0248137.
10. Tannor EK, Nyarko OO, Adu-Boakye Y, Owusu Konadu S, Opoku G, Ankobea-Kokroe F, Opare Addo M, Amuzu EX, Ansah GJ, Appiah-Boateng K, Ansong D (2022) Burden of hypertension in Ghana – Analysis of awareness and screening campaign in the Ashanti Region of Ghana. JRSM Cardiovasc Dis 11:.
11. WHO Gh. Beating noncommunicable diseases through primary healthcare. WHO | Regional Office for Africa, https://www.afro.who.int/countries/ghana/news/beating-noncommunicable-diseases-through-primary-healthcare (2022, accessed 24 July 2023).
12. Elnaem MH, Mosaad M, Abdelaziz DH, Mansour NO, Usman A, Elrggal ME, Cheema E (2022) Disparities in Prevalence and Barriers to Hypertension Control: A Systematic Review. Int J Environ Res Public Health 19:14571.
13. Charchar FJ, Prestes PR, Mills C, Ching SM, Neupane D, Marques FZ, Sharman JE, Vogt L, Burrell LM, Korostovtseva L, Zec M, Patil M, Schultz MG, Wallen MP, Renna NF, Islam SMS, Hiremath S, Gyeltshen T, Chia Y-C, Gupta A, Schutte AE, Klein B, Borghi C, Browning CJ, Czesnikiewicz-Guzik M, Lee H-Y, Itoh H, Miura K, Brunström M, Campbell NRC, Akinnibossun OA, Veerabhadrappa P, Wainford RD, Kruger R, Thomas SA, Komori T, Ralapanawa U, Cornelissen VA, Kapil V, Li Y, Zhang Y, Jafar TH, Khan N, Williams B, Stergiou G, Tomaszewski M (2024) Lifestyle management of hypertension: International Society of Hypertension position paper endorsed by the World Hypertension League and European Society of Hypertension. J Hypertens 42:23–49.
14. Galson SW, Pesambili M, Vissoci JRN, Manavalan P, Hertz JT, Temu G, Staton CA, Stanifer JW (2023)

Hypertension in an Emergency Department Population in Moshi, Tanzania; A Qualitative Study of Barriers to Hypertension Control. PLoS One 18:e0279377.

15. Amuasi JohnH, Agbogbatey MK, Sarfo FS, Beyuo A, Duah K, Agasiya P, Arthur A, Appiah L, Nguah SB, Bockarie A, Ayisi-Boateng NK, Boateng KGA, Adusei-Mensah N, Akpalu A, Ovbiagele B (2022) Feasibility, acceptability, and appropriateness of a mobile health stroke intervention among Ghanaian health workers. J Neurol Sci 439:120304.

16. Cao W, Milks MW, Liu X, Gregory ME, Addison D, Zhang P, Li L (2022) mHealth Interventions for Self-management of Hypertension: Framework and Systematic Review on Engagement, Interactivity, and Tailoring. JMIR Mhealth Uhealth 10:e29415.

17. Hsu C-H, Alavi A, Dong M (2022) Editorial: mHealth for Non-Communicable Diseases. Front Public Health 10:.

18. LeFevre AE, Mohan D, Hutchful D, Jennings L, Mehl G, Labrique A, Romano K, Moorthy A (2017) Mobile Technology for Community Health in Ghana: what happens when technical functionality threatens the effectiveness of digital health programs? BMC Med Inform Decis Mak 17:27.

19. Perski O, Blandford A, West R, Michie S (2017) Conceptualising engagement with digital behaviour change interventions: a systematic review using principles from critical interpretive synthesis. Transl Behav Med 7:254–267.

20. Yardley L, Spring BJ, Riper H, Morrison LG, Crane DH, Curtis K, Merchant GC, Naughton F, Blandford A (2016) Understanding and Promoting Effective Engagement With Digital Behavior Change Interventions. Am J Prev Med 51:833–842.

21. WHO. Self-care for health and well-being, https://www.who.int/news-room/fact-sheets/detail/self-care-health-interventions (2024, accessed 1 August 2024).

22. Dorgbetor CI, Dickson KS, Kwabena Ameyaw E, Setorwu Adde K (2022) Prevalence and Associated Factors of Hypertension among Women in Southern Ghana: Evidence from 2014 GDHS. Int J Hypertens 2022:1–10.

23. Entsua-Mensah K, Doku A, Adzamli I (2012) The National Cardiothoracic Centre, Accra Ghana: proceedings of the second International Update Course in Cardiology - improving the coverage of cardiology services. Pan Afr Med J 11:8

24. Sarfo FS, Mobula LM, Adade T, Commodore-Mensah Y, Agyei M, Kokuro C, Adu-Gyamfi R, Duah C, Ovbiagele B (2020) Low blood pressure levels & incident stroke risk among elderly Ghanaians with hypertension. J Neurol Sci 413:116770.

25. Cremers AL, Alege A, Nelissen HE, Okwor TJ, Osibogun A, Gerrets R, Van't Hoog AH (2019) Patients' and healthcare providers' perceptions and practices regarding hypertension, pharmacy-based care, and mHealth in Lagos, Nigeria. J Hypertens 37:389–397.

26. Lu X, Yang H, Xia X, Lu X, Lin J, Liu F, Gu D (2019) Interactive Mobile Health Intervention and Blood Pressure Management in Adults. Hypertension 74:697–704.

27. GSS (2010) Population and Housing Census. Ho Municipality. September 2014.

28. GSS (2021) Population and Housing Census. 22 September 2021.

29. Cai Y, Hansell AL, Blangiardo M, Burton PR, de Hoogh K, Doiron D, Fortier I, Gulliver J, Hveem K, Mbatchou S, Morley DW, Stolk RP, Zijlema WL, Elliott P, Hodgson S (2017) Long-term exposure to road traffic noise, ambient air pollution, and cardiovascular risk factors in the HUNT and lifelines cohorts. Eur Heart J 38:2290–2296.

30. Spruill TM (2010) Chronic Psychosocial Stress and Hypertension. Curr Hypertens Rep 12:10–16.

31. Forouzanfar MH, Liu P, Roth GA, Ng M, Biryukov S, et al. (2017) Global Burden of Hypertension and Systolic Blood Pressure of at Least 110 to 115 mm Hg, 1990-2015. JAMA 317:165.

32. Lv M, Wu T, Jiang S, Chen W, Zhang J (2021) Effects of Telemedicine and mHealth on Systolic Blood Pressure Management in Stroke Patients: Systematic Review and Meta-Analysis of Randomized Controlled Trials. JMIR Mhealth Uhealth 9:e24116.

33. Gazit T, Gutman M, Beatty AL (2021) Assessment of Hypertension Control Among Adults Participating in a Mobile Technology Blood Pressure Self-management Program. JAMA Netw Open 4:e2127008.

34. Cook NR, Cohen J, Hebert PR, Taylor JO, Hennekens CH (1995) Implications of small reductions in diastolic blood pressure for primary prevention. Arch Intern Med 155:701–9

35. Suzuki Y, Kaneko H, Yano Y, Okada A, Matsuoka S, Fujiu K, Michihata N, Jo T, Takeda N, Morita H, Node K, Yasunaga H, Komuro I (2023) Reduction in blood pressure for people with isolated diastolic hypertension and cardiovascular outcomes. Eur J Prev Cardiol 30:928–934.

36. Hessler DM, Fisher L, Bowyer V, Dickinson LM, Jortberg BT, Kwan B, Fernald DH, Simpson M, Dickinson WP (2019) Self-management support for chronic disease in primary care: frequency of patient self-management problems and patient reported priorities, and alignment with ultimate behavior goal selection. BMC Fam Pract 20:120.

37. Xu H, Long H (2020) The Effect of Smartphone App–Based Interventions for Patients With Hypertension: Systematic Review and Meta-Analysis. JMIR Mhealth Uhealth 8:e21759.