UGANDA NATIONAL INSTITUTE OF PUBLIC HEALTH
Quarterly Epidemiological Bulletin: July–September, 2022
Volume 7 / Issue 3

Effectiveness of a Group-based Education and Monitoring Program Delivered by Community Health Workers to Improve Control of High Blood Pressure in Island Districts of Lake Victoria, Uganda, February-March 2022

Authors: *Andrew Kwiringira[1*], Richard Migisha[1], Lilian Bulage[1], Benon Kwesiga[1], Daniel Kadobera[1], George Upenytho[2], and Alex R. Ario[1]*
Institutional affiliations: *[1]Uganda Public Health Fellowship Program, Kampala, Uganda, Uganda National Institute of Public Health, Kampala, Uganda, [2]Department of Community Health, Ministry of Health, Kampala, Uganda*
****Correspondence:*** *Email: akwiringira@musph.ac.ug, Tel: +256775997741*

Summary

Background: *Identifying and treating high blood pressure is critical to preventing a wide range of health problems; however, communities with poor access to healthcare may be unaware of their hypertension. While use of community health workers (CHWs) can address gaps in human resources for health, CHWs in Uganda have not been used previously for blood pressure (BP) screening and management. We report results of an initiative to train CHWs to evaluate BP and to administer group-based education in remote Kalangala and Buvuma island districts of Lake Victoria, Uganda, February-March 2022.*
Methods: *We randomly selected 42 of 212 villages in two island districts. We trained 84 island-based CHWs on measuring BP for 5 days. From February-March 2022, CHWs visited all households in the selected villages and invited all adults ≥18 years to be screened for high blood pressure. We used the World Health Organization's STEPwise tool to collect data on demographic and behavioral characteristics and BP measurements. High blood pressure was defined as systolic BP (SBP) ≥140 mm Hg and/or diastolic BP (DBP) ≥90 mm Hg over three readings. CHWs created and led support groups of up to 20 persons for individuals identified with high blood pressure at baseline. These support group meetings were conducted every two weeks for three months. At each group meeting, CHWs re-measured BP and administered self-management and lifestyle education to the participants. The paired t-test was used to compare mean values of systolic blood pressure (SBP) and diastolic blood pressure (DBP) before and after the intervention. Generalized estimating equations (GEE) were used to model longitudinal changes in BP.*
Results: *We trained 84 CHWs to measure BP and deliver the intervention package. Among 2,016 community members, 570 (28.3%) had high blood pressure; of these, 63 (11.1%) had a previous diagnosis of hypertension. The prevalence of high blood pressure was higher among*

persons older than 40 years. Sex, education, alcohol use, and tobacco smoking were not associated with hypertension. The comparison of systolic blood pressure (SBP) and diastolic blood pressure (DBP) before and after the intervention revealed significant reductions in both parameters (-7±14 and -3±10 mmHg, respectively). GEE showed decreases of -1.133 (SBP) and -0.543 mmHg (DBP)/fortnight.
Conclusion: *High blood pressure was common but undiagnosed. The CHW-led group-based self-management and education for controlling high blood pressure was effective in island districts in Uganda. Scaling up the intervention in other hard-to-reach districts could improve control of high blood pressure on a large scale across Uganda.*

Introduction

Hypertension (high blood pressure) is a leading contributor to the global burden of disease and premature death, accounting for approximately 9.4 million deaths annually [1] As of 2015, the prevalence of hypertension was 26.4% among adults aged 18 to 64 years in Uganda, but only 7.7% of persons with hypertension were aware of it [2]. The prevalence of undiagnosed high blood pressure is higher in areas where there is limited access to healthcare facilities and essential medicines [3], such as island districts of Lake Victoria. Most households in these island districts live beyond the targeted five kilometres maximum from the nearest health facility [4].

The use of community health workers (CHWs) has been identified as one strategy to address inaccessibility to healthcare facilities and to address the gaps in human resources for health [5]. However, the role of CHWs and their contributions in many countries, including Uganda, is largely limited to maternal and child health as well as prevention and treatment of infectious diseases [6]. Although some studies have shown the effectiveness of CHWs in management of hypertension [7, 8], these studies were intensive, costly, highly structured, and time-consuming individual-based interventions.

Population-level public health measures such as increased awareness of hypertension and lifestyle modifications are generally considered more cost-effective means of controlling hypertension than treatment-oriented programs [9], which most developing countries lack capacity to implement on a large scale [10]. Our approach of using a CHW-led group-based education and blood pressure monitoring program is a potentially cheaper alternative to

managing hypertension in disadvantaged and hard-to-reach areas. This project incorporated comprehensive data collection at baseline and during the intervention which enabled us to assess the effect of the intervention and to assess the strength and challenges of implementing the program. We determined whether a CHW-led group-based education and monitoring program for the management of high blood pressure is effective in a hard-to-reach setting.

Methods

Project setting and population

The project was conducted in two island districts of Lake Victoria: Buvuma and Kalangala district, neither of which have inland territory. Most households in these island districts live beyond the targeted five kilometers maximum from the nearest health facility [4]. Health facilities are also inadequately equipped to provide screening and management of hypertension [11] and health workers are not always available in this setting [12]. In each district, we randomly selected one parish from each of 7 sub counties using a random number generator and we randomly selected 3 villages from each of the 7 selected parishes using a random number generator. All selected villages were included in the cross-sectional survey.

Sample size: The estimated prevalence of high blood pressure in Uganda was 26% among persons 18 years of age or older [2]. Our sample size was calculated to detect a mean difference of 6 mm and 2 mm Hg in systolic and diastolic blood pressure from baseline to endline. To do this, we needed to enroll 296 individuals with high blood pressure.

Project implementation design: The project employed a pre-post intervention design without comparison group. Initially, a baseline community-based survey was conducted by CHWs to identify participants with high blood pressure, followed a CHW-led group-based education and blood pressure monitoring intervention administered to participants identified to have high blood pressure at baseline.

Baseline survey: Prior to commencing the study, we trained 84 CHWs to measure BP, deliver a group-based self-management and education over a 5-day course. We trained all CHWs who were already working in the selected villages. The training focused on education about high

blood pressure and how to manage it, adherence to medications, and lifestyle changes, such as increasing physical activity and following a healthier diet. CHWs then invited all residents ≥ 18 years to participate in the cross-sectional survey. CHWs conducted house-to-house notification and encouragement to ensure that all residents ≥ 18 years are informed about the survey. CHWs approached participants at their homes, provided a written participant information sheet. We used the World Health Organization's STEPwise tool to collect data on demographic and behavioral characteristics and BP measurements [13]. CHWs measured Blood Pressure (BP) after the participant had been seated quietly for at least 15 minutes. Three measurements were taken at 3-minute intervals using the appropriate cuff size and a calibrated digital automatic BP monitor according to the WHO STEPS protocol [25]. All participants with systolic BP (SBP) 140 mm Hg and/or diastolic BP (DBP) 90 mm Hg over three readings were informed they may have high blood pressure and were advised to visit a clinician to have their BP re-checked.

Intervention: CHWs created and led group-based self-management and education support groups of up to 20 individuals identified with high blood pressure at baseline. These group meetings, each lasting ~90 minutes, were held every 2 weeks for 3 months within the villages in which the participants resided. No incentive was given to the participants to join the group meetings. At each group meeting, CHWs re-measured BP and delivered education about high blood pressure and how to manage it, in the local language. This included details about adhering to medications and the importance of making lifestyle changes, such as increasing physical activity and following a healthier diet. Pictorial flipcharts were used as education aids, and handouts regarding high blood pressure control were provided to participants to use at home. We held four focus group discussions (FGDs) with CHWs and eight FGDs with residents who attended the group meetings; four FGDs with an average of 11 participants each and two FGDs with an average of 9 CHWs were held in Buvuma District. In Kalangala District, we conducted four FGDs with an average of 10 attendees each and two FGDs with an average of 9 CHWs each. FGDs were held with participants to learn more about the difficulties in diagnosing, treating, and controlling hypertension. FGDs were conducted with CHWs to explore the experiences, strength, and challenges of implementing the intervention. FGDs with

participants explored the perceptions of the level of support obtained from the CHWs and their experiences in managing their high blood pressure

Outcomes: The outcomes of this study were prevalence of high blood pressure. Change in SBP and DBP from baseline, measured in accordance with the WHO STEPS protocol [25]. CHWs experiences, strength and challenges of implementing the intervention and the participants perceptions of the level of support obtained from the CHWs and their experiences in managing their high blood pressure.

Data analysis: We analyzed data in STATA version 16 (Statcorp, College Station, TX, USA). Prevalence of high blood pressure was reported as proportion estimated in STATA. We used modified Poisson regression to assess factors associated with high blood pressure. We used Paired t-test to compare mean values of SBP and DBP before and after the intervention. Generalized estimating equations (GEE) were used to model correlated and longitudinal data for investigating the predictors of longitudinal changes in BP after controlling the confounding factors. Factors with P values ≤ 0.05 were considered as significant. Thematic analysis of focus group discussions was used to investigate the mechanisms of impact.

Ethics approval and consent to participate

We obtained permission from the Ministry of Health (MOH) and sought administrative clearance from District Health Officers to conduct this evaluation. The Office of Science, U.S. Centers for Disease Control and Prevention, determined that the primary intent of this evaluation was public health practice. It was determined therefore to not be human subject research.

We sought verbal consent from all respondents before data collection. Participants were told that their participation was voluntary and that there would be no negative consequences if they refused to participate. During data collection, respondents were assigned unique identifiers instead of names to protect their confidentiality. Participants who were found to have high

blood pressure were referred to the health workers. Information was stored in password-protected computers and was not shared with anyone outside the investigation team.

Results

Baseline survey

Characteristics of participants

Of the 2,016 participants, 1,201 (59.6%) were female, 1,076 (53.3%) were aged between 20 to 39 years, and 857 (43.4%) had attained at least secondary school education. The average age of participants was 35.1 years (Standard Deviation = 13.1).

Prevalence of high blood pressure

Of the 2,016 participants, 570 (28.3%) had high blood pressure; of these, only 63 (11.1%) knew that they had a previous diagnosis of hypertension.

Factors associated with high blood pressure

Old age was associated with high blood pressure. The prevalence of high blood pressure was significantly higher among persons aged 40-49 years (aPR=2.7; 95% CI=1.3-5.5) and ≥50 years (aPR=3.6; 95% CI=1.8-7.3) compared to participants aged 18-19 years. The other factors we investigated to determine if they were associated with high blood pressure but did not attain statistical significance included: sex, level of education, tobacco use, and alcohol use. Table 3 gives a summary of the association analysis between the prevalence of high blood pressure and the various potential risk factors

Table 2: Factors associated with high blood pressure, effectiveness of CHW-led group-based education and monitoring program in island districts of Lake Victoria, Uganda, 2021

Variable	High blood pressure Percent	High blood pressure		Unadjusted PR (95% C.I)	Adjusted PR* (95% C.I)
		Yes	No		
Age					
18-19	13.9	25	155	1.00	

20-29	20.4	134	524	1.46 (0.96-1.95)	1.40 (0.90-1.91)
30-39	27.5	115	303	1.51 (1.01-2.15)	1.53 (1.03-2.03)
40-49	35.7	137	247	2.50 (1.24-5.30)	2.65 (1.29-5.46)
>50	41.2	155	221	3.51 (1.74-7.10)	3.61 (1.79-7.29)
Sex					
Female	28.1	337	864	1.00	
Male	28.6	233	582	0.88 (0.69-1.11)	1.10 (0.91-1.23)
Education					
Primary	29.8	231	543	1.00	
None	28.9	106	261	0.97 (0.80-1.17)	0.96 (0.79-1.17)
Secondary	27.9	174	450	0.93 (0.79-1.10)	1.01 (0.85-1.18)
University	23.5	59	192	0.79 (0.61-1.00)	0.83 (0.65-1.06)
Alcohol use					
Yes	29.4	169	406	1.00	
No	27.8	401	1,039	0.95 (0.81-1.10)	0.96 (0.82-1.11)
Tobacco use					
Yes	31.2	34	75	1.00	
No	28.1	536	1,371	0.90 (0.67-1.20)	1.06 (0.77-1.47)

Effect of the intervention on high blood pressure control

Out of 570 participants identified with high blood pressure at baseline, 552 (97%) were included in the intervention program. Out of 18 participants who declined to participate in the intervention, 12 frequently travelled out of their districts and 6 were immobilized at their homes. Overall, approximately 15 participants attended each of the meetings. Overall, each

participant attended at least 5 meetings. The average duration of meetings was 76.6 min (SD 21.0).

The comparison of SBP and DBP at baseline and after the intervention program are presented in Table 3. After the intervention, significant reductions in SBP (-6.86 ± 13.61 mmHg) and DBP (-2.66 ± 9.96 mmHg) were seen (P < 0.001).

Table 3. Systolic and diastolic blood pressure before and after the intervention during a CHW-led group-based education and monitoring program in island districts of Lake Victoria, Uganda, 2021

					95% CI Difference	
Variable	**Before**	**After**	**Difference**	**P-value**	**Lower**	**Upper**
SBP	143.15±14.36	136.29±13.81	-6.86±13.61	<0.001	-8.78	-4.94
DBP	96.37±9.67	93.97±7.89	-2.66+9.91	<0.001	-3.95	-1.45

SBP: Systolic blood pressure; DBP: Diastolic blood pressure

After adjusting for confounding variables like age, sex, alcohol use, tobacco use, GEE showed that SBP and DBP decreased about 1.133 and 0.028 mmHg/fortnight, respectively (Table 4).

Table 4. The effect of the intervention on changes in blood pressure overtime during, CHW-led group-based education and monitoring program in island districts of Lake Victoria, Uganda, 2021

	Systolic Blood Pressure			**Diastolic Blood Pressure**		
Fixed factors	**Beta**	**Std. Error**	**p**	**Beta**	**Std. Error**	**P**
Participation time (fortnight)	-1.133	0.035	<0.001	-0.543	0.028	0.002

Participants perceptions of the level of support obtained from the community health workers and their experiences in managing their high blood pressure

The most compelling reason for participants to attend the meetings was to learn more about high blood pressure and how to manage it. Participants stated that the information they received from their health care providers about how to control hypertension was basic, consisting mostly of prescriptions for medication.

''I attended group meetings to learn about high blood pressure, our health workers don't give us enough information when we go to clinics, they write drugs and only tell you how to swallow them." — participant

Participants stated that the meetings provided them with knowledge about high blood pressure and how to manage it through simple and practical lifestyle changes such as diet, exercise, and medication adherence.

"I got knowledge on high blood pressure, mainly knowledge on how to control it and we used simple behaviour change approaches like diet, physical exercise and drug adherence." — participant

The lack of medication distribution during the meetings was a major topic of discussion among the participants. Participants expected medications to be distributed and they expressed their belief that providing medications would increase attendance at meetings. Participants reported that the high cost of medication was a barrier to maintaining BP control.

''We thought we were going to be getting high blood pressure drugs in our group meetings but we didn't, attendance can be high if drugs are given" — participant

Participants who attended meetings suggested that the program should be improved by providing medications during meetings, including free blood sugar monitoring, home visits, reminders to attend meetings and ensuring convenient meeting locations in addition to blood pressure monitoring.

Community health workers' experiences, strength, and challenges of implementing the intervention

CHWs expressed their support for the meetings and the importance of continuing them in their communities. Participants suggested that future meetings could benefit from the inclusion of previous participants, the provision of blood pressure medications, and the incorporation of home visits. CHWs also reported that training, and supportive supervision of them during the intervention were important enablers to intervention implementation.

"We should include our participants who are self-managing their BP in the next program and allow them share their experience, then it motivates other members in the program."—CHW

"If we visit people's homes and check their blood pressure at least once in a month they will focus on diet control and exercise."— CHW

"They will definitely come to our meetings if we give them blood pressure tablets."— CHW

"The training and supportive supervision helped equipped us with adequate knowledge and skills necessary to implement the intervention."' —CHW

Discussion

The prevalence of high blood pressure was high but undiagnosed in island districts of Lake Victoria in Uganda in 2022. The only factor found to be associated with high blood pressure was age. The comparison of systolic blood pressure (SBP) and diastolic blood pressure (DBP) before and after the intervention revealed significant reductions in both parameters. During the evaluation of intervention implementation, CHWs reported that the training they had received

increased their skills. Supportive supervision was also identified as helpful during the program delivery.

Only 11% of participants with high blood pressure were aware that they had hypertension. This is lower than the 28% awareness reported in urban settings in Uganda [14]. The high prevalence of undiagnosed high blood pressure in island districts of Lake Victoria may be due to limited access to healthcare facilities and essential medicines [3]. Most households in these island districts live beyond the targeted five kilometers maximum from the nearest health facility [4]. Health facilities are also inadequately equipped to provide screening and management of hypertension [11] and health workers are not always available in rural and remote settings [12]. More so, people in rural settings do not go for routine medical checkup and seek health services only when they are very sick [15]. Training the CHWs in monitoring BP and providing education enables a reorganization of health tasks to improve access [16].

In our study, we did not find associations between high blood pressure and some of the factors that have often be identified to be associated with high blood pressure, such as tobacco use [17] and alcohol use [18]. This may be due to differential patterns of alcohol use in remote islands, compared with other settings [19]. In addition, smoking is uncommon in our setting and our sample size may have had an impact on our ability to identify associations with smoking and high blood pressure. Our findings are consistent with a national non-communicable disease risk factor survey [2], conducted in Uganda that also found only age to be associated with high blood pressure. This implies that there must be other risk factors for high blood pressure in the Ugandan setting, other than those assessed using the WHO STEPS protocol deployed in both surveys. Indeed, obesity and diabetes were found to be associated with high blood pressure in Uganda [20]. Elsewhere, genetics have also been documented as a risk factor for high blood pressure [21]. Our baseline survey focused on identifying modifiable risk factors of high blood pressure that were targeted through life-style modification sessions delivered by CHWs.

This study showed that a group-based education and monitoring program delivered by CHWs was effective in lowering blood pressure. Despite the fact that this was only a three-month intervention, the blood pressure of the participants was reduced.
In addition to the education provided to intervention participants, their blood pressure was measured at each session. This ongoing monitoring may have empowered participants to determine whether and how their lifestyle changes resulted in tangible benefits [22]. This method also provides motivation to keep or adopt new behavioral changes [22], which may be one of the intervention's success mechanisms. This suggests that BP surveillance itself can help control BP in regions with poor access to healthcare. In addition, the program included several evidence-based components for improving blood pressure control, such as medication adherence [23], regular blood pressure monitoring [22], and encouraging lifestyle changes such as increased physical activity [24].

Our findings are consistent with other studies that showed the effectiveness of CHWs in control of high blood pressure [7, 8, 25]. However, these studies involved intensive, time-consuming individual-based interventions. Our approach of using a group-based intervention provides an effective and potentially cheaper alternative to managing high blood pressure in hard-to reach settings. Another aspect of CHWs role in management of high blood pressure was referring participants with high blood pressure to the health workers. In such communities where health-seeking behaviour is poor [15], and people only visit health facilities when they have serious symptoms, CHWs played a critical role of referring participants with high blood pressure for further management. Qualitative data from focus groups provides understanding of the factors that influence the causal relationship between implementation and outcome in the real world [26], and can guide scaling up the program in other settings. For example, CHWs reported that training, and supportive supervision were important enablers to intervention implementation and participants reported that dietary changes, especifically salt reduction, and frequent blood pressure monitoring as beneficial. These evidence-based components [27, 28], should be prioritised in scale up of similar programs.

Study strengths and limitations

The inclusion of process measures from the start of the intervention allowed for measurement of implementation and process measures throughout the study, which was a major strength of this study. There are some limitations to our study that may influence the interpretation of our findings. First, the 3-month intervention was relatively short. Because of this, we cannot determine whether there is a long-lasting improvement in controlling high blood pressure from our group-based education and monitoring program. Second, some of the reduction in BP observed may be attributable to the Hawthorne effect, whereby participants alter behaviors just because they are being observed. Third, inability to generalize findings to urban settings in Uganda because the study sample size was limited to rural island districts in Uganda.

Conclusion

High blood pressure was common but undiagnosed in island districts of Lake Victoria. The CHW-led group-based self-management and education for improving the control of high blood pressure was effective in reducing both SBP and DBP and is potentially feasible. There is considerable potential to scale up across rural Uganda and potentially other resource-limited regions in other countries.

Conflict of Interest

The authors declare that they had no competing interests.

Acknowledgements

We acknowledge TEPHINET for funding and technical support. We also acknowledge the Uganda Public Health Fellowship Program and the Ministry of Health for implementation and infrastructural support. Uganda Public Health Fellowship Program is funded by the US Centers for Disease Control and Prevention, Uganda. We are grateful to the study team and study participants for their involvement in the study.

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