Trials

RESEARCH Open Access

Health extension workers led home-based multicomponent intervention improves linkage to hypertension care in northwest Ethiopia: cluster-randomized controlled trial

Destaw Fetene Teshome[1*], Shitaye Alemu Balcha[2], Tadesse Awoke Ayele[1], Asmamaw Atnafu[3], Getnet Mitike[4] and Kassahun Alemu Gelaye[1]

Abstract

Background Uncontrolled hypertension is the leading cause of cardiovascular and cerebrovascular diseases in Ethiopia. Early detection and referral of hypertensive patients for clinical care is critical for initiating lifestyle changes and antihypertensive medications. This study aimed to evaluate the effects of health extension workers led home-based multicomponent intervention on linkage to hypertension care in patients with hypertension in rural districts of northwest Ethiopia.

Methods A parallel group, cluster randomized controlled trial was conducted in 20 rural communities. A total of 456 (228 in the intervention and 228 in the control clusters) participants were enrolled and followed for nine months. Participants in the intervention clusters received the interventions (home health education, behavioral and medication adherence counseling, and referral to nearby health facility) four times every other month for 40–60 min. The primary outcome was clinical linkage for hypertension care and the secondary outcome was initiation of antihypertensive treatment. Generalized estimating equation was used to evaluate the intervention's effect using an intention-to-treat approach. Effect sizes of relative benefit increases, absolute benefit increases, and attributable benefit were used. All statistical analyses were two-sided with a *p*-value of < 0.05.

Results The overall average systolic and diastolic blood pressure at baseline were 145.81 (± 13.89) mmHg and 87.11 (± 7.42) mmHg, respectively. The proportion of linkage to hypertension care increased from 11.0% at baseline to 66.2% at 9 months in the intervention group and from 12.3 to 39.7% in the control group, with an absolute benefit increase of 27.5% (95% CI: 19.6%, 35.4%; *P*-value < 0.001). The attributable benefit associated with the intervention was 40.1% (95% CI 20.7%, 59.5%) which means that more than a third of linkage to hypertension care was due to the HEWs led home-based multicomponent intervention. However, it is noteworthy that only 10.3% of patients initiated antihypertensive medication.

Conclusions In this study, health extension workers led home-based multicomponent interventions that provided home health education, behavioral counseling, and referral to a nearby health facility to improve linkage to hypertension care. A multicomponent intervention implemented on a large scale is likely to improve linkage to hypertension care and reduce hypertension-related morbidity and mortality in the country.

*Correspondence:
Destaw Fetene Teshome
destaw.fetene@gmail.com
Full list of author information is available at the end of the article

Trial registration PACTR202102729454417.
Keywords Hypertension, Linkage, Health extension workers, Ethiopia

Background

Noncommunicable diseases (NCDs), a global public health problem [1], account for 37.5% of disease burden and 43.5% of deaths in Ethiopia [2]. Hypertension, one of the most common NCD risk factors, is now recognized as a major global public health issue affecting over 1.4 billion people worldwide [3]. It also becomes a major threat to the well-being of Ethiopians, affecting 18.5% of the rural adult population [4]. Despite the high prevalence of hypertension, controlling it remains a challenge in Ethiopia, with only one out of every 67 hypertensive patients achieving optimal blood pressure control [5]. Uncontrolled hypertension is a major cause of cardiovascular diseases (CVDs) [6], strokes [7, 8], and premature mortality in the country [9]. Uncontrolled blood pressure is partly explained by the unawareness of patients about their blood pressure [10]. In studies conducted in Hosanna town [11] and Dabat district [12], for example, only 24.6% and 40.3% of hypertensive patients were aware of their condition, respectively, implying that the remainder are unaware of their condition and are not receiving treatment.

To combat this epidemic, early detection of hypertension and integration into care are critical for timely initiation of treatment and risk factors management, improved blood pressure control, and reduced morbidity and mortality associated with it [13, 14]. Once hypertension has been diagnosed, there should be access to primary care and early antihypertensive treatment to improve blood pressure control and long-term clinical benefits [15]. Early start of antihypertensive treatment is associated with a more effective and more lasting blood pressure control and may reduce the impact of cumulative CVD risk exposure [13]. The WHO Global Action Plan for the Prevention and Control of NCDs proposed that at least 50% of eligible people should receive drug therapy and counseling to prevent heart attacks and strokes [16]. However, only 16% to 28% [12, 17] of those who were aware of their disease received antihypertensive treatment, and only 2.8% of hypertensive patients received treatment [17]. Access to health care, trained staff, essential drugs, and organizational capacity for the delivery of chronic care may influence linkage, treatment, and retention in hypertension care, which is especially difficult for people with limited financial resources [14]. Low rates of hypertension awareness, treatment, and control may indicate a lack of access to and engagement with the healthcare system, necessitating community-based interventions to increase blood pressure screening and management [18].

Community and home-based hypertension screening programs, defined as a comprehensive and integrated intervention that is not limited to clinical care settings, are one of the most effective and feasible strategies for early detection of hypertension and controlling blood pressure [19]. Community health workers (CHWs) are increasingly being recognized as an important component of government efforts to provide clinical services and procedures and combat NCDs in low-resource settings where there is a shortage of higher-level healthcare providers [20, 21]. They can help an already overburdened health-care system, particularly in rural communities, by effectively maximizing health care resources and improving care quality [22]. Community-based health education and healthy lifestyle counseling interventions provided by CHWs have shown promising results in hypertension detection, linkage to healthcare facilities, and treatment initiation [23–25]. An interventional study conducted in South Africa, Mexico, and Guatemala concluded that screening for hypertension by CHWs is very cost-effective compared to the usual clinic-based screening [26].

Ethiopia has a well-known health extension program, a community-based primary health care delivery model that has increased access to preventive, promotive, and curative services for rural Ethiopians [27, 28]. The health extension workers (HEWs) also comprise the largest category of health workers in the Ethiopian health sector. Despite recent additions of NCDs and mental health to health extension program packages, HEWs lack the necessary training and do not provide hypertension care [29]. Hence, this trial is aimed to evaluate the effect of health extension workers led home-based multicomponent intervention on linkage to hypertension care and treatment, lifestyle modification, medication adherence, blood pressure change, and optimal blood pressure control in rural areas of northwest Ethiopia.

Research hypothesis

1. Health extension workers led home-based multicomponent intervention significantly improves linkage to hypertension care for patients with hypertension as compared with the usual care.
2. Health extension workers led home-based multicomponent intervention significantly improves hyperten-

sive patients' antihypertensive treatment initiation as compared with the usual care.

Materials and methods

Study design and setting

A two-arm parallel cluster randomized controlled pragmatic trial was used to evaluate the effects of HEWs led home-based intervention on clinical linkage and treatment in hypertensive patients. Two rural areas of northwest Ethiopia, namely Gondar Zuria district located in Central Gondar Zone and Dabat district located in the North Gondar Administrative Zone of the Amhara Region in Ethiopia, were selected for this trial. The districts have both urban and rural kebeles (Ethiopia's lowest administrative levels). Health extension workers are the backbone of the health extension program in Ethiopia [30]. According to the district Public Health Office, there were 77 and 102 rural HEWs in Dabat and Gondar Zuria districts, respectively, in 2018. The details of the study design and setting are described elsewhere [31].

Participants and clusters

A cluster is defined as a kebele (Ethiopia's smallest administrative unit) with one health post serving 3000 to 5000 people. Kebeles which had at least two working HEWs at the health post were eligible for the study. The adult population aged 25 years and more with high blood pressure during home-based hypertension screening and willing to participate in the study were eligible to be part of the trial. Patients with hypertension who needed immediate hypertension care (blood pressure ≥ 180/110 mmHg and one or more of the following symptoms: visual disturbance, dizziness, numbness, confusion, headache, chest pain, shortness of breath, or leg swelling) [32], controlled their high blood pressure, and left the kebeles were excluded.

Intervention package

The intervention for this study was named "health extension workers led home-based multicomponent intervention" [31]. This intervention package included home-based health education about hypertension, behavioral counseling, medication adherence counseling, and referral to a nearby health facility. The intervention aimed to improve clinical linkage to hypertension care and treatment.

Intervention group

Twenty HEWs in the intervention group received three days of training about the intervention package. The intervention package included four components: health education about hypertension, behavioral counseling, medication adherence counseling, and referral to a nearby health facility. It aimed to improve linkage to hypertension care, improve healthy lifestyle, reduce HBP, and achieve optimal blood pressure control in hypertensive patients.

The HEWs provided the intervention to each participant for a total of 9 months. They provided a 60-min health education to discuss general hypertensive disease and treatment knowledge during the first visit. The HEWs provided individualized and family-based brief health education. They explained hypertension and its major modifiable risk factors, the chronic nature of the disease, the potential complications of untreated and uncontrolled hypertension, and the possibility of needing lifelong medications to the participants. Moreover, every 2 months, the HEWs visited participants' homes and provided 40–60 min of home health education, behavioral counseling intervention, and clinical linkage (referral with slip). Health extension workers used the Health Belief Model approach to counsel patients on healthy dietary habits, alcohol moderation, and regular blood pressure check-ups. They used motivational and effective communication, goal setting, and family support for behavior change to change unhealthy lifestyle behaviors. They provided intensive counseling for patients on healthy lifestyle modification using the five A's approach: Ask, Advise, Agree, Assist, and Arrange [33].

The HEWs provided patients with hypertension a referral slip that explains the nature of the disease, the reason for the referral, and the importance of starting treatment as soon as possible if they are eligible (Additional file 1). Furthermore, through a home visit, the HEWs remind participants to seek treatment and care at a nearby health facility. Health extension workers taught participants about the purpose of using medications, the negative effects of non-adherence, the positive effects of treatment, etc.

Control group

Health extension workers in the control group were not informed about the study's goal and not involved in the intervention. They did not provide any of the intervention components to trial participants. They provided routine care (the usual home visits for maternal and child health service, malaria prevention and control, family planning services, and latrine construction) based on existing community services without any additional training. However, both participants in the intervention and control group took antihypertensive medications prescribed by the health care providers.

Intervention fidelity

Measuring intervention fidelity is essential for determining how well an intervention is delivered [34].

Accordingly, a manual of operating procedure was developed and implemented, intensive training was provided to HEWs in the intervention group, daily communication with the interventionists was established, and the supervisory team conducted a spot check when the HEWs delivered the intervention. Fidelity checklist, which included the frequency, duration, and intensity of the intervention, was prepared and used to evaluate fidelity of the intervention.

Outcome measures

The primary outcomes of this trial were the differences between the intervention and control groups in the proportion of clinical linkage to hypertension care from baseline to 3, 6, and 9 months of follow-up. The secondary outcome was initiation of antihypertensive treatment from baseline to 3, 6, and 9 months of follow-up.

Sample size determination

The sample size was calculated according to the double population proportion formula for individual randomization. The design effect is thought to account for the lack of independence among patients within clusters and increase the power of the study. The design effect is defined as $1+(m-1)\ \rho$, where m is the average cluster size and ρ is the intra-cluster correlation coefficient for the specific outcome. Accordingly, the minimum sample size to determine the effect of HEWs led home-based multicomponent intervention on clinical linkage and treatment is calculated using a 65.1% proportion of clinical linkage in patients with hypertension in the intervention group and a 46.7% proportion of clinical linkage in the absence of intervention [35]. The 95% confidence interval ($\alpha=0.05$), 80% power ($\beta=0.20$), an intra-class correlation of 0.03, and the number of clusters per arm to be 10 are also considered to obtain a total of 190 patients with hypertension per arm. Taking a 20% loss to follow-up into account, a total of 456 participants (228 in each arm) were included.

Cluster and participant recruitment

A simple random sampling method was used to select 20 kebeles from the eligible kebeles. Home-based hypertension screening was done from 2423 adults aged ≥ 25 years, and 758 of them were found to have hypertension. The research team re-measured the blood pressure of adults who were identified as potentially hypertensive in a previous home-based hypertension screening study. Adults who have been diagnosed with hypertension for the second time were evaluated for eligibility. A simple random sampling method was used to enroll an average of 23 hypertensive cases per cluster. An epidemiologist from the research team completed the participants' eligibility forms and enrolled participants in the follow-up study.

Randomization and awareness of assignment

Randomization took place at the kebele level, stratified by physical distance to the nearest healthcare facility (within 5 km and greater than 5 km). Ten kebeles within 5 km (4 from Dabat and 6 from Gondar Zuria district) and another 10 kebeles at a distance greater than 5 km (4 from Gondar Zuria and 6 from Dabat district) were randomly allocated to either the intervention or control groups. Computer-generated random numbers were used to generate the randomization list. A biostatistician, a member of the research team who did not interact with the study participants, used a 1:1 allocation ratio to randomly assign 20 kebeles to either the intervention or control group.

Neither the participants nor the HEWs were masked with respect to the participants' group assignment. The risk of contamination was minimized using buffering kebele/s, whereby the intervention and control kebeles were geographically separated and the chance of intervention cluster participants meeting control cluster participants was insignificant. Health extension workers in the intervention clusters were taught not to share information about the study with those HEWs in the control group. The outcome assessors were masked to the intervention allocation of participants.

Study visits and data collection procedures

A baseline survey was conducted before randomization. Data on socio-demographics and economic factors, behavioral risk factors, psychosocial stress levels, and history of NCDs [36], knowledge and beliefs of participants about hypertension, health insurance coverage, and access to health care were collected. Physical measurements such as height, weight, and blood pressure were also measured.

Five health professionals and 5 supervisors took 3 days of training on how to conduct interviews with patients, measure blood pressure, weight, and height. Data were collected through face-to-face interviews using an interviewer-administered Amharic version of the questionnaire. Trained data collectors, masked to the randomization status of the clusters, visited participants' homes and collected the data.

Rural household assets were used to calculate family wealth [37] and classified it into three equal-sized groups: poor, medium, and rich. The respondents' health insurance status was determined using household community-based health insurance membership [38]. It was classified as uninsured if participants did not have community-based health insurance, underinsured if they had

community-based health insurance but it did not cover all of their health-care costs, and adequately insured if they had community-based health insurance that covered all of their health-care costs.

At each visit, blood pressure was taken twice at 5-min intervals. An aneroid sphygmomanometer and stethoscope were used to take blood pressure in the sitting position on the left arm to the nearest 2 mmHg. Participants who drank caffeinated beverages such as tea or coffee, or had been working within 30 min were made to stay for 30 min prior to blood pressure measurements. According to the new guideline, hypertension (high blood pressure) is defined as a mean systolic blood pressure of ≥ 130 mmHg or a diastolic blood pressure of ≥ 80 mmHg. Stage 1 hypertension is defined as a systolic pressure ranging from 130 to 139 mm Hg or a diastolic pressure ranging from 80 to 89 mm Hg and Stage 2 hypertension is defined as a systolic pressure of 140 mm Hg or higher or a diastolic pressure of 90 mm Hg or higher [39].

Data on clinical linkage and initiation of care and treatment were collected in both the intervention and control groups at baseline, 3, 6, and 9 months. A successful linkage to hypertension care was defined as visiting a health care facility for hypertension care within 9-month follow-up period. Hypertension treatment rate was defined as the percentage of people who have hypertension and are receiving recommended antihypertensive treatment. Retention in care was defined as the proportion of hypertensive patients on antihypertensive treatment who received treatment during the data collection period. The participants' heights were measured with a tape to the nearest 0.1 cm. Participants were asked to stand upright, without shoes, with their heels together and their gaze forward. Participants' weight was measured to the nearest 0.1 kg using a digital weighing scale while they wore light clothing. The body mass index was calculated using the formula weight in kg/height in m^2 and categorized as underweight (< 18.5), normal weight (18.5–24.9), overweight (25–29.9), or obese (≥ 30) [40].

Trial management

A manual of operating procedures (MOP) was developed for both the intervention and data collection. The manual of operating procedures describes the procedures for staff training, participant recruitment, instructions for all forms and procedures, patient education, behavioral counseling intervention, blood pressure measurement, and other operational aspects of the study. The data collection process was monitored daily by the research team via phone and onsite supervision. To ensure the success of the study, efforts were made to retain study participants throughout the trial period. The names and contact information of individuals closely related to the participant were obtained during enrollment. Compliance with the intervention was only measured in the intervention arm during the follow-up period.

Statistical analysis and data management

The data was entered into Epidata and analyzed using Stata 16. Coding, data cleansing, checking frequencies, and crosstab were completed. The CONSORT flow chart was used to summarize the number of participants who were assessed for eligibility; the reasons for screening failure; the number of participants who were enrolled, lost from follow-ups; and completed the baseline and follow-up visits, and the number of participants who were analyzed in the trial. The baseline characteristics of participants were described using frequency and proportions for categorical variables and mean with standard deviations for continuous variables. The baseline characteristics of the study participants between the intervention and control group were compared for uniformity using a chi-square ($\chi 2$) test for categorical variables, a two-tailed independent t-test for the continuous variables.

The primary analyses adhered to the principle of intent-to-treat. Generalized estimating equations were used to evaluate the outcome variables using an intention-to-treat approach, taking repeated measures into account. The effect sizes such as relative benefit increase (RBI), absolute benefit increase (ABI), and attributable benefit (AB) and 95% CI were used to evaluate the intervention effect on clinical linkage or treatment.

Additional analyses

Subgroup analyses were performed to investigate the heterogeneity of the intervention effect on linkage to hypertension care based on age, sex, level of education, family history of hypertension, baseline hypertension stage, and adequate health insurance coverage. Sensitivity analysis for the primary outcome of hypertension care linkage was performed by changing any of the primary analysis assumptions of missing data and controlling for potential confounders. The attrition rate for each group, as well as the difference in attrition between the intervention and control groups, were calculated. Differential attrition is considered when the absolute value of the attrition difference is ≥ 0.05 standard deviations. Missing data were handled using complete-case analysis and multiple imputation, with the assumption that missing data are not missing at random. Adjusted analysis for the primary outcome was performed based on participants' age, sex, family history of hypertension, chronic obstructive pulmonary disease, and community-based health insurance coverage.

Results

Participants flow

Out of the 2423 adult population screened for high blood pressure, 758 were found to have hypertension and re-checked for high blood pressure. Due to lapses in developing the intervention package following hypertension screening, 117 people had achieved optimal blood pressure control, 17 had moved away, three died, and one was critically ill and excluded from the study. Finally, 620 hypertensive patients were determined to be eligible for enrollment. The trial enrolled 456 hypertensive patients, with 228 randomly assigned to the intervention group and 228 to the control group. All of the enrolled participants provided baseline data. Follow-up linkage to primary healthcare for hypertension management measures were available for 444 (97.4%) participants at follow-up time one, 428 (93.9%) at follow-up time two, and 425 (93.2%) at follow-up time 3 or endline (Fig. 1).

Baseline characteristics

The mean age of participants was 54.2 ± 15.2 years in the intervention group and 54.5 ± 14.8 years in the control group. Females comprised 258 (56.6%) of the participants, with 135 (59.2%) in the intervention group and 123 (53.9%) in the control group. Three hundred forty-nine (76.5%) of the participants could not read or write, with 169 (74.1%) in the intervention group and 180 (78.9%) in the control group. One hundred twenty (26.3%) of trial participants had adequate community-based health insurance. The intervention group, however, had a slightly higher percentage (30.3%) of adequate health insurance than the control group. The average baseline

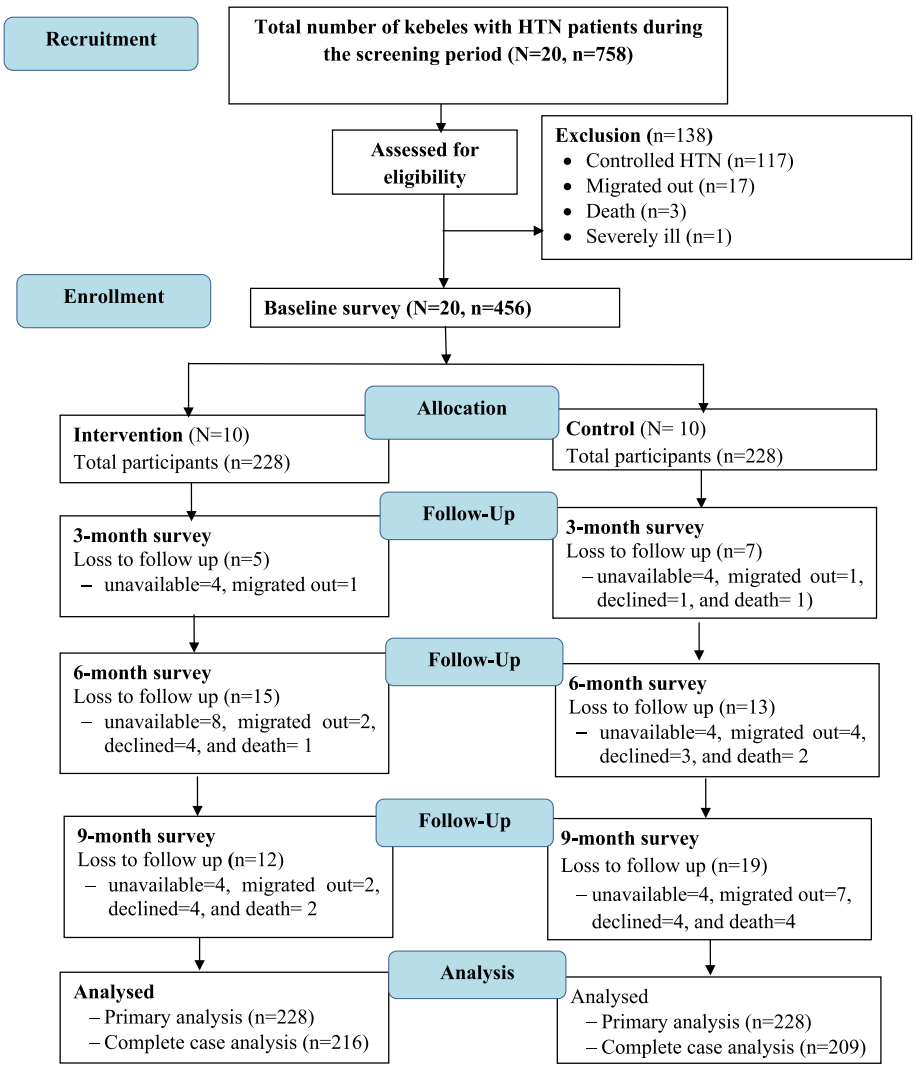

Fig. 1 The CONSORT flow chart of participants' diagram

systolic and diastolic blood pressure was 145.81 (± 13.89) mmHg and 87.11 (± 7.42) mmHg, respectively.

Of the participants, 380 (83.3%) had stage 2 hypertension, 90 (19.7%) had a family history of hypertension, and 9 (2.0%) had chronic respiratory disease. There were 53 (11.6%) participants who were linked for hypertension care, with 25 (11.0%) in the intervention group and 28 (12.3%) in the control group. Sixteen (3.5%) of the participants were also on antihypertensive medication, with 9 (3.9%) in the intervention group and 7 (3.1%) in the control group. Four hundred four (88.6%) of trial participants used foot transportation to get to the nearest health care facility. The baseline characteristics of all trial participants were uniformly distributed between the intervention and control groups, indicating that randomization was successful (Table 1).

Linkage to hypertension care and initiation of treatment

During the 3-month follow-up period, 104 (46.6%) of participants in the intervention group and 50 (22.6%) of participants in the control group visited health care facilities for hypertension management. Six months after the intervention, 124 (58.2%) of participants in the intervention group and 75 (34.9%) of participants in the control group visited health care facilities for hypertension care and treatment. The proportion of participants linked to hypertension care increased from 11.0% at baseline to 66.2% at 9 months in the intervention group and from 12.3 to 39.7% in the control group (Table 2 and Fig. 2). The ABI was 27.5% (95% CI: 19.6%, 35.4%; *P*-value < 0.001). The proportion of patients in the intervention group who initiated antihypertensive medication increased from 3.9% at baseline to 11.6% at 9 months, and the proportion of patients who started antihypertensive medication/s in the control group increased from 3.1% at baseline to 9.1% at 9 months, with an insignificant absolute benefit increase of 1.5% (95% CI: (− 2.1, 5.2, *P*-value = 0.411) (Table 2).

The generalized estimating equation revealed that intervention group participants were 1.67 times more likely than control group participants to be linked to a healthcare facility for hypertension care (RBI = 1.67; 95% CI: 1.41, 1.97). However, in both adjusted and unadjusted analyses, there is no statistically significant difference in the rate of hypertension treatment between the intervention and control groups (Table 3).

Sub group analysis

The subgroup analysis revealed that the intervention effect on linkage to hypertension care and treatment differed across age groups, family history of hypertension, and stage of hypertension. Though the intervention improves linkage to hypertension across all age groups, intervention group participants aged 25–34 years and 35–44 years were 3.43 and 2 times more likely to be linked to hypertension care, respectively, than control group participants in the same age group. Furthermore, patients with stage one hypertension and those with no family history of hypertension benefit from the intervention (Additional file 2).

Sensitivity analysis

After adjusting for sex, age, family history of hypertension, chronic obstructive pulmonary disease, and adequate community-based health insurance coverage, the rate of linkage to hypertension care in the intervention group was 1.66 times higher than in the control group (RBI = 1.66; 95% CI: 1.41, 1.96), which was similar to the unadjusted intervention effect (Table 3). The rate of linkage to hypertension care was consistent with the primary analysis after complete case analysis (Additional file 3) indicating that the method we used was robust.

Discussion

In this trial, health extension workers led home-based multicomponent intervention incorporating home health education, behavioral counseling, and referral to a nearby health facility that significantly improved linkage to hypertension care and treatment compared to the control group. Two-thirds (66.2%) of trial participants in the intervention group were linked to primary healthcare, compared to nearly 40% in the control group during the 9-month follow-up period. The attributable benefit increase (attributable rate) was 27.5% (95% CI: 19.6%, 35.4%; *P*-value < 0.001), with the attributable benefit associated with the intervention being 40.1% (95% CI 20.7%, 59.5%), implying that the HEWs led home-based multicomponent intervention was responsible for more than a third of the linkage to hypertension care.

A higher proportion of hypertension patients being linked to care has significant clinical importance, with increased access to primary care because it allows a large number of undiagnosed hypertensive patients to receive comprehensive care, ranging from treatment initiation to rehabilitation and palliative care [41] and thus reducing the burden of uncontrolled hypertension and its consequences [42]. Hence, referring people with hypertension to clinical care is a precondition for controlling blood pressure [43]. Improving access to primary care following home-based hypertension screening has also public health contributions as it can improve patient compliance, reduce health-care costs, hospitalization, and slow down CVDs mortality [44, 45]. This high rate of linkage to hypertension care led by the HEWs also bridges the gap between community-based hypertension screening and medical management, which has policy implications.

Table 1 Baseline characteristics of participants stratified by intervention and control group, northwest Ethiopia, March 2021–January 2022

Characteristics	Overall ($n=456$)	Intervention group ($n=228$)	Control group ($n=228$)	*P*-value
Sex				0.26
Male	198 (43.4)	93 (40.8)	105 (46.1)	
Female	258 (56.6)	135 (59.2)	123 (53.9)	
Age, mean (SD) in years	54.3 (13.0)	54.2 (15.2)	54.5 (14.8)	0.85
Age group, in years				0.89
25–34	41 (9.0)	23 (10.1)	18 (7.9)	
35–44	78 (17.1)	37 (16.2)	41 (18.0)	
45–54	102 (22.4)	49 (21.5)	53 (23.3)	
55–64	100 (21.9)	52 (22.8)	48 (21.0)	
≥65	135 (29.6)	67 (29.4)	68 (29.8)	
Marital status				0.56
Single	9 (2.0)	6 (2.6)	3 (1.3)	
Married	359 (78.7)	176 (77.2)	183 (80.3)	
Divorced	27 (5.9)	16 (7.0)	11 (4.8)	
Widowed	61 (13.4)	30 (13.2)	31 (13.6)	
Educational status				0.48
Could not read or write	349 (76.5)	169 (74.1)	180 (78.9)	
Able to read and write	73 (16.0)	40 (17.5)	33 (14.5)	
Primary school and above	34 (7.5)	19 (8.3)	15 (6.6)	
Household wealth index				0.11
Poor	152 (33.3)	78 (34.2)	74 (32.5)	
Medium	152 (33.3)	66 (29.0)	86 (37.7)	
Rich	152 (33.4)	84 (36. 8)	68 (29. 8)	
Family size				0.09
<5 members	192 (42.1)	87 (38.2)	105 (46.1)	
≥5 members	264 (57.9)	141 (61.8)	123 (53.9)	
Body mass index, mean (SD)		20.1 (2.5)	20.1 (2.8)	0.80
Types of transport				0.77
On foot	404 (88.6)	203 (89.0)	201 (88.2)	
Public transport	52 (11.4)	25 (11.0)	27 (11.8)	
Community health insurance				0.06
Adequately insured	120 (26.3)	69 (30.3)	51 (22.3)	
Partially insured	57 (12.5)	32 (14.0)	25 (11.0)	
Not insured	279 (61.2)	127 (55.7)	152 (66.7)	
Hypertension				0.32
Stage 1	76 (16.7)	42 (18.4)	34 (14.9)	
Stage 2	380 (83.3)	186 (81.6)	194 (85.1)	
Family history of hypertension	90 (19.7)	47 (20.6)	43 (18.9)	0.64
Chronic respiratory diseases	9 (2.0)	6 (2.6)	3 (1.3)	0.31
Linked to hypertension care	53 (11.6)	25 (11.0)	28 (12.3)	0.66
On antihypertensive medication	16 (3.5)	9 (3.9)	7 (3.1)	0.61

The finding was in line with other studies conducted in various settings. A cluster randomized trial conducted in Kenya, in which CHWs equipped with a tailored behavioral communication strategy and mHealth tool improved linkage to hypertension care to 49% [46]. A study on uptake of referral for clinical assessment and retention in care within 6 weeks of referral following a large population screening for hypertension and diabetes program in Malawi found that 60.9% of patients visited health providers for clinical assessment [47]. The finding

Table 2 Effects of the multicomponent intervention on linkage to hypertension care and treatment among hypertensive patients in northwest Ethiopia, March 2021–January 2022

Follow-up time	Intervention group		Control group		ABI (95% CI)	*P*-value
	Number of patients	Number (%)	Number of patients	Number (%)		
Proportion of linkage to hypertension healthcare						
Baseline	228	25 (11.0%)	228	28 (12.3%)	−1.3 (−9.4, 6.7)	0.750
Month 3	223	104 (46.6%)	221	50 (22.6%)	24.9 (17.1, 32.7)	< 0.001
Month 6	213	124 (58.2%)	215	75 (34.9%)	24.5 (16.6, 32.4)	< 0.001
Month 9	216	143 (66.2%)	209	83 (39.7%)	27.5 (19.6, 35.4)	< 0.001
Proportion of patients started antihypertensive medication						
Baseline	228	9 (3.9%)	228	7 (3.1%)	0.8 (−4.0, 5.8)	0.725
Month 3	223	22 (9.9%)	221	14 (6.3%)	2.6 (−0.9, 6.2)	0.149
Month 6	213	24 (11.3%)	215	17 (7.9%)	2.0 (−1.6, 5.6)	0.278
Month 9	216	25 (11.6%)	209	19 (9.1%)	1.5 (−2.1, 5.2)	0.411

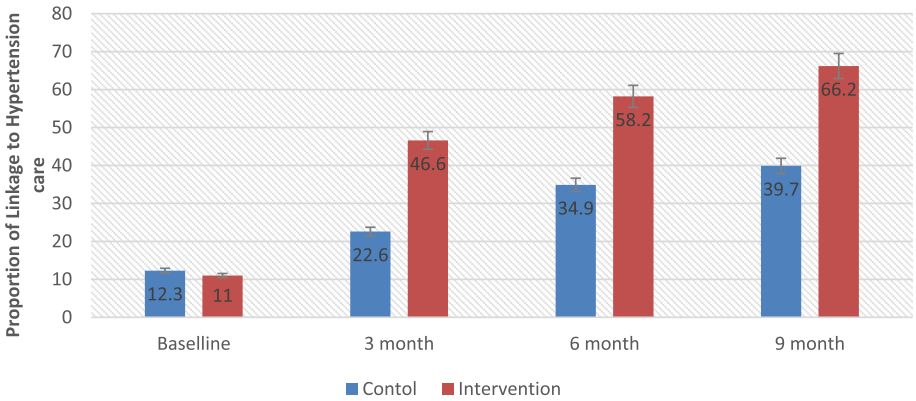

Fig. 2 Proportion of clinical linkage to hypertension care among hypertensive patients in northwest Ethiopia, March 2021–January 2022

Table 3 Effect of HEWs led home-based multicomponent intervention on linkage to hypertension care and treatment initiation in northwest Ethiopia, March 2021–January 2022

Outcome measures	RBI (95% CI)	*P* value	RBI (95% CI)	*P* value
Linkage to hypertension care	1.67 (1.41, 1.97)	< 0.001	1.66 (1.41, 1.96)*	< 0.001
Initiation of antihypertensive medication	1.31 (0.78, 2.17)	0.305	1.24 (0.76, 2.03)**	0.387

*Adjusted for sex, age, family history of hypertension, chronic obstructive pulmonary disease, and health insurance coverage

**Adjusted for sex, age, and family history of hypertension

was also consistent with a community-based longitudinal study conducted in urban slum clusters in central India, in which CHWs performed home-based CVDs screening, home visits every 2 months to reinforce linkages to public health facilities, and adherence to drug treatment achieved 55.3% linkage to primary care facilities [48].

Our findings were higher than a study conducted in Kenya, which found a poor linkage to care after community-based screening (31%) [49]. In South Africa, a community-based early detection, care, and control of hypertension led by community caregivers trained in hypertension and diabetes screening resulted in a 28.5% clinical linkage for hypertension care and treatment [50]. The discrepancy could be explained by the difference in the intervention strategy, where in this trial the composition of the intervention provided by HEWs, i.e., health education and behavioral counseling, was based on the Health Belief Model, and participants were referred to a nearby health facility using a referral slip. The community caregivers in the other study, on the other hand, only

provided patients with NCD-related health education, promotion, and hypertension screening.

In contrast, linkage to hypertension care in our study was lower than that of a prospective study conducted in rural Uganda, in which a community health campaign offering hypertension screening, education, referral appointments, and travel vouchers achieved 83% linkage to care within 6 months of the intervention [51]. However, the study in rural Uganda included travel vouchers that could be reimbursed for a nominal amount upon successful linkage at the local health center or regional hospital, but not in this trial. It is known that transportation cost is one of the barriers to healthcare services/clinical linkage.

The trial determines which subpopulations are most likely to benefit from the intervention. Intervention group participants aged 25–34 and 35–44 years were 3.4 and 2 times more likely to be linked to the primary care for hypertension management, respectively, than the same age group in the control group. Because hypertension has no immediate health consequences, young people may be hesitant to seek hypertension care, showing a difference in hypertension care linkage between intervention and control group participants [52]. Studies conducted in rural Uganda [51] and rural South Africa [53], for example, revealed the younger age group had lower linkage to care and then treatment rates after home-based identification of hypertension than the older age group. This implies that age should be taken into account when identifying participants for this specific intervention. Furthermore, patients with stage 1 hypertension and those with no family history of hypertension also benefit from the intervention.

Despite improved access to primary care for hypertension management, only 10.3% of those seeking medical attention were taking antihypertensive medication at the end of the 9-month period, with no significant differences in the trial's antihypertensive treatment initiation between the intervention and control groups. This indicates a significant gap between hypertension linkage and treatment initiation at the primary care level. This disparity could be caused by lack of trained healthcare providers, a poor primary health care system, and a lack of antihypertensive medications. A systematic literature review, for example, provides evidence of low rates of hypertension treatment after linkage to hypertension, which are most likely due to a shortage of skilled health care providers, a poor primary health care system, and antihypertensive medications' unavailability [54].

Our findings suggest that properly trained and supervised HEWs improve linkage to hypertension care, implying that HEWs have the potential to provide home-based multicomponent interventions. If the HEW led home-based multicomponent intervention in hypertension management is scaled up, it has the potential to reduce the workload of well-trained healthcare providers while rapidly linking patients to nearby health facilities and increasing the number of patients receiving therapy. This is the first trial to look at the effects of a home-based multicomponent intervention led by HEWs on linkage to hypertension care and treatment in rural settings of Ethiopia where there is a shortage of trained healthcare providers. The kebeles were geographically separated to reduce intervention contamination between groups. The inclusion of qualitative research in the randomized controlled trial design will allow us to explore the barriers and enablers of linkage to hypertension care, antihypertensive treatment initiation, and retention in primary healthcare. The use of a random sampling method to obtain a representative sample from the population under study may increase the generalizability of the study. However, because it was a cluster randomization trial, the interventionist who delivered the intervention was not blinded.

Conclusions

Health Extension workers led home-based multicomponent interventions that included home health education, behavioral counseling, and referral to a nearby health facility, resulting in effective linkage to hypertension care. It does not, however, result in a significant improvement in hypertension medication initiation, emphasizing the importance of identifying and addressing barriers to hypertension care and treatment in primary care settings. We recommend conducting large-scale research addressing barriers to hypertension care and treatment in primary care settings of the referral system.

Abbreviations

ABI	Absolute benefit increase
HEWs	Health extension workers
CHWs	Community health workers
RBI	Relative benefit increase

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s13063-025-08862-2.

Additional file 1: Figure S1. Patient Referral slip to the nearest health facility for clinical linkage (Amharic).

Additional file 2: Table S1. Effect of HEWs led home-based multicomponent intervention on linkage to hypertension care, northwest Ethiopia, March 2021-January 2022: Subgroup analysis.

Additional file 3: Table S2. Effect of the intervention on linkage to hypertension care and treatment: Complete Case Analysis.

Acknowledgements

The trial was carried out with the support of the University of Gondar, Ethiopia. We would like to thank the health extension workers who implemented the

interventions. We extend our thanks to the Amhara Public Health Institute (APHI), as well as the Zonal and District health administrations, for their cooperation in allowing us to conduct the study. We would like to express our heartfelt appreciation to the study participants for their willingness to take part in this trial and the data collectors for their service.

Authors' contributions

DFT is the principal investigator of the study. DFT was involved in the conception, design of research questions, study conduct, data analysis, and manuscript writing. SAB, TAA, AA, GM, and KAG participated in selecting appropriate research design and critical review of the manuscript. All authors read and approved the manuscript.

Funding

This work was supported by the University of Gondar. The funders had no involvement in the study design, participant selection, data collection, or data analysis. The corresponding author had full access to the data in the study and final responsibility for the decision to submit for publication.

Data availability

This manuscript includes all of the data generated or analyzed during the course of the trial. However, the deidentified datasets used in the reported study are available upon reasonable request from the corresponding author.

Declarations

Ethics approval and consent to participate

The Institutional Review Board (IRB) of the University of Gondar approved this trial (Ref. No: V/P/RCS/05/2293/2020). Written informed consent for participation in the form of a signature or thumb print was obtained from each study participant prior to enrollment. Consent for randomization to either of the intervention or control groups was obtained from the district health officer before randomization. Potential participants have been given detailed information about the study's objectives, procedures, importance, risks, and benefits. Confidentiality of data was assured by using identification numbers and limiting access to the data. Participant participation in the study were on a voluntary basis. The chance to ask any question about the study, as well as the right to refuse or terminate the interview, was provided.

Consent for publication

Not applicable.

Competing interests

Authors declare no competing interests.

Author details

[1]Department of Epidemiology and Biostatistics, Institute of Public Health, College of Medicine and Health Sciences, University of Gondar, Gondar, Ethiopia. [2]Department of Internal Medicine, School of Medicine, College of Medicine and Health Sciences, University of Gondar, Gondar, Ethiopia. [3]Department of Health Systems and Policy, Institute of Public Health, College of Medicine and Health Sciences, University of Gondar, Gondar, Ethiopia. [4]International Institute for Primary Health Care-Ethiopia, Addis Ababa, Ethiopia.

Received: 27 September 2022 Accepted: 5 May 2025
Published online: 19 May 2025

References

1. World Health Organization. Noncommunicable diseases; 2021.
2. Addressing the impact of noncommunicable diseases and injuries in Ethiopia: a Collaboration with the Global Lancet Commission on Reframing NCDIs for the Poorest Billion. Addis Ababa; 2018.
3. Egan BM, Kjeldsen SE, Grassi G, Esler M, Mancia G. The global burden of hypertension exceeds 1.4 billion people: should a systolic blood pressure target below 130 become the universal standard. J hypertens. 2019;37(6):1148–53.
4. Tiruneh SA, Bukayaw YA, Yigizaw ST, Angaw DA. Prevalence of hypertension and its determinants in Ethiopia: A systematic review and meta-analysis. PLoS ONE. 2020;15(12): e0244642.
5. Ethiopia sets to improve hypertension prevention and control at primary health care level Ethiopia: World Health Organization; 2019. Available from: https://www.afro.who.int/fr/node/11607#:~:text=Hypertension%20is%20one%20of%20the,getting%20appropriate%20treatment%20and%20care. Accessed 31 July 2019.
6. Tefera YG, Abegaz TM, Abebe TB, Mekuria AB. The changing trend of cardiovascular disease and its clinical characteristics in Ethiopia: hospital-based observational study. Vascular health and risk management. 2017;13:143.
7. Temesgen TG, Teshome B, Njogu P. Treatment Outcomes and Associated Factors among Hospitalized Stroke Patients at Shashemene Referral Hospital, Ethiopia. Stroke Res Treat. 2018;(1).
8. Erkabu SG, Agedie Y, Mihretu DD, Semere A, Alemu YM. Ischemic and Hemorrhagic Stroke in Bahir Dar, Ethiopia: A Retrospective Hospital-Based Study. Journal of Stroke Cerebrovascular Diseases. 2018;27(6):1533–8.
9. Health and Health Related Indicators. Addis Ababa, Ethiopia.: Federal Ministry of Health; 2010.
10. Tesfaye B, Haile D, Lake B, Belachew T, Tesfaye T, Abera H. Uncontrolled hypertension and associated factors among adult hypertensive patients on follow-up at Jimma University Teaching and Specialized Hospital: cross-sectional study. Research Reports in Clinical Cardiology. 2017;8:21–9.
11. Asfaw LS, Ayanto SY, Gurmamo FL. Hypertension and its associated factors in Hosanna town, Southern Ethiopia: community based cross-sectional study. BMC Res Notes. 2018;11(1):306.
12. Abebe SM, Berhane Y, Worku A, Getachew A. Prevalence and associated factors of hypertension: a crossectional community based study in Northwest Ethiopia. PLoS ONE. 2015;10(4): e0125210.
13. Volpe M, Gallo G, Tocci G. Is early and fast blood pressure control important in hypertension management? Int J Cardiol. 2018;254:328–32.
14. Rachlis B, Naanyu V, Wachira J, Genberg B, Koech B, Kamene R, et al. Identifying common barriers and facilitators to linkage and retention in chronic disease care in western Kenya. 2016;16(1):741.
15. Han X, McCombs J, Chu M, Dougherty JS, Fox DS. Impact of early initiation of antihypertensive medications for patients with hypertension or elevated blood pressure. J Hypertens. 2019;37(6):1276–84.
16. Organization WH. Global NCD target: prevent heart attacks and strokes through drug therapy and counselling. World Health Organization; 2016.
17. Ethiopian Public Health Institute. Ethiopia steps report on risk factors for non-communicable diseaes and prevalence of selected NCDs. Addis Ababa Ethiopia Public Health Institute; 2016.
18. Agyemang C, Bruijnzeels MA, Owusu-Dabo E. Factors associated with hypertension awareness, treatment, and control in Ghana, West Africa. J Hum Hypertens. 2006;20(1):67–71.
19. Ma Y, Lu H, Zhang Y, Wang Y, Li S, Yan F, et al. Effectiveness of home visiting on patients with hypertension: A systematic review and meta-analysis. Medicine. 2021;100(10):1–9. https://doi.org/10.1097/MD.0000000000024072.
20. Abdullah AS, Rawal LB, Choudhury SR, Baral S, Jiang L, Sha T, et al. Use of community health workers to manage and prevent noncommunicable diseases: policy options based on the findings of the coach study. 2018.
21. Gaziano TA, Abrahams-Gessel S, Denman CA, Montano CM, Khanam M, Puoane T, et al. An assessment of community health workers' ability to screen for cardiovascular disease risk with a simple, non-invasive risk assessment instrument in Bangladesh, Guatemala, Mexico, and South Africa: an observational study. Lancet Glob Health. 2015;3(9):e556–63.
22. Witmer A, Seifer SD, Finocchio L, Leslie J, O'Neil EH. Community health workers: integral members of the health care work force. Am J public health. 1995;85(8_Pt_1):1055–8.
23. Tsolekile LP, Puoane T, Schneider H, Levitt NS, Steyn K. The roles of community health workers in management of non-communicable diseases in an urban township. African Journal of Primary Health Care Family Medicine. 2014;6(1):1–8.
24. Abdel-All M, Putica B, Praveen D, Abimbola S, Joshi R. Effectiveness of community health worker training programmes for cardiovascular disease management in low-income and middle-income countries: a systematic review. BMJ Open. 2017;7(11): e015529.

25. Kotwani P, Balzer L, Kwarisiima D, Clark TD, Kabami J, Byonanebye D, et al. Evaluating linkage to care for hypertension after community-based screening in rural Uganda. Tropical Medicine International Health. 2014;19(4):459–68.
26. Gaziano T, Abrahams-Gessel S, Surka S, Sy S, Pandya A, Denman CA, et al. Cardiovascular disease screening by community health workers can be cost-effective in low-resource countries. 2015;34(9):1538–45.
27. Assefa Y, Gelaw YA, Hill PS, Taye BW, Van Damme W. Community health extension program of Ethiopia, 2003–2018: successes and challenges toward universal coverage for primary healthcare services. Globalization health & place. 2019;15(1):24.
28. Zulliger R. Ethiopian Community Health Worker Programs. Available from: https://www.chwcentral.org/blog/ethiopian-community-health-worker-programs. 28 Feb 2018
29. Health Mo. Realizing Universal Health Coverage Through Primary Health Care. Addis Ababa, Ethiopia; 2020.
30. Damtew Z, Chekagn C, Moges A. The Health Extension Program of Ethiopia: Strengthening the Community Platform. Harvard Health Policy Rev. 2016. 2017.
31. Teshome DF, Alemu S, Ayele TA, Atnafu A, Gelaye KA. Effect of health extension workers led home-based intervention on hypertension management in Northwest Ethiopia, 2021: study protocol for a cluster randomised controlled trial. BMJ Open. 2022;12(3): e051178.
32. Worku K. Ethiopian primary health care clinical guidelines. Addis Ababa: Federal Democratic Republic of Ethiopia. Ministry of Health; 2017.
33. Whitlock EP, Orleans CT, Pender N, Allan J. Evaluating primary care behavioral counseling interventions: an evidence-based approach. Am J Prev Med. 2002;22(4):267–84.
34. Lambert JD, Greaves CJ, Farrand P, Cross R, Haase AM, Taylor AH. Assessment of fidelity in individual level behaviour change interventions promoting physical activity among adults: a systematic review. BMC Public Health. 2017;17(1):1–13.
35. Krieger J, Collier C, Song L, Martin D. Linking community-based blood pressure measurement to clinical care: a randomized controlled trial of outreach and tracking by community health workers. Am J Public Health. 1999;89(6):856–61.
36. World Health Organization. The WHO STEPwise approach to chronic disease risk factor surveillance (STEPS). Geneva, Switzerland: World Health Organization; 2017.
37. Ethiopia Demographic and Health Survey 2016. Addis Ababa, Ethiopia: Central Statistical Agency; 2017
38. EPHI I. Ethiopian Public Health Institute (EPHI)[Ethiopia] and ICF. Ethiopia Mini Demographic and Health Survey 2019: Key Indicators. 2019.
39. Whelton P. New ACC/AHA high blood pressure guidelines lowe definition of hypertension. American College of Cardiology. 2017.
40. World Health Organization report. Surveillance of chronic disease risk factors: country level data and comparable estimates. World Health Organization; 2005. Report No.: 9241593024.
41. Primary health care. World Health Organization; 2021.
42. Adomako NO, Marfo AFA, Opare-Addo MNA, Nyamekye N, Owusu-Daaku FT. Blood Pressure Control, Accessibility, and Adherence to Antihypertensive Medications: Patients Seeking Care in Two Hospitals in the Ashanti Region of Ghana. Int J hypertens. 2021;2021. https://doi.org/10.1155/2021/9637760.
43. van de Vijver S, Oti S, Addo J, de Graft-Aikins A, Agyemang C. Review of community-based interventions for prevention of cardiovascular diseases in low-and middle-income countries. Ethn Health. 2012;17(6):651–76.
44. Choi D, Choi S, Kim H, Kim K, Kim N, Ko A, et al. Impact of continuity of care on cardiovascular disease risk among newly-diagnosed hypertension patients. Sci Rep. 2020;10(1):1–9.
45. Rajmohan D, Golubykh K, Avdeeva A, Mahmood A, Aleem MS, Hashmi S, et al., editors. Impact of Primary Care Access and Continuity of Care in Reduction of Hospital/Emergency Department Admissions in Patients With Hypertension: A Systematic Review. CIRCULATION; 2020: LIPPINCOTT WILLIAMS & WILKINS TWO COMMERCE SQ, MARKET ST, PHILADELPHIA. 2001
46. Vedanthan R, Kamano JH, DeLong AK, Naanyu V, Binanay CA, Bloomfield GS, et al. Community health workers improve linkage to hypertension care in Western Kenya. J Am Coll Cardiol. 2019;74(15):1897–906.
47. Musicha C, Crampin A, Kayuni N, Koole O, Amberbir A, Malamula G, et al. Accessing clinical services and retention in care following screening for hypertension and diabetes among Malawian adults: an urban/rural comparison. J Hypertens. 2016;34(11):2172.
48. Pakhare A, Joshi A, Anwar R, Dubey K, Kumar S, Atal S, et al. Linkage to primary-care public health facilities for cardiovascular disease prevention: a community-based cohort study from urban slums in India. BMJ Open. 2021;11(8): e045997.
49. Pastakia SD, Ali SM, Kamano JH, Akwanalo CO, Ndege SK, Buckwalter VL, et al. Screening for diabetes and hypertension in a rural low income setting in western Kenya utilizing home-based and community-based strategies. 2013;9(1):21.
50. James S, Sewpaul R, Reddy P, Madela S, Madela S. Early detection, care and control of hypertension and diabetes in South Africa: A community-based approach. African Journal of Primary Health Care and Family Medicine. 2020;12(1):1–9.
51. Kotwani P, Balzer L, Kwarisiima D, Clark TD, Kabami J, Byonanebye D, et al. Evaluating linkage to care for hypertension after community-based screening in rural U ganda. 2014;19(4):459–68.
52. Okuyama K, Akai K, Kijima T, Abe T, Isomura M, Nabika T. Effect of geographic accessibility to primary care on treatment status of hypertension. PLoS ONE. 2019;14(3): e0213098.
53. Siedner MJ, Baisley K, Orne-Gliemann J, Pillay D, Koole O, Wong EB, et al. Linkage to primary care after home-based blood pressure screening in rural KwaZulu-Natal. South Africa: a population-based cohort study. 2018;8(12): e023369.
54. Maimaris W, Paty J, Perel P, Legido-Quigley H, Balabanova D,Nieuwlaat R, et al. The influence of health systems on hypertension awareness, treatment, and control: a systematic literature review. 2013;10(7): e1001490.

Publisher's Note