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Approaches and outcomes of community health worker's interventions for hypertension management and control in low-income and middle-income countries: systematic review

Grace Wambura Mbuthia ,[1] Karani Magutah,[2] Jennifer Pellowski[3]

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[1]College of Health Sciences, Jomo Kenyatta University of Agriculture and Technology, Nairobi, Kenya
[2]College of Health Sciences, School of Medicine, Moi University, Eldoret, Kenya
[3]International Health Institute, School of Public Health, Brown University, Providence, Rhode Island, USA

Correspondence to
Dr Grace Wambura Mbuthia; grace.mbuthia@jkuat.ac.ke

ABSTRACT

Objectives To critically appraise the scope, content and outcomes of community health worker (CHW) interventions designed to reduce blood pressure (BP) in low-income and middle-income countries (LMICs).

Method We performed a database search (PUBMED, EMBASE, CINAHL, PsycINFO, OpenGrey, Cochrane Central Trials Register and Cochrane Database of Systematic Reviews) to identify studies in LMICs from 2000 to 2020. Eligible studies were interventional studies published in English and reporting CHW interventions for management of BP in LMICs. Two independent reviewers screened the titles, abstracts and full texts of publications for eligibility and inclusion. Relevant information was extracted from these studies using a tailored template. Risk of bias was assessed using the Cochrane collaboration risk of bias tool. Qualitative synthesis of results was done through general summary of the characteristics and findings of each study. We also analysed the patterns of interventions and their outcomes across the studies. Results were presented in form of narrative and tables.

Results Of the 1557 articles identified, 14 met the predefined criteria. Of these, 12 were cluster randomised trials whereas two were pretest/post-test studies. The CHW interventions were mainly community-based and focused on behaviour change for promoting BP control among hypertensive patients as well as healthy individuals. The interventions had positive effects in the BP reduction, linkage to care, treatment adherence and in reducing cardivascular-disease risk level.

Discussion and conclusion The current review is limited in that, a meta-analysis to show the overall effect of CHW interventions in the management of hypertension was not possible due to the diversity of the interventions, and outcomes of the studies included in the review. Summarised outcomes of individual studies showed CHW enhanced the control and management of hypertension. Further studies are needed to indicate the impact and cost-effectiveness of CHW-led interventions in the control and management of hypertension in LMICs.

Strengths and limitations of this study

- This is the first systematic review with focus on approaches and outcomes of community health worker (CHW) interventions in the management and prevention of hypertension in low-income and middle-income countries.
- We conducted a comprehensive search of databases to ensure that all the relevant publications were identified.
- Potential bias in the conduction of this review was minimised by having the authors independently screen the search results and extract the data autonomously.
- Due to diversity of the study participants, interventions and outcomes of the studies included in the review, a quantitative synthesis (meta-analysis) to show the overall effect of CHW interventions was not possible and therefore this review has reported summarised outcomes for individual studies.

INTRODUCTION

Globally, hypertension is a leading modifiable risk factor for cardiovascular disease (CVD) and premature death,[1 2] with an estimated 1.13 billion people worldwide living with it. Two-thirds of this burdened population live in low-income and middle-income countries (LMICs).[3] The WHO targets to have a worldwide 25% reduction in the prevalence of hypertension by the year 2025.[4] Due to an ageing population and increase in lifestyle risk factors such as lack of physical activity, unhealthy diet, smoking and alcohol consumption, the global prevalence of hypertension is increasing.[2] However, there are disparities in these changes of prevalence of hypertension worldwide. While high-income countries experienced a modest decrease (2.6%) in hypertension prevalence in the last two decades, the LMICs experienced significant increase of 7.7%.[5] The proportion of controlled hypertension is also low, especially in LMICs with only 7.7% of patients with hypertension having controlled blood

pressure (BP) (<140/90 mm Hg) in LMICs.[5] Concerted efforts are urgently needed to combat the emerging hypertension burden in LMICs.

Health workers are critical to addressing this emerging burden. In light of critical shortages in the health workforce in LMICs, community health workers (CHWs) are increasingly recognised as an essential part of the health workforce needed to achieve public health goals.[6–10] However, the concept of CHWs has no universal definition and has evolved to suit specific contexts, norms and cultures.[11] In their systematic review 'Who is a Community Health Worker?'[11] Olaniran *et al* concluded that a single definition may not project the diversity of this group of health workers and emphasised that these are 'individuals with an in-depth understanding of the community culture and language, have received standardised job-related training which is of shorter duration than health professionals, and have a primary goal of providing culturally appropriate health services to the community'.[11] In this review a CHW will refer to 'lay health worker carrying out functions related to healthcare delivery; trained in some way in the context of the intervention and having no formal professional or paraprofessional certificate or degree in tertiary education'.[12] Use of CHWs has been identified as an important strategy in the delivery of culturally relevant programmes for hypertension control in different settings. The CHWs approach is not only affordable and sustainable but also enhances cultural relevance of health information, providing an important linkage between community and healthcare system.[13]

Previously, systematic reviews have assessed the effectiveness of CHW community-based programmes in the management and prevention of non-communicable diseases (NCDs)[7 14–16] but few have focused on the care of people with hypertension specifically.[17 18] Evidence from systematic reviews of community-based randomised controlled trials (RCTs) and cluster randomised trials from LMICs show that CHWs are effective in altering the risk factors for NCDs and demonstrated their effectiveness in modification of physical parameters such as BP and cholesterol levels.[7] Although CHW delivered community-based BP screening and education initiatives are recommended for management and prevention of hypertension in LMIC,[19] there are few systematic reviews focused in this area. Reviews have demonstrated the effectiveness of training programmes for CHW[20] and task-sharing with non-physician health workers[21] in the management of hypertension in LMICs. Similarly, in their systematic review examining implementation strategies for the control of BP,[22] Mills *et al* found that multilevel and multicomponent strategies such as team-based care involving non-physician healthcare workers[23] were the most effective in the management of hypertension. The purpose of this systematic review was to critically appraise the scope, content and outcomes of CHW interventions designed to reduce BP in LMICs.

Review question/objective

The objective of this systematic review was to identify studies reporting on CHW interventions for hypertension management and control and determine the approaches and outcomes of such interventions in LMICs. Specifically, we asked: (1) what are the types of CHW interventions in the management and control of BP in LMICs and (2) what are the outcomes of CHW interventions on the management and control of BP in LMICs?

METHODS

We carried out a systematic review of literature and a descriptive review of studies reporting CHW interventions for hypertension management and control. The review followed the recommended methodological framework of conducting a systematic review of healthcare interventions[24] and the reporting adhered to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses 2020 guidelines for reporting such reviews.[25]

Eligibility criteria

We identified peer-reviewed literature—RCTs, quasi-experimental and pretest/posttest studies published between January 2000 and September 2020. We included studies that were available in English language and focused on the management and control of high BP among adult population in LMICs.

Inclusion criteria

Studies were included in the analysis if they met the following;

Population: Studies focusing on management or control of BP among the general population or among pre-hypertensive or hypertensive patients.

Intervention: CHW interventions focused on management and control of hypertension. In the current study, CHW referred to a lay health worker who is not formally and professionally trained, either paid or working on voluntary basis, and carrying out functions associated with healthcare delivery in the management and control of hypertension.

Comparison: Studies had a comparison control arm of either no intervention, usual care or another intervention. However, pretest/post-test studies with a well-defined intervention were also included.

Outcomes: Reduction in BP, proportion of patients with controlled BP, engagement in hypertension care, adherence to hypertensive drugs and reduction in cardiovascular risk.

Study designs: RCTs, quasi experimental and pretest/post-test studies were included.

Setting: Only studies conducted in LMICs (as defined by the World bank) were included.

Exclusion criteria

Studies whose intervention was not adequately described or whose outcomes were not clearly described were excluded from this analysis.

Information sources

We searched for relevant studies in electronic databases: PUBMED, EMBASE, CINAHL, PsycINFO, OpenGrey, Cochrane Central Trials Register and Cochrane Database of Systematic Reviews. This comprehensive search was needful to identify interventional studies meeting the eligibility criteria in LMICs.

Search strategy

The relevant studies were identified using different search strategies. The basic search string used towards this review was "Community Health Workers"[Mesh] OR "community health volunteers" OR "lay health workers") AND "Hypertension"[Mesh]) OR "Cardiovascular Diseases"[Mesh]) OR "Blood Pressure"[Mesh]) AND "Developing Countries"[Mesh] OR "low and middle income countries") AND ("Randomized Controlled Trials as Topic"[Mesh] OR "Non-Randomized Controlled Trials as Topic"[Mesh]). Other alternative terms were added during the search. The full search strategies for each of the databases included are provided in online supplemental appendix 1.

Study selection

We employed Covidence, an online software (Covidence, Roende, Denmark) to extract and screen for articles to be included in the study. The inclusion criteria described above informed the study selection. Two reviewers (GM and KM) assessed all retrieved lists of citations and abstracts independently. The full texts of all potentially eligible studies were retrieved and critically examined to ensure they met all the inclusion criteria. Discrepancies between reviewers about the eligibility of retrieved studies were resolved by discussion. The reference lists of the selected publications were also searched for identification of additional studies.

Data extraction and risk of bias assessment

Data extraction was done using a tailored data extraction template that was created using guidelines outlined in the Cochrane Handbook for Systematic Reviews of Interventions.[26] Relevant data including the author, year of publication, type of publication and journal published in, study location, study design, sample size and baseline characteristics, intervention features, outcome measurements and key findings were extracted into an Excel sheet template.

The quality of the studies that met all the inclusion criteria was assessed using the Cochrane collaboration risk of bias tool.[27] Specifically, the risk of bias in generation of the randomisation sequence, allocation concealment and blinding (participants, personnel and outcome assessors), incomplete outcome data and selective reporting were assessed as high, low or unclear. Two authors (GM and KM) assessed the risk of bias and disagreements were resolved by consensus.

Synthesis of the results

Qualitative synthesis of all the studies that met the inclusion criteria described above was done by summarising the characteristics and findings of the individual studies. The study characteristics and findings were summarised in form of a table. We used text to describe different strategies used in the recruitment, training of CHW and in the implementation of interventions for control of hypertension. We characterised the CHW intervention by examining the recruitment process for CHW—whether drawn from government employees or not and the duration of training offered in readiness for the implementation of the interventions. We also categorised the CHW interventions depending on the content and place where interventions were offered. The content of the CHW interventions was focused on either behavioural communication for lifestyle change or the role of CHW as a mediator between patient and healthcare system. The interventions were either home/community based or clinic based. We also categorised studies based on whether they had reported significant reduction in BP or improvement in the number of participants with controlled BP. The patterns for different CHW interventions and outcomes across different studies was described in the narrative.

Patient and public involvement

We did not involve patients or members of the public in the design, or conduct, or reporting, or dissemination plans of this research.

RESULTS

The search strategy identified 1557 records through database searching (n=1525) and reference lists (n=32). After excluding duplicates, a total of 1383 records were reviewed(figure 1). Out of these, 1346 were excluded because information provided in the title and abstract did not meet the inclusion criteria leaving 36 potentially

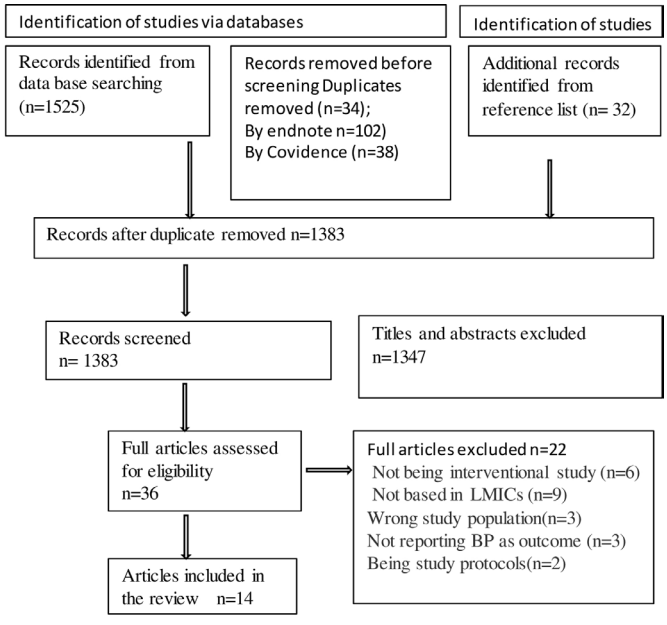

Figure 1 PRISMA flow chart. BP, blood pressure; LMICs, low-income and middle-income countries; PRISMA, Preferred Reporting Items for Systematic Reviews and Meta-Analyses.

eligible studies for full text review. Of these, 22 did not meet all the inclusion criteria and were excluded for reasons(some more than one), that included not being interventional studies,[28–33] not based in LMICs,[34–43] being protocols of studies,[44 45] wrong study population[46–48] and not reporting on BP as an outcome.[28 35 49] Thus, a final 14 studies were used for final data extraction, twelve being cluster randomised trials[22 50–60] and the other two being interventional pretest and posttest studies.[61 62] The summary characteristics of the included papers is included in table 1. The study populations were hypertensive patients in six studies,[22 53 55–57 60] had at least one CVD risk factor in two studies[52 59] and in six studies the participants involved the general population.[50 51 54 58 61 62] All the studies involved adult populations except one study that involved children and young people aged 3–39 years.[54] The duration of the interventions ranged from 3 months to 2 years. Geographically, nine studies were from South Asia,[52–54 56–61] three from sub-Saharan Africa[50 51 55] and one from East Asia[62] and one from South America.[22]

Risk of bias for the included studies

The risk of bias of the included studies is shown in figure 2. The risk of selection bias as result of sequence generation and allocation concealment was low in 12 (86%) of the studies and high in 2 (14%). The risk of performance bias and reporting bias due to lack of blinding of participants, personnel and outcome assessors was low in eight (57%) and high in one, but unclear in five (36%) of the studies. The risk of attrition bias (lost to follow-up) was low in 11 (79%), high in one and unclear in two studies while risk of bias due to selective outcome reporting was low in 11 (79%) of the studies and unclear in 3 (21%).

Recruitment and training of CHW

Given the nature of CHW intervention for management of hypertension, the CHW acted as both provider and recipients of the intervention. We, therefore, examined the recruitment and training requirements for CHW applied in different studies. While all the studies met the inclusion criteria of CHW defined as a lay health worker with basic training to supply community members access to health and social services, the recruitment and training of the same was different across the studies. In all of the studies CHW were persons with at least 8–10 years of education drawn from the local community but in some of the studies[58 61] the CHW were specifically female. Most of the studies[55–57 59] used government CHW already working in the healthcare system while other studies[51–54 58 60] recruited CHW specifically for the study following same criterion used in recruiting the Government CHWs. There was no standard training for the CHW across the different studies in this review. The CHW underwent various forms of training to be able to carry out their roles in the studies. The training period ranged from 2 days to 6 weeks with ongoing support from the healthcare workers. In some of the studies the trainings were shorter ranging from 2 to 5 days[22 56 58 59] while others ranged from 4 to 6 weeks.[52–54 60 61] In some of the studies the training period was staggered throughout the study period.[52 57 61] In one of the studies the length of the training period for CHW was not specified.[55]

Similarly, the content of the training was different across the studies. The content of training included, home health education on CVD risks and behaviour change communication strategies,[55 57 58 60] basics of hypertension and assessments of CVD risk factors to include measurements technique for BP monitoring and anthropometric measurements,[22 52 53 56 58 59 61] as well as referral procedure for hypertensive patients[58] and survey methods.[53] The recruitment and the CHW training details was not reported in 2 of the studies.[50 51]

Content and approaches of the CHWs interventions

The CHWs intervention were designed to promote BP control mainly for hypertensive patients and those with CVD risks but also targeted prevention of high BP in healthy individuals. The interventions were either home based or community based with an exception of one study,[51] which incorporated the use of CHWs in the primary health clinic to assist nurses in the management of hypertension.

The content of the activities implemented by the CHWs during the interventions was similar across many of the studies. In addition to the screening or monitoring of hypertension through BP measurements and audits which was the main outcome measure in this review, the CHW were also involved in other activities geared to the management and control of hypertension. First, the major activity in the CHW interventions as outlined in table 1 was health promotion through home-based health education and lifestyle counselling[22 52–55 57 58 60] and community level behaviour change communication.[50 56 61 62] Health education included teaching about hypertension, motivation to engage in care and support for healthy lifestyle change such as reduction in salt intake. Second, in one of the studies[59] CHW were involved in CVD risk assessment using a mobile tablet-based CVD risk assessment tool. Third, in addition to the health education and BP monitoring, one trial incorporated physical activity component of 60 min of heart exercise three times a week for a period of 3 months.[62] Fourth, the CHWs provided follow-up for hypertensive patients and supported patients by monitoring treatment adherence in one of the trials.[53] Finally, in some studies CHWs were used as mediators between patients and the healthcare system by providing referral and encouraging linkage to care for those requiring hypertensive treatment.[55 59 61]

Outcomes and main findings of the studies

The outcomes for the CHWs interventions were different for various studies as shown in table 1. The reported primary outcome in most of the studies[22 50 52–55 57 58] was changes in mean systolic BP (SBP) while other studies[51 56 59 61] reported proportion of participants with controlled BP (SBP <140 mm Hg and diastolic BP (DBP) <90 mm Hg)

Table 1 Summary of papers included

Author, year, journal and setting	Study design	Baseline sample characteristics	Intervention design	Outcome measurement	Key findings
Joshi *et al*, 2019 American Heart Journal (V.216) Rural India[53]	A cluster randomised trial	**Controls** 1611 (567 hypertensive), mean age 61.7±10.4 years, mean SBP 130.3±20.8, mean DBP 79.4±11.7, interheart risk score 10; **Intervention** 1650 (597 hypertensive), mean age 61.7±10.2 years, mean SBP 130.3±20.5, DBP 78.9±11.3, interheart risk score (10)	CHWs home visitation to encourage prescriptions' adherence and measure BP. CHWs provided short goal-directed printed slogans to promote integration of preventive therapies with activities of daily living.	Primary outcome- Mean SBP. Secondary outcome-inter-heart risk score, and adherence to prescription drugs intake	SBP drop was not impacted Inter-heart risk score dropped to 8.2 (intervention) vs 8.3 (control) CHWs promoted adherence to therapy
Jafar *et al*, 2009 Annals of Internal Medicine (v.151) Karachi, Pakistan[60]	A cluster randomised trial	1341 hypertensive (SBP ≥140 mm Hg or DBP ≥90 mm Hg or on antihypertensive and all aged ≥40 years)	Home health education (HHE) by CHWs: 3-monthly HHE, and annual training of GP in hypertension management.	Primary outcome—change in SBP from baseline to the last follow-up visit (2 years). Secondary outcome - % with <140 mm Hg SBP and <90 mm Hg DBP at last follow-up (2 years)	SBP decrease in HHE and GP group (10.8 mm Hg (95% CI 8.9 to 12.8 mm Hg) than in the GP-only, HHE-only, or no intervention groups (p<0.001).
Jafar *et al*, 2020 The New England Journal of Medicine Multicountry: Rural Bangladesh, Pakistan and Sri Lanka[57]	A cluster-randomise controlled trial	2645 hypertensive adults—1330 intervention group, 1315 control Mean age 58.8±11.5 years 64.3% were female (877 in intervention and 824 in control), 35.7% male (distribution not described), BP was uncontrolled in 69.6% and very poorly controlled in 29.6% of participants SBP (intervention group 146.7±22.4, control group 144.7±21.0 mm Hg); DBP (89.1±14.7intervention group and 87.8±13.8 in control)	Home-planned CHWs-led health education (intervention) together with 3-monthly BP monitoring for 24 Months,	Primary outcome— Reduction in SBP at 24 months. Secondary outcomes—Reduction in DBP at 24 weeks. and, % of participants with BP control (SBP <140 mm Hg and DBP <90 mm Hg)	Mean SBP reduction greater with intervention (by 5.2 mm Hg) compared with controls DBP reduction of 2.8 mm Hg greater in intervention than in control group. BP control (<140/90 mm Hg) achieved in 53.2% of intervention group compared with 43.7% in control group Summary: Linking government trained CHWs with existing public healthcare infrastructure enhanced BP reduction than in usual care.
Vedanthan *et al*, 2019 Journal of American College of Cardiology (vol 74) Turbo, Western Kenya[69]	A cluster randomised trial	1460 Participants (58% female, 42% male). **Contro**l (usual care) 491, **Intervention** paper-based (500), and smartphone (469). Pooled baseline SBP 159.4 mm Hg, DBP 89.7±12 mm Hg. Usual care (158.4±19.6 and 89.0±12.3), Paper based (158.3±20.3 and 90.4±12.1) and Smart Phone (161.3±18.5 and 89.7±11.5) for SBP and DBP, respectively.	Linkage to care intervention through tailored behavioural communication by CHWs using 'paper-based' and 'smartphone-based' approaches.	Primary outcomes - 1) linkage to care, and 2) change in SBP. Secondary outcome—DBP change.	Overall improvement (49%) linkage to care. Significantly greater linkage in the usual care and smartphone arms. Average overall follow-up SBP and DBP were 149.9 and 90.8 mm Hg, respectively. Modest improvement in SBP in smart phone than usual care groups (–13.1 mm Hg vs –9.7), **but** difference insignificant. BP control (<140/90) achieved in 26% of participants — Group differences insignificant.

Continued

Table 1 Continued

Author, year, journal and setting	Study design	Baseline sample characteristics	Intervention design	Outcome measurement	Key findings
Peiris *et al*, 2019 PLoS ONE West Godavari District, Andhra Pradesh, Rural India[59]	A stepped-wedge, cluster randomised controlled trial	**Intervention group** (n=4348, 55.6% Female). 60.3±10.7 years, 46.8% no formal schooling, 45.7% (1986) hypertensive, Angina 11.8%, stroke 9.2%; 10 year CVD risk SBP>160 mm Hg or DBP>100 mm Hg 53.4% (2324); on antihypertensives 41.8%; SBP 156.6±22.9; DBP 89.1±13.8 **Control group** (n=4294) 55.9% Female). 61.0±10.9 years, 46.9% no formal schooling, 46.5% hypertensive (ie, 1997), Angina 11.8%, stroke 8.1%; 10 year CVD risk SBP>160 mm Hg or DBP>100 mm Hg 52.4% (2251); on BP drugs 42.3%; SBP 157.3±23.2; DBP 88.8±13.9	Three, 6 months intervention thus: (1) mobile tablet based CVD risk assessment by CHWs; (2) electronic referral to PHC doctors; and (3) a tracking system for follow-up care.	Primary outcome—proportion whose SBP drops <140 mm Hg. Secondary outcomes—difference in mean BP levels, difference in proportion using BP drugs.	Increased treatment rates among high risk individuals assessed by CHWs, but, the effects on BP were not demonstrated.
Jafar *et al*, 2010 British Medical Journal Karachi, Pakistan[54]	A cluster randomised controlled trial	4023 participants, aged 3—39 years—mean age for HHE, the intervention n=2008 was 18.9±9.8, for control n=2015 was 19.0±9.8; males in HHE 46.3% (ie, 929); Males in control 45.8% (ie, 923); mean SBP in HHE 114±14 mm Hg, in control 115±14; mean DBP in HHE 74±11, in control also 74±11. HHE literacy 11.5%, in non HHE 13.8%	3-monthly home based family health education by CHWs	Primary outcome — change in SBP after 2 years follow-up. Secondary outcome —Change in DBP between baseline and at 2 years	Family based HHE by CHWs reduced the usual rise in BP with age in children and young adults.
He *et al*, 2017 The Journal of the American Medical Association Argentina (area not specified) [22]	A cluster randomised trial	1432 hypertensive adults Mean age intervention group (n=743) age 56.1±13.6 years, control (n=689) 55.5±13.0 years. 52.6% and 53.4% of intervention and control groups respectively were female, Mean SBP 151.7±16.8 and 149.8±15.5 mm Hg and DBP, 92.2±12.2 and 90.1±12.9 among intervention and control groups respectively. 86% in intervention group and 84% in control group were on BP drugs	multicomponent intervention: (1) CHW—led home health coaching, BP monitoring, BP audit and feedback, and (2) a GP intervention, and a (3) text messaging intervention over 18 months. Controls receiving usual care.	Primary outcomes of differences in SBP and DBP between baseline and follow-up end Secondary outcomes were % with controlled BP <140/90 mm Hg	CHWs helped low-income patients with uncontrolled hypertension achieve greater decrease in SBP and DBP through multicomponent interventions compared with patients receiving usual care over 18 months.
Khetan *et al*, 2019 Global Heart journal Dalkhola, India[52]	A Cluster Randomised Controlled Trial	1242 adults (35 to 70 years drawn from 12 clusters with at least 1 CVD risk factor (hypertension 650, diabetes 317, smoking 500) Intervention group- 736 Mean age 52.1±9.6 years Control group- 506 Mean age- 51.7±9.8 years.	Behavioural change communication and BP monitoring through regular CHWs home visits once every 2 months for 2 years. The control group received usual care in the community	Primary outcomes were change in SBP, FBG and self-reported number of daily cigarettes from visit one to post-intervention among hypertensives, diabetics and smokers.	Improved SBP in hypertension, and inconclusive effect on FBG in diabetes, and no demonstrable effect on smoking.
Setiawan and Sargowo, 2018 European Society of cardiology congress Batu City, Indonesia[62]	Interventional pre and post-test study	102 subjects (Men 21; Women 81) aged 30 to 75. Mean Framingham Risk Score (FRS) of 6.17 65.75	Community based primary intervention that included 60 min of heart exercise thrice weekly for 3 months, and regular health counselling and education on lifestyle changes	Primary outcome —change in mean value of FRS	A community-based health education and physical activity programme significantly improved the FRS of a farmer's population. Mean FRS changed from 6.17 65.75 to 4.16 63.92 post-intervention group (Z score=–6.009; p=0.00).

Continued

Table 1 Continued

Author, year, journal and setting	Study design	Baseline sample characteristics	Intervention design	Outcome measurement	Key findings
Sankaran *et al*, 2016 Journal of general internal medicine Rural region of Southern India[61]	Interventional pre and post study	598 patients over the age 60 were screened. Baseline hypertension prevalence rate of 44%.	CHW trained for 7 months offered a community intervention for 1 year, that involved diagnosis, management and referral of patients with uncontrolled BP and provision of continuing medications and lifestyle advice to those with well-controlled hypertension. GPs did initial evaluation and medication while nurses supervised CHWs, weekly.	Primary outcome- BP control at 1 year	After 1 year, 51.8% of hypertensive patients had BP <140/90 mm Hg. A teaching programme educating CHWs about hypertension followed by screening, diagnosis, and management of hypertension by CHW in the field is a feasible mechanism for achieving hypertension control in a remote tribal community in India.
Gamage *et al*, 2020 Plos One- Medicine South India[56]	A cluster randomised controlled trial	2382 hypertensive patients. Intervention group- 637 from five clusters Mean age-56.6±14.3 Mean SBP 140.5±22.7 Mean DBP 80.4±13.7 Controlled hypertension- 43.5 On hypertensive drugs-38% Control group-1097 form 10 clusters Mean age-56.9 Mean SBP 137.8±22.2 Mean DBP 80.6±13.9 Controlled hypertension-50.1% On hypertensive drugs –40.6%	Trained CHWs delivered group-based intervention to hypertensive people, consisting of 6 fortnightly sessions of ~90 min held within participants' villages (clusters). Sessions included BP monitoring, education about hypertension, and support for healthy lifestyle change.	Primary outcome-change from baseline in the proportion of people with controlled hypertension (BP <140/90 mm Hg) Secondary outcome- change in SBP and DBP from baseline	BP declined an average of 5.0/2.1 mm Hg more in the intervention group than the usual care group, and control of BP improved from baseline to follow-up, more in the intervention (from 227 (49.5%] to 320 (69.7%] individuals) than in the control group (from 528 (52.2%] to 624 (61.7%] individuals) (OR1.6, 95% CI 1.2 to 2.1; p=0.001)
Neupane *et al*, 2018 Lancet Glob Health Nepal[58]	An open-label, cluster-randomised trial	1468 with mean BP of 122/80 mm Hg. 16% of participants were smokers, 11% were drinking alcohol in amounts harmful to their health, and 5% had low physical activity. Intervention group 425 normotensive 175 pre-hypertensive 255 hypertensive Control 305 normotensive 128 pre-hypertensive 180 hypertensive	A lifestyle intervention led by female community health volunteers (FCHVs) or usual care (control group). 43 FCHVs provided home visits every 4 months for lifestyle counselling and BP monitoring for a period of 1 year.	Primary outcome- mean SBP at 1 year.	The intervention was effective for reduction of BP in individuals with hypertension and ameliorates age-related increases in BP in adults without hypertension in the general population. The mean SBP at 1 year was significantly lower in the intervention group than in the control for all cohorts (−2.28 mm Hg (95% CI −3.77 to −0.79, p=0.003) for normotensive participants, −3.08 mm Hg (−5.58 to −0.59, p=0.015) for prehypertensive participants, and −4.90 mm Hg (−7.78 to −2.00, p=0.001) among hypertensives.
Cappuccio *et al*, 2006 BMC Public Health Ashanti region of central Ghana[50]	A community-based cluster randomised trial	1013 participants from 12 villages (628 women, 481 rural dwellers). Intervention group Mean age-54 ±11 years Mean BMI- 21±4 Mean SBP- 129±25 Mean DBP- 77±13 Hypertensive 30% Control group Mean age-55 ±11 years Mean BMI- 21±4 Mean SBP- 127±27 Mean DBP- 76±13 Hypertensive —28 %	Community-based trial of health promotion for population-wide reduction in salt intake, to lower population BP. Health promotion targeted villagers willing to attend and was provided through daily sessions in week one followed by 6 months' once weekly sessions in communal places (church and schools)	Primary outcome- change in mean BP and urinary sodium.	At 6 months the intervention group showed a reduction in systolic (2.54 mm Hg (-1.45 to 6.54) and diastolic (3.95 mm Hg (0.78 to 7.11), p=0.015) BP when compared with control. There was no significant change in UNa.

Continued

Table 1 Continued

Author, year, journal and setting	Study design	Baseline sample characteristics	Intervention design	Outcome measurement	Key findings
Goudge *et al*, 2018 BMJ Global health Mpumalanga Province, South Africa[51]	A pragmatic cluster randomised controlled trial with repeated cross-sectional surveys.	Control group - 1908 adults with mean age of 56.4±19.8 years, females –56% No hypertension-53.7% Controlled hypertension on medication-10.2% Uncontrolled hypertension on medication-9.2% Not on treatment- 27% Intervention group - 1505 adults Mean age-56.81±9.7 years Females –55% No hypertension-53% Controlled hypertension on medication-6.6% Uncontrolled hypertension on medication-8.8% Not on treatment- 31.6%	Intervention consisted of two LHWs assigned to each clinic to support nurses over for 18 months in management of patients with chronic disease through booking appointments, retrieving and filing patient files, health education, taking vital signs, prepacking of medication and texting reminders for appointments	Primary outcome -change of proportion of the population who had uncontrolled hypertension with a risk profile indicating at least moderate risk of CVD. Secondary outcomes - changes in proportion of the population with undiagnosed hypertension, had their BP measured, were using medication for hypertension and retention in care of people with diagnosed hypertension defined.	There was no reduction in those with moderate or greater CVD risk but there was improved adherence. The intervention did not improve BP control, despite its success in increasing the number of patients with hypertension attending the clinic, as well as the number that attended on their appointed day.

BMI, body mass index; BP, blood pressure; CHWs, community health workers; CVD, cardiovascular disease; DBP, diastolic BP; FBG, fasting blood glucose; GP, general practitioner; HHE, home health education; LHWs, lay health workers; PHC, primary healthcare; SBP, systolic BP; UNa, urinary sodium.

Figure 2 Risk for bias assessment.

as a primary outcome. There was significant reduction in the mean SBP in seven studies[22 50 52 54 57 58 60] while in two of the studies[53 55] the reduction in mean SBP was insignificant. Two of the RCTs reported a reduction in the usual rise in BP with age among children and young adults[54] and normotensive adults in the general population.[58] Similarly, three studies[56 57 61] reported significant improvement in the proportion of participants with controlled BP as result of the CHW interventions while three other studies[51 55 59] did not find any significant improvement in the BP control for participants. It is notable that even for studies which reported negative results in the control of BP, there were positive effect on linkage to care,[55 59] treatment adherence[51 53] and inter-heart risk score.[53] In other studies there was improvement in the primary outcome of mean change in Framingham risk score,[62] and reduction in the proportion of patients with moderate or high CVD risk level.[51]

Other outcomes reported in the studies were changes in DBP,[55–57 60] changes in urinary sodium,[50] proportion of the population with undiagnosed hypertension, proportions who had their BP measured and those retained in care among the diagnosed hypertensive patients,[51] as well as difference in the proportion of patients on hypertension treatment.[51 59] In one RCT that had participants with at least one CVD risk factor, FBS among diabetes patients and mean number of daily cigarettes among smokers were reported as primary outcomes in addition to change in SBP.[52] In this study, CHWs interventions had a positive effect on SBP but had inconclusive effect on FBS and mean number of cigarettes smoked.[52]

Outcomes trends in relation to the implementation strategy of the CHW intervention

Studies whose CHW intervention focused on community-based/home-based behavioural change

communication[22 50 52 54 57 58 60] had significant reduction in SBP and significant improvement in the proportion of participants with controlled BP.[56 57 61] On the other hand, interventions that focused on the role of CHW as mediators between patient and healthcare system through referral, linkage to care and monitoring drug adherence[51 53 55 59] did not have significant impact on BP control.

Although the studies lacked a standard requirement for CHW training in terms of duration and content, training was an important component of the CHW intervention for management and control of hypertension. Studies that had training ranging from 4 to 6 weeks had positive outcomes with those that staggered the trainings across the entire intervention period all showing positive outcomes[52 57 61] in the control and management of high BP.

DISCUSSION

Weak healthcare systems and a rising burden of CVD calls for health system innovations in the management of CVD in LMICs. CHWs have been suggested as a way to achieve that goal, with their potential ability to quickly integrate into the healthcare system. With short training periods, CHW can provide community-based care that is cost-effective and achieve high-quality outcomes.[7] Our review examined the nature and the role CHWs can play in management of hypertension in LMIC. This review found that, in general, studies that linked CHWs with existing public healthcare infrastructure enhanced control and management of BP over and above usual care. The CHW interventions had positive effects in the reduction of BP, linkage to care, treatment adherence and in reducing CVD risk level among both hypertensive and normotensive individuals in LMICs. This underscores the important role CHWs would play in the management of hypertension yet at a cheaper cost in countries with leaner economic muscle.[63–65] The review further showed that CHW play diverse roles ranging from preventive, therapeutic and health systems utilisation in management of hypertension.

With the growing burden of NCDs, primary prevention is a major pillars in the control of these diseases in LMICs.[66] In light of critical shortages in the health workforce in LMICs, CHWs provide cheaper alternative that would form the backbone of most primary healthcare (PHC) services for management and control of both communicable and NCDs.[67] The studies in this review demonstrate that task-shifting of roles such as health education, interpersonal communication on lifestyle modifications with a focus on primary prevention, screening for early diagnosis and supporting self-management behaviour can lead to significant reduction of BP. Studies from developing countries show that CHWs have high acceptability at local community level which, may contribute to the dual benefit of providing both cheaper and acceptable labour in addition to the direct contribution in BP control.[68]

While trained CHW may not perform in the same capacity as trained nurses and health educators, with appropriate and specifically focused training and supervision they can successfully contribute to the management of hypertension, as demonstrated by many of the studies reviewed. In the current review, we did not find any standards in the training of CHW for management of hypertension. The training duration ranged from 2 days to 6 weeks and the content was different across the studies depending on the focus of the intervention. The reviews showed that CHWs intervention entailed screening, promotion and monitoring of BP and its control strategies at both home and community levels where only basic PHC approaches were required. The basics required here could be easy and faster to teach with no need for unnecessary scientific details and the favourable study results from the current review show that such training as the CHWs received is enough to yield demonstrable behaviour change and BP modulation outcomes.[22 50–62]

There is general agreement in the reviewed literature that CHWs can contribute to significant reduction of BP and hypertension as a key modifiable risk factor for CVD and premature death,[1 2] especially in the LMICs.[3] This review shows that enjoining CHWs in the screening and care of hypertensive patients from such countries has positive results in care of such patients. Most of the studies in this review had low risk of selection bias in both sequence generation and allocation concealment through randomisation (11 studies), had low performance bias because they had both participants and investigators blinded (8 studies), had blinding of assessors and so detection bias was minimal (9 studies), and had selective reporting bias minimised at conceptualisation and implementation of the protocol as opposed to allowing a direct influence of the outcomes at dissemination stage (11 studies) strengthens the evidence of our review. As such, the evidence deduced on importance of CHWs in mitigation of hypertension becomes especially critical for countries with less resources, an ageing population, an increase in sedentary lifestyles and other lifestyle risk factors, and a concomitant direct increase in proportions of the general population who are hypertensive.[2] The literature suggests a way out of the increasing incidence of hypertension in these countries and rising proportion of persons with poorly controlled BP. The CHWs drawn from these communities would advance the care needed and supplement the lean professional workforce available. CHWs have cultural understanding which is crucial in providing the necessary linkage between community and healthcare system.[13] The current review also demonstrates that their roles can be diverse yet effective in the control and management of high BP and other cardiovascular risk factors.

Study limitations and strengths

Our study represents a scope review of approaches and outcomes specific to CHW interventions in the management and control of hypertension in LMICs. The strengths of the current study are that we conducted comprehensive searches of databases to ensure that all relevant publications were identified. We also reduced potential

bias in the review by having the authors independently screen through the search results and extract the data autonomously. However, the study is limited in that, due to diversity of the study participants, interventions and outcomes of the studies included in the review, a quantitative synthesis (meta-analysis) of the overall effect of CHW interventions was not possible and therefore outcomes were summarised for individual studies.

Implications of the results for practice, policy and future research

This study showed that CHWs drawn from community are an important resource in the management and control of hypertension. Preference should be given to CHW interventions focused on behaviour change communication and lifestyle counselling for reduction of high BP for both hypertensive and normotensive individuals. There is a need for adoption of standard curricula for training of CHW for the control and management of hypertension to guide translation of such interventions in different settings in LMICs. Future reviews should look into the overall effect of the various components of CHW interventions and their cost-effectiveness in the management and control of CVDs.

CONCLUSIONS

In conclusion, the review suggests that CHWs interventions linked with support and/or supervision from healthcare workers provides a promising avenue for achieving improvements in hypertension control in LMICs. There is need to adopt this and integrate CHW community-based lifestyle interventions in PHC for overall reduction of CVD risks.

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ORCID iD

Grace Wambura Mbuthia http://orcid.org/0000-0003-0994-5249

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