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Community health worker-facilitated home visits for hypertension management in urban Nepal: a mixed-methods process evaluation

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ABSTRACT

Objectives Hypertension remains poorly controlled globally, highlighting the need for scalable community-based strategies. Although community health worker (CHW)-facilitated interventions show promise, implementation evidence from low- and middle-income countries remains limited. This study assessed the implementation processes, mechanisms of impact and contextual factors influencing a CHW-facilitated home visit intervention for hypertension management.

Design Mixed-methods process evaluation nested within a randomised cluster trial.

Setting An urban municipality in Nepal.

Participants Individuals with hypertension were surveyed at baseline (n=1252) and follow-up (n=1098). CHWs completed routine monitoring forms and home visits were observed (n=47). In-depth interviews were conducted with individuals with hypertension (n=20), spouses (n=7), adult children (n=13), CHWs (n=8) and public primary healthcare providers (n=5).

Results Overall, 86% of participants completed all six planned home visits. Visits were generally delivered with fidelity, with minor adaptations to fit participant and family contexts. Participants reported high satisfaction and perceived benefits, including improved knowledge, family support and uptake of self-blood pressure monitoring. However, developed behavioural action plans often lacked specificity, limiting progress follow-up and accountability. Weak public primary care capacity, medication stockouts and preference for higher-level or private facilities constrained care linkage.

Conclusion CHW-facilitated home visits addressed key individual and family-level barriers to hypertension management, but impact was limited by uneven behaviour uptake and constrained public primary healthcare capacity for medication supply and titration. Strengthened CHW training and mentorship are needed to support effective behaviour change. Integration of community interventions with functional primary care systems is essential for sustained hypertension control in low-resource urban settings.

Trial Registration number NCT05292469; date of registration: 22 March 2022; URL: https://clinicaltrials.gov/ct2/show/NCT05292469?cntry=NP&draw=2&rank=6.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ Multiple data collection methods guided by the Medical Research Council framework enabled a comprehensive assessment of intervention implementation.
⇒ Inclusion of both intervention recipients and providers in the study sample enabled assessment of implementation factors from multiple perspectives.
⇒ This study presents evidence on the implementation outcomes and experiences of a community health worker-facilitated hypertension intervention in Nepal, informing future scale-up efforts.
⇒ Findings are limited to a single urban municipality, which may restrict generalisability.

INTRODUCTION

Hypertension is a significant risk factor for cardiovascular diseases,[1] identified as the single most preventable cause of premature deaths worldwide.[2] In South Asia, 55% of the adult population has high blood pressure, 37% are on treatment, but only 17% have their blood pressure adequately controlled.[3] In Nepal, 32% of adults have hypertension, yet only 50% are aware, 27% are on treatment and 38% have their blood pressure controlled.[4] Non-pharmacological interventions, such as a healthy diet low in salt and rich in fruits and vegetables, regular physical activity, maintaining a healthy body weight and avoiding tobacco and alcohol, can reduce blood pressure.[5] However, pharmacological treatment is often required to achieve optimal blood pressure control.[5] Efforts to address hypertension have traditionally focused on early detection and treatment through training of primary healthcare providers (doctors, nurses and paramedics) and increasing public awareness.[6] Despite these efforts, hypertension control rates have remained suboptimal.[4]

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Recognising this challenge, the WHO has emphasised the urgent need for countries to scale up effective hypertension care, estimating that such efforts could prevent an estimated 76 million deaths globally between 2023 and 2050.[7] Consequently, there is a pressing need for evidence-based community interventions that support patients and families in overcoming barriers to hypertension treatment and long-term blood pressure control.[8]

We were inspired to test the impact of a comprehensive approach to hypertension management (CAHM) in urban Nepal after observing positive effects of community interventions on blood pressure control in Argentina,[9] India[10] and Nepal.[11 12] Our trial evaluated the effectiveness of community health worker (CHW)-facilitated home visits combined with training of public primary healthcare providers in supporting patients and families to manage hypertension. The intervention achieved a greater reduction in systolic (1.7 mm Hg; 95% CI −0.1 to 3.4) and diastolic (1.6 mm Hg; 95% CI 0.5 to 2.6) blood pressure compared with the control group.[13] Our trial results also reported the intervention's impact on lifestyle behaviours, such as improvement in adequate physical activity (OR 2.2; 95% CI 1.6 to 3.1) and reduction in daily dietary salt intake of 0.7 grams (95% CI 0.5 to 0.9 grams) and no improvements on adherence to antihypertensive medications and global dietary requirement scores.[13]

While several studies have demonstrated effectiveness in improving clinical outcomes, there remains a paucity of in-depth analysis and reporting on implementation outcomes of hypertension trials to inform scalability in low- and middle-income countries (LMICs). In this paper, we present findings from the trial process evaluation to provide explanations that enhance understanding of the trial results. We focus on three core domains: implementation (assessed through reach, dose and fidelity), mechanism of impact (how participants' perception and satisfaction with intervention influenced behaviour change) and context (the health system and individual level factors influencing implementation and potential impact of the CAHM intervention).

METHODS

We conducted a mixed-methods process evaluation nested within a cluster randomised trial to understand the implementation of the CAHM intervention. The process evaluation was guided by the Medical Research Council's (MRC) framework for complex interventions, which is structured around three core components: implementation, mechanism of impact and context as shown in figure 1.[14] (1) Implementation examined the extent to which the intervention was delivered as intended and was assessed as (a) reach, defined as the proportion of eligible participants approached who were enrolled in the trial and the ease with which CHWs scheduled and completed home visits; (b) dose, defined as the proportion of participants who received the full intervention, measured as completion of all six planned CHW-facilitated home visits; (c) fidelity, defined as CHW's adherence to the planned session components in the home visit manual including any modification made to intervention delivery and the reasons for these changes. (2) Mechanism of impact: explored how participants perceived the intervention including their proximal responses such as satisfaction and how these perceptions were expected to contribute to changes in behavioural and health outcomes. (3) Context involved understanding the broader environment in which the intervention was implemented, including health system factors, community characteristics and individual circumstances that influenced implementation and the intervention's potential effects. The Consolidated criteria for Reporting Qualitative research checklist was followed in reporting the study findings. In accordance with MRC guidance, process data were collected before analysing the trial results.[14]

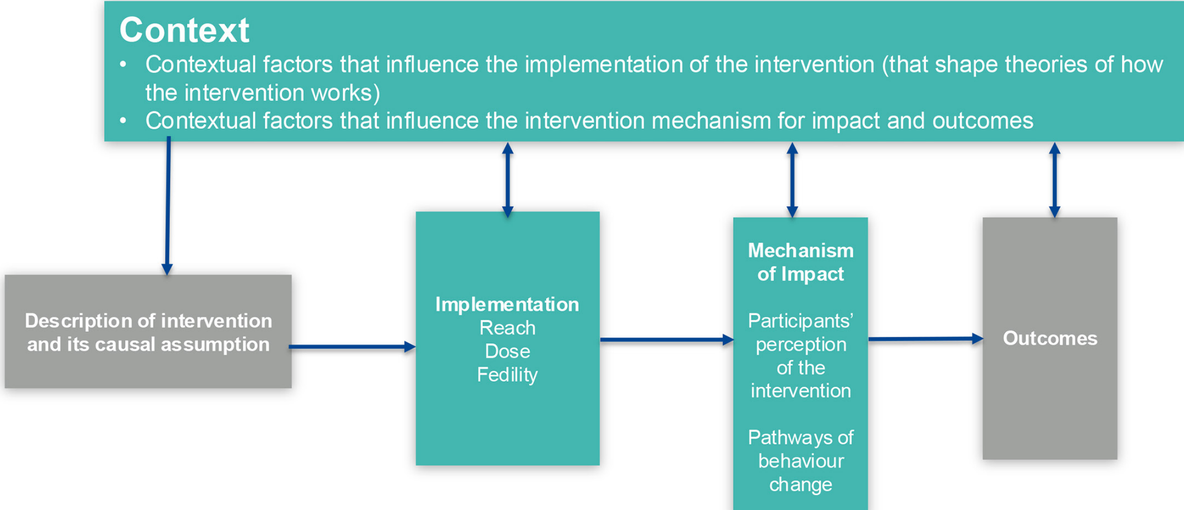

Figure 1 Medical Research Council framework's components assessed in this study.

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Study setting

The study was conducted in Budhanilkantha, an urban municipality in Kathmandu district, Nepal. Hypertension-related services, including blood pressure monitoring, lifestyle counselling and antihypertensive medication (amlodipine), are provided free of charge through a network of 11 municipal primary healthcare facilities. However, titration of antihypertensive medication requires physician oversight, and none of the public healthcare facilities in the study clusters have a physician. Physicians are available only at hospitals and private clinics, where consultation requires out-of-pocket payment.

Despite relatively good physical access to healthcare facilities, the burden of hypertension is high in urban Nepal.[4] A baseline survey conducted between May and November 2022 among individuals with hypertension in study clusters found that 55.6% had controlled blood pressure and 73.2% reported good adherence to antihypertensives.[13] Many low-income patients seek care from private pharmacies due to inconvenient opening hours and irregular availability of antihypertensive medication at public healthcare facilities, as well as high costs associated with seeking care at hospitals.[15]

Urban populations are also highly heterogenous and mobile, and their healthcare needs may not be adequately addressed through a predominantly facility-based healthcare system. Under Nepal's federal system, municipalities leading health service delivery need evidence from community-based interventions to effectively reach marginalised communities and address the growing burden of hypertension.

The CAHM intervention

The intervention comprised four components (see Box 1) to support patients and their families in managing hypertension, targeting medication adherence, follow-up care, blood pressure self-monitoring, healthy weight maintenance, a low-sodium and low-fat diet, physical activity and reduced alcohol and tobacco use. A Nepali-language home visit manual, adapted from 'Your heart, your life: A CHW's manual for the Hispanic community'[16] and supplemented with a family engagement component was developed with input from the trial cardiologist, municipal health coordinator and formative research on facilitators and barriers to hypertension control.[15] This allowed tailoring to individuals, family and community context, fostering trust between patients and primary healthcare providers, addressing misconceptions and supporting sustainable behaviour change.

Box 1 Comprehensive Approach to Hypertension Management (CAHM) Intervention

Healthcare providers' training: public primary healthcare providers completed 4 days of training on the Nepal government's package for essential non-communicable diseases (PEN). The training strengthened their ability to identify, refer and follow-up with hypertension patients, follow standardised management protocols and apply effective interpersonal communication and counselling skills to support behaviour change.

Community health worker (CHW) selection and training: six salaried CHWs (five female, one male) with a certificate in nursing or health assistant were recruited to conduct home visits. Municipal and ward offices circulated the call for applications, and shortlisted candidates were interviewed based on experience, communication skills and familiarity with the area. CHWs completed the same 4-day PEN training alongside healthcare providers to promote collaboration and establish linkage for blood pressure audits and follow-up care. An additional 4-day training, led by SB (first author), focused on home visit manual. CHWs practised mock sessions with peers and conducted pilot sessions with three hypertension patients each. Manual content was refined for sequencing and clarity, and the intervention coordinator supervised at least two initial home visits before CHWs worked independently. A 3-day refresher training course was conducted covering healthy diet, physical activity and medication adherence for subsequent visits.

Patient support: participants received an informational package including (a) log for blood pressure readings, physical activity, diet planning and medication tracking. (b) Omron HEM-8712 automatic blood pressure monitor and (c) a weekly medication organiser (pillbox).

Home visits: CHWs conducted six home visits. The first home visit (90 min) focused on understanding the family context, fostering dialogue through open-ended questions, encouraging reflection, building confidence and setting actionable goals based on hypertension management guidelines.[42] CHW demonstrated blood pressure measurement and use of the informational package and pillbox. Visits 2–4 (60 min each) included blood pressure monitoring, review of action plans and participatory discussions to resolve challenges faced by participants and families. The final two visits reinforced prior content, supported maintenance of healthy behaviours and addressed ongoing challenges, without introducing new topics.

Data collection procedures

We employed four data collection methods: trial surveys, routine monitoring, direct observation and in-depth interviews. Written informed consent was obtained from all participants prior to data collection. For trial participants, written consent for baseline and follow-up surveys, home visits and qualitative interviews was obtained at enrolment. For participants who could not read, the consent form was read aloud in the presence of a literate witness chosen by the participant, and consent was documented using a thumbprint. Data were collected face-to-face at participants' homes, and at the workplace for trial-employed CHWs and public healthcare providers, with privacy maintained. All data were collected in accordance with the Declaration of Helsinki. Ethical approval was obtained from the Nepal Health Research Council (protocol number: 682/2021) on 24 December 2021 and the Regional Committee for Medical and Health Research Ethics, Norway (reference number: 399479) on 22 February 2022.

Direct observations and in-depth interviews (IDIs) were conducted by two female public health graduates: SB (first author) and the process coordinator (PC), each with 10 years of qualitative research experience. They were not involved in intervention delivery, though they trained CHWs and facilitated monthly review meetings. Participants may have perceived researchers to be evaluators

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assessing CHW's performance and their progress. To minimise this, researchers explained that the IDIs aimed to understand experiences with home visits and improve the intervention for future recipients. Participants were also assured that their responses would not affect the health services they received or the incentives provided to the CHWs.

Trial surveys

Trained enumerators administered a structured Nepali-language questionnaire to individuals with hypertension enrolled in the trial (both intervention and control arms) 1252 participants at baseline and 1098 at follow-up (median interval: 10 months). Sociodemographic data and health behaviours such as smoking, alcohol use and health-seeking behaviours were collected from all participants. Intervention participants were additionally asked about their home visit experiences, family support and the development and implementation of the behavioural action plans.

Routine monitoring

After each home visit, CHWs completed a semistructured paper-based form documenting factors that influenced delivery and participant engagement, as well as agreed action plans and progress made.

Direct observation

The PC conducted semistructured observations of 47 home visits (involving 54 participants) to assess fidelity to the home visit manual. At least five home visits per CHW were purposively selected, ensuring participant representation across gender, educational level and ethnic background. During each observation, the PC recorded the number of family members present, any disturbances, the level of participant and family member engagement in discussions and action plan development and the CHW's competency in following up on previously agreed action plans and addressing participants' concerns.

In-depth interviews

A total of 53 IDIs were conducted with intervention participants (n=20), family members (n=20), CHWs (n=8) and healthcare providers from intervention facilities (n=5). Participants were purposively selected to ensure maximum variation in age, gender, ethnicity, education, employment status and use of public healthcare services. All those approached agreed to participate.

SB and PC reviewed observation data and monitoring forms to develop the IDI guides (see online supplemental file 1 for interview guides and observation and monitoring forms). Although the guides were not pre-tested and interviews were not repeated, they were iteratively adjusted based on post-interview reflections. IDI with participants and family members explored experience with home visits, including barriers and facilitators to participation and their influence on hypertension management. IDI guides for CHWs explored implementation-related issues including factors affecting scheduling, family attendance, interactions during home visits, challenges or enjoyable aspects of visits and perception of effectiveness of intervention. Interviews with healthcare providers examined the health system's adoption of the intervention. IDIs provided rich narratives, offering insights into individual experiences, contextual factors and the reasons behind actions and perceived appropriateness of the intervention.[17] Interviews were concluded on reaching code saturation (eg, we have heard it all) and meaning saturation (eg, we have understood it all).[18] The average interview length was 30 min and participants were not informed of the questions in advance.

Data management and analysis

Survey data were downloaded from the Open Data Kit server. SB and the PC manually reviewed 10 monitoring forms and five observation forms to generate codes on factors affecting fidelity to the home visit manual and implementation of action plan. These codes were then used to enter the data from all monitoring and observation forms into an Excel sheet. Quantitative data were summarised as frequencies and proportions using Stata V.18.

All IDIs were audio recorded and transcribed verbatim in Nepali, with the PC checking transcript quality. Analysis was conducted in Nepali without translation, using abductive reasoning, combining inductive and deductive approaches[19] and managed in Dedoose V.9 (Socio Cultural Research Consultants, Los Angeles, California, USA). Deductive coding was guided by MRC's process evaluation framework, while inductive coding captured unanticipated concepts. Initial codes from five transcripts were double-checked for consistency. PC and LP (second author) coded the data, and LP drafted thick descriptions with support from SB. SB wrote the narrative report in English with illustrative quotes, and AS (co-author) reviewed the draft, providing detailed feedback. All co-authors reviewed the final draft for interpretive accuracy and consistency. Reflexive memos and regular debriefing sessions among analysts supported interpretive rigour. Transcripts were not reviewed by participants, but findings were shared with municipality stakeholders on 4 August 2025.

Data integration

Qualitative and quantitative data were collected concurrently and accorded equal importance, following a convergent mixed-method design.[20] Quantitative and qualitative data were integrated at the interpretive stage[21] (see figure 2). Results were analysed separately using their respective analytic procedures and then merged using joint displays that aligned quantitative outcomes with the corresponding qualitative themes. Integration assessed convergence, divergence or complementarity between data sources, enhancing insights beyond those from quantitative findings alone.[21]

Qualitative themes from IDIs are presented alongside complementary quantitative data from surveys,

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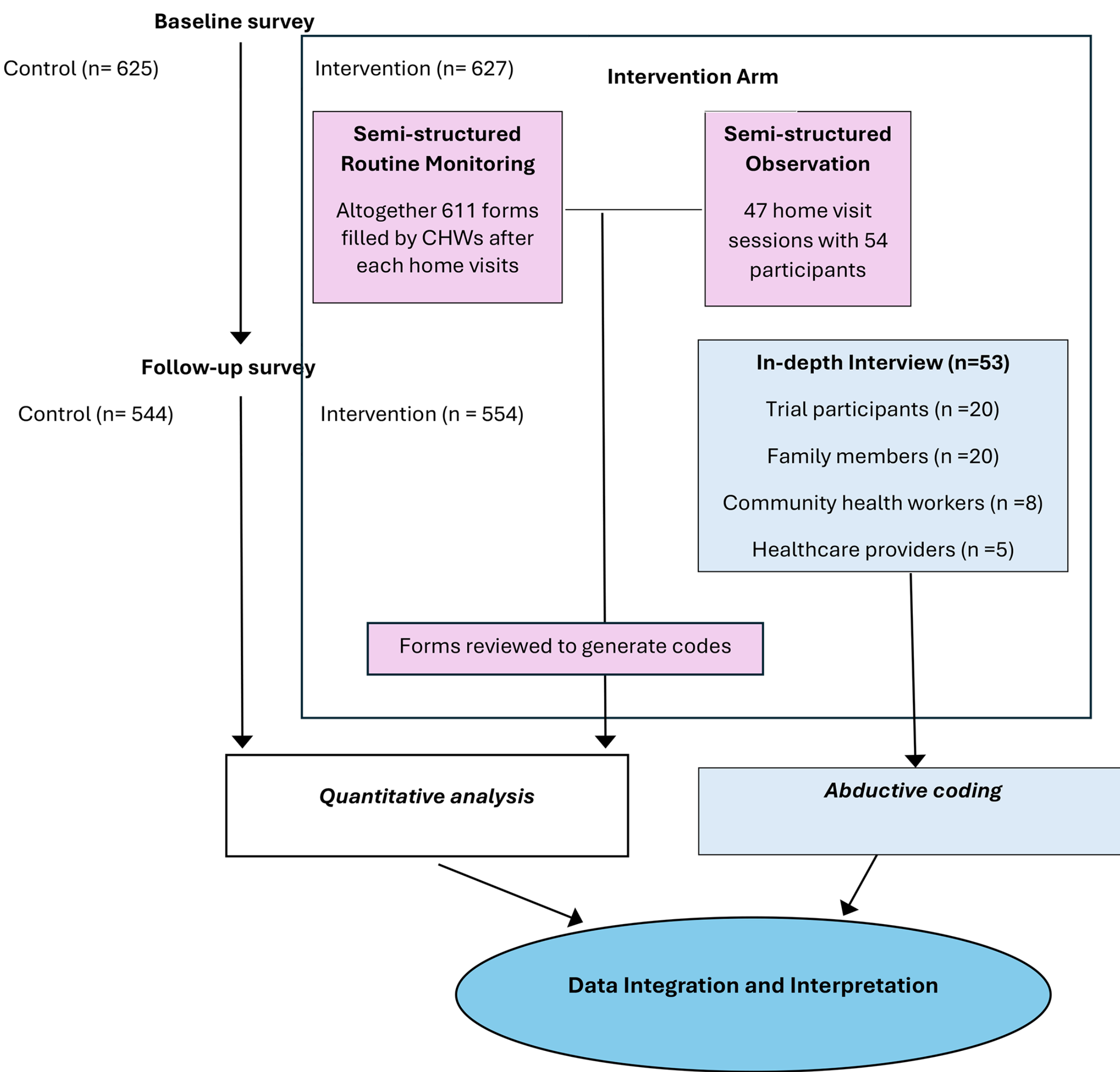

Figure 2 Study data sources and analysis flow chart. CHW, community health worker.

monitoring records and observations to generate meta-inferences.[22] This integrated analysis identified concordance and discrepancy between planned and actual home visits and clarified how contextual factors and the underlying causal mechanism may have contributed to reductions in blood pressure. Verbatim participant accounts provided insights directly relevant to the study objectives. Together, the quantitative and qualitative findings provide a complete account of CAHM implementation that would not have been achievable using a single-method approach. Meta-inferences were generated by interpreting how qualitative findings helped explain observed quantitative patterns.

Patients and public involvement

Participating hypertension patients, their family members, healthcare providers and CHWs were informed about the objective of the study and its implication. However, they were not directly involved in developing the research questions and study design. The results of this study were shared in a dissemination event in the study municipality among municipal officials.

RESULTS

We present the study results aligning with the three domains of MRC framework: (1) implementation assessed through (a) reach, (b) dose and (c) fidelity and adaptations, (2) mechanism of impact reporting acceptability measured by perceived satisfaction with the intervention and (3) context covering individual, community and health system factors influencing implementation and potential effects.

Characteristics of the study participants

Table 1 presents the sociodemographic characteristics of study participants. Participants in IDIs were younger (mean age 55.3 years, SD 15.4) than those in observed home visits (mean age 60.9 years, SD 11.6) and the overall trial (mean age 57.5 years, SD 12.1). Educational attainment was low across all samples, with most participants having no formal or primary education. A high proportion of participants had been prescribed antihypertensive medication, with hypertension duration ranging from 6 years to 10 years. Family members interviewed were mostly female and all had attended at

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Table 1 Socio-economic characteristics of participants in quantitative and qualitative sample

Characteristics	In-depth interview: Hypertension patients (n=20) Frequency	%	Family members (n=20): Spouse (n=7)	Adult child (n=13)	Home visits observed (n=54 participants from 47 home visits) Frequency	%	Enrolled trial participants (n=1252) Frequency	%
Age								
Mean, SD	55.3	15.4	NA	NA	60.9	11.6	57.5	12.1
44 years	4	20.0			4	7.4	184	14.7
59 years	8	40.0			14	27.9	527	42.1
≥60 years	8	40.0			36	66.7	541	43.2
Education								
Years of education, median, IQR	2.5	10	NA	NA	0	8	3	10
No formal education	7	35.0			20	37.0	413	33.0
Primary (0–4 grade)	7	35.0			22	40.8	458	36.6
Secondary (5–10 grade)	2	10.0			8	14.8	220	17.6
High school and above	4	20.0			4	7.4	84	12.8
Family size								
Median, IQR	4	2	NA	NA	5	3	4	3
Female	14	70.0	4	9	31	57.4	752	60.1
Currently married	13	65.0	NA	NA	43	79.6	1050	83.9
Ethnicity								
Brahmin/Chettri	13	65.0	2	5	29	53.7	674	53.8
Newar	2	10.0	2	4	7	12.9	238	19.0
Tamang/Rai/Sherpa/Magar/Gurung	2	10.0	2	4	13	24.1	260	20.8
Dalits	3	15.0	1	0	5	9.3	89	6.4
Occupation								
Unemployed	14	70.0	NA	NA	37	68.5	691	55.2
Retired	0	0.0			4	7.4	132	10.5
Paid employment	2	10.0			2	3.7	106	8.5
Self-employed	4	20.0			11	20.4	323	23.1
Per-capita income (US$)								
Median, IQR	753.8	700.0			666.7	769.2	769.2	825.6
Low	7	35.0	NA	NA	26	48.9	432	34.5
Medium	8	40.0			15	27.8	403	32.2
High	5	25.0			13	24.1	417	33.3
Diabetic	3	15.0	NA	NA	17	31.5	718	57.4
Prescribed antihypertensives	19	95.0	NA	NA	52	96.3	1180	94.3
Years since hypertension diagnosis								
Median, IQR	9.1	8.7	NA	NA	9.7	8.1	6.4	8.8
Uncontrolled blood pressure (≥120/80 mm Hg)	13	65.0	NA	NA	26	48.2	556	44.4
Type of health facility for seeking hypertension care								
Public	6	30.0	NA	NA	22	40.7	228	9.2

Continued

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Table 1 Continued

Characteristics	In-depth interview				Home visits observed (n=54 participants from 47 home visits)		Enrolled trial participants (n=1252)	
	Hypertension patients (n=20)		Family members (n=20)					
	Frequency	%	Spouse (n=7)	Adult child (n=13)	Frequency	%	Frequency	%
Private	14	70.0			32	59.3	1024	81.8
Family members' attendance during home visits								
None attended	1	5.0	0	0	4	7.4		
All attended	8	40.0	3	5	17	31.5	NA	NA
At least one attended	11	55.0	4	5	33	61.1		
Observed home visits								
First home visit					14	29.8		
Second home visit					9	19.1		
Third home visit	NA	NA	NA	NA	11	23.4	NA	NA
Fourth home visit					6	12.8		
Fifth home visit					3	6.4		
Sixth home visit					4	8.5		
Home visits attended by family members	NA	NA	NA	NA	32	68.0	NA	NA

least one home visit; only one of the 20 family members identified as Dalit.

Implementation of intervention

Reach

Altogether, 1257 eligible participants were approached to achieve the required sample size of 1252; five declined, yielding a response rate of 99.6%. Qualitative interviews indicated that scheduling home visits was generally straightforward; however, repeated follow-up was often required for participants with demanding work schedules, such as shopkeepers, who often preferred visits at their workplaces. Among observed visits, 8.5% were delayed because participants were absent at the time CHWs arrived and 38.3% of visits were paused by visitors or for household errands, although most visits were ultimately completed.

> Sometimes home visits don't get scheduled even after two or three calls or get cancelled due to the busy schedule of the participants… but by the fourth call, they come round and agree to home visits. CHW2

> Once a participant received a phone call, he said he had to leave ……so I quickly covered all the important aspects. CHW6

Dose

CHWs completed 99.5% of the first home visits and 86.0% of the six planned visits. Participants' characteristics did not differ between those who completed all six visits and those who did not (table 2). One factor that may have hindered completion of all visits was the perceived requirement to maintain blood pressure logs, as CHWs explained that some participants avoided subsequent visits when logs were incomplete. These misunderstandings were addressed by CHWs during home visits, who emphasised that maintaining blood pressure logs was intended for participants' benefit and not a mandatory task.

> The participant was very enthusiastic about scheduling home visit, but all of a sudden became hesitant and kept postponing. Later, I realized they were avoiding because they hadn't maintained the blood pressure logs. CHW2

Fidelity to the CHW delivered home visit and modifications made

Home visit delivery and session fidelity

CHWs delivered 68.5% of the sessions observed as planned. Initial challenges with new material were addressed through supervisory feedback and additional practice. CHWs reported high participant enthusiasm during early sessions, and ongoing support during monthly review meetings with the trial management team reinforced their motivation to deliver home visits.

> Sessions are good when participants are willing to be involved … and we are encouraged to help if they are trying to implement their action. CHW3

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Table 2 Comparison of characteristics between participants completing and not completing six home visits

Characteristics	Enrolled in intervention (n=627)		Completed six home visits (n=539)		Not completing six home visits (n=88)		P value
	Frequency	%	Frequency	%	Frequency	%	
Age, mean, SD	57.7	12.1	57.9	11.8	57.2	14.1	0.63
Years of education, median, IQR	2	10	2	10	3	10	0.43
Sex							0.39
Female	368	58.7	320	59.4	48	54.5	
Male	259	41.3	219	40.6	40	45.5	
Currently married	531	84.7	456	84.6	75	85.2	0.88
Ethnicity							0.07
Brahmin/Chettri	326	52.0	279	51.8	47	53.4	
Newar	139	22.2	128	23.7	11	12.5	
Tamang/Rai/Sherpa/Magar/Gurung	118	18.8	97	18.0	21	23.9	
Dalits	44	7.0	35	6.5	9	10.2	
Occupation							0.60
Unemployed	376	60.0	322	59.7	54	61.3	
Retired	52	8.3	47	8.7	5	5.7	
Paid employment	54	8.6	44	8.2	10	11.4	
Self-employed	145	23.1	126	23.4	19	21.6	
Per-capita income (US$), median, IQR	692.3	769.2	692.3	769.2	630.8	743.1	0.42

Visit duration and participant engagement

Shorter home visits than planned: most observed visits were 15–30 min shorter than scheduled (90 min for the first visit and 60 min for subsequent visits). Shortened length was attributed to participant impatience, with younger participants eager to return to work and older participants having trouble maintaining focus.

Multiple participants in the visit: although visits were planned for individual participants, monitoring data show 23.6% included two or more participants, usually from the same household and rarely with a neighbour (0.82%). Multiple participants limited CHW's ability to prioritise individual concerns and tailor behavioural actions, as discussions were often dominated by one participant.

> Discussion is good (in sessions with two participants), but there was pressure to listen and remember what everyone said and to develop an action plan for each participant… There usually is one participant who is better at sharing their problems, so other participants' problems may get overshadowed. CHW5

Family attendance and involvement

Family members were encouraged to attend home visits. Monitoring data showed that family attendance for the first visit was 84.5% and declined over time. Overall, 3.9% of participants had no family attendance at any visit, while 34.5% had consistent family participation across visits. Family attendance was not associated with participants' age or education (data not shown). However, CHWs recalled greater family participation among older participants and those unable to read and write. Reasons for non-attendance included waning interest, unavailability, competing schedules and participants' desire for privacy. CHWs adapted visit delivery based on family context and participant preferences.

> Family members didn't attend because they were busy, or at work… usually during home visits we find elderly couples, one or both are participants… CHW2

> Some participants were reluctant to share their problems in the presence of family members but shared freely when alone… I didn't force them to invite family members… also when participants said they were self-reliant and didn't need family members' support … CHW2

Quality of interactions

About 75.9% of observed sessions had good interaction (two-way communication), 12.9% were rated as fair (limited participant responses) and 11.1% were poor (one-way communication). The quality and length of discussions were influenced by participants' comprehension, interest and curiosity. Enthusiasm varied; some participants actively engaged on all topics in a single

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session, while others required prompts to understand issues and participate in finding solutions.

> … there was one young female participant with no formal education, she didn't take antihypertensives regularly, she only took them when her family brought the medicine for her, …… the story in the home visit manual helped open about her problems with non-adherence. CHW3

CHWs' competency in devising an action plan

Analysis of action plans recorded in monitoring forms indicated that hypertension patients were assigned sole responsibility for implementing solutions, even when family members were available to assist in developing them. For instance, if a patient had poor dietary habits, they were expected to purchase, prepare and consume healthy food entirely on their own. Additionally, the action plans were often non-specific. For example, a patient who missed a hypertension follow-up might have an action listed as 'go for a hypertension follow-up' without any details on how to accomplish. The lack of specificity made it difficult to monitor progress and update the action plan during subsequent visits.

Mechanism of impact

Perception of intervention

The majority of participants reported being satisfied with home visits (96.8%), found them acceptable for receiving counselling (97.1%) and considered the timing (98.2%), duration (98.9%) and frequency (98.8%) appropriate (table 3). Family involvement enhanced the intervention's perceived impact: 74.9% reported improved family communication regarding health, although shared responsibility was not consistently reflected in action plans. Qualitative interviews highlighted that positive pre-existing relationships with family members were crucial for active problem-solving.

> She (the CHW) was very respectful, answered our questions patiently and clearly. Family member

> Participants feel they have agreed to reduce weight so they must try, …and family members are motivated because they think when a stranger is coming to their home to support, they are also responsible in achieving the behavioural goal together. CHW2

> Sometimes family members don't speak to each other, eg, daughter-in-law and mother-in-law, mother-in-law doesn't know how to measure blood pressure, nor can she read and implement the developed action plan… In such a situation, we are helpless. CHW3

Despite the high satisfaction, 10.1% did not fully understand what was communicated, and 7.0% felt their viewpoints were ignored. Education level was not associated with home visit experience. Improvement in systolic blood pressure was also not associated with home visit experience, though participants with improved systolic blood pressure were more likely to report satisfaction (61.3% vs 38.9% p=0.01) (data not shown). Qualitative data indicated that satisfaction stemmed from CHWs' politeness, the provision of blood pressure monitors and the interactive and tailored activity-based sessions for weight and blood pressure monitoring, medication adherence and physical activity, all of which fostered a sense of support and personalisation.

> I liked the fact that she [CHW] didn't force… she encouraged him to walk for 5 min today…and to gradually increase to 10 and 15 min…he followed her advice and now he can walk further. Family member

Pathways for behavioural change

Participants reported a positive perception of the intervention's role in supporting healthy behaviours and improving hypertension management. Interlinked

Table 3 Participants' experience with home visits

	Total (n=554)		
Statements	**Agree**	**Disagree**	**Neither agree nor disagree**
You were satisfied with the discussion you had with the CHW during home visit.	536 (96.8%)	6 (1.1%)	12 (2.2%)
Home visit is an acceptable way to receive counselling and advice on health.	538 (97.1%)	8 (1.4%)	8 (1.4%)
The timing of the home visit was suitable for you.	544 (98.2%)	4 (0.7%)	6 (1.1%)
The duration of home visit was suitable for you.	548 (98.9%)	2 (0.4%)	4 (0.7%)
The frequency of home visits was suitable for you.	514 (92.8%)	7 (1.3%)	33 (6.0%)
Home visits enabled you to interact better with your family.	415 (74.9%)	77 (13.9%)	62 (11.2%)
It was difficult to understand what was being said during the home visit.	56 (10.1%)	487 (87.9%)	11 (2.0%)
You felt your opinions and viewpoints shared during the home visits were ignored.	39 (7.0%)	511 (92.2%)	4 (0.7%)

CHW, community health worker.

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pathways of behaviour change emerged through both quantitative and qualitative narratives.

Regular blood pressure monitoring

The monitoring data indicate that home visits promoted home blood pressure monitoring, with 77.8% of participants maintaining logs, of which 46.4% were complete, 31.4% partial. In the follow-up survey, 63.9% reported needing additional support for blood pressure monitoring, particularly older participants (51.1% of those >60 years vs 39.5% of those 45–59 years vs 9.3% of those 21–44 years, p<0.01), those with less than primary education (81.1% vs 18.9%, p<0.01) and females (70.3% vs 29.7% males, p<0.01). Qualitative interviews identified limited literacy and busy family members as key barriers to regular blood pressure monitoring.

> Many participants cannot read and write… so they may not maintain logs, but they measure blood pressure, they say their family leaves early for work and comes back late, so they are unable to record. CHW6

> When my blood pressure is uncontrolled or when I don't feel well, I measure blood pressure twice, in the morning and evening, otherwise I measure once a week. Participant

Access to hypertension information

Intervention participants showed higher health literacy and trust, which may explain the modest reduction in systolic blood pressure (1.7 mm Hg higher than the control group).[13] About 90.5% of the intervention group knew where to find reliable hypertension advice versus 61.1% in the control (table 4), although improvement in systolic blood pressure was not directly linked to this knowledge (data not shown).

Overall, knowledge of dietary salt intake was similar in both groups (table 4). However, participants in the control arm more frequently reported adding salt (35.1% vs 6.7% in the intervention), minimising consumption of processed foods (94.3% vs 88.6%) and reducing the amount of salt used during cooking (84.9% vs 75.3%) and were less likely to avoid eating out (7.7% vs 28.9% in the intervention). Qualitative interviews also showed participants were consciously making efforts to avoid salty food.

> I don't eat out these days …I have avoided eating packaged food that has high salt so now my blood pressure has also decreased. I have realized that if I eat out than my blood pressure increases immediately. Participant

Reduce alcohol and cigarette smoking

The proportion of non-drinkers increased in the intervention arm from 61.7% at baseline to 80.9% at follow-up, while remaining largely stable in the control arm (84.2%–82.4%) (table 5). Smoking rates did not change in either arm. Qualitative findings indicated that younger participants were more likely to reduce or quit smoking, often linking cessation to their recent hypertension diagnosis, whereas older participants were more resistant, citing previous unsuccessful quit attempts and scepticism about the benefits of quitting at their age.

> When she [CHW] started to visit… I used to drink every day…Now I don't drink, I used to smoke more than one packet per day, now I smoke 8 to 10 cigarettes….because I cough more….and I also know it is not good for me, I am trying, but I have cravings. Participant

Engaging in physical activity

Increased knowledge about the benefits of physical activity and enhanced family support resulting from continuous engagement with CHWs during home visits encouraged participants to engage in physical activity, particularly walking. Family support was crucial for women to allocate time for structured activities and motivation increased when family members participated in practice sessions. CHWs' tailored and non-pressured approach helped sustain motivation. Participants who adopted familiar activities, such as dancing or yoga, were more likely to enjoy and maintain physical activity. Gender and age-related differences were reported, with males more often walking outdoors, females relying on household chores and older adults choosing gentler, longer walks suited to their physical capacity.

> Father walks around the neighbourhood during the day, but mother is usually busy with household chores…she doesn't just sit idle. She goes to the animal shed to tend to the goats. Family member

Adherence to antihypertensives

The intervention had no measurable effect on antihypertensive medication adherence.[13] However, qualitative interviews indicated that home visits promoted household-level support and encouraged physician consultation for dose adjustment.

> We are both on medication, I remind my husband to take medicine…When I remind him, I also take my medicine…so we do not forget Family member

Practical strategies imparted during home visits, such as using pillboxes, placing medicines in visible locations and tracking medication stock, were adopted by participants.

> There was one form in the information package, it really helped to keep track of the medicine and know when and which medicine needed to be purchased. Family member

However, during follow-up interviews, 53.2% reported finding pillbox use cumbersome, which may explain why only 36.0% were found to use pillbox in monitoring data. Qualitative interviews further identified incompatibility with the medication strips and stigma associating pillbox

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Table 4 Health literacy and adherence to behaviours as reported in the follow-up survey

	Intervention n=554		Control n=544		
	N	%	N	%	P value
Health literacy					
Do you know sources of trustworthy information for hypertension management?					<0.01
Disagree	45	8.1	210	38.6	
Agree	302	90.6	332	61.1	
Do not know	7	1.3	2	0.4	
Do you know what you must do when you have problems in controlling your blood pressure?					<0.01
Disagree	22	4.0	28	5.2	
Agree	528	95.3	514	80.1	
Do not know	4	0.7	2	0.4	
Do you watch for changes in your health?					<0.01
Disagree	15	2.9	29	5.3	
Agree	535	96.6	509	93.6	
Do not know	3	0.5	6	1.1	
Can you easily find the health services that you need to manage hypertension?					<0.01
Disagree	39	7.0	10	1.9	
Agree	512			97.9	
Do not know	3	0.5	1	0.2	
Do you receive advice about how to care for your health from a healthcare provider?					<0.01
Disagree	18	3.2	14	2.6	
Agree	535	96.6	525	96.5	
Do not know	1	0.2	5	0.9	
Do you understand the advice given by the healthcare provider?					<0.01
Disagree	26	4.7	15	2.8	
Agree	527	95.1	526	96.7	
Do not know	1	0.2	3	0.6	
Do you know which types of diet you need to follow for effective control of blood pressure?					<0.01
Disagree	9	1.6	8	1.5	
Agree	542	97.9	534	98.1	
Do not know	3	0.5	2	0.4	
Do you know ways to help you take hypertension medication correctly as instructed by a health worker?					<0.01
Disagree	16	2.9	17	3.1	
Agree	530	95.7	520	95.5	
Do not know	8	1.4	7	1.3	
Salt intake knowledge and behaviour					
Do you think salt intake causes a serious problem? (yes/no)					<0.01
Yes	533	96.2	537	98.7	
How important is lowering salt in your diet? (Yes/No)					<0.01
Yes, it is important	538	97.1	541	99.4	

Continued

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Table 4 Continued

	Intervention n=554		Control n=544		
	N	%	N	%	P value
Do you do anything to lower salt intake? (Yes/No)					<0.01
Yes	360	65.5	405	74.4	
If you do something to lower salt intake, what do you do to lower salt in your diet? (multiple responses read out to them)					
Minimise consumption of processed foods	319	88.6	382	94.3	<0.01
Look at the salt or sodium labels on food	9	2.5	17	4.2	0.2
Add salt at the table	24	6.7	142	35.1	<0.01
Choose food with a low amount of salt	281	78.1	333	82.2	0.1
Reduce amount of salt when cooking	271	75.3	344	84.9	<0.01
Use spices other than salt when cooking	14	3.9	29	7.2	0.1
Avoid eating out	104	28.9	31	7.7	<0.01

use with ageing and cognitive decline as additional barriers.

> If the medicines were given as pills, it would be easy to arrange in the pill box, but we get them in strips, so it is not easy. Participant

Some participants continued modifying doses without medical consultation, reflecting scepticism about antihypertensive medications that CHWs could not fully address. Additional challenges, including disrupted supply, limited drug options at public primary healthcare facilities and high costs, further impeded adherence and led some participants to reduce the physician-recommended doses.

> My brothers were taking antihypertensives…they wanted me to take too, but I kept avoiding… she (CHW) convinced me to take … but I only take half 2.5 mg even though I am prescribed 5 mg. Participant

Contextual factors affecting implementation

Patient preference for hospitals and barriers to primary care linkage

Despite the intervention's intent to strengthen linkages to public primary healthcare facilities, participants in the intervention arm continued to prefer higher-level facilities for hypertension follow-up (66.1% vs 27.2%) (table 6). The absence of physicians at the public primary healthcare facility to titrate antihypertensive medication and assess complications likely contributed to this preference for hospitals. Continued reliance on higher-level facilities may have limited the impact of community-level support and undermined the role of public primary healthcare facilities in chronic disease management. Additionally, despite free services at public primary healthcare facilities, poorer families were reluctant to seek care due to concerns about the costs of diagnostic tests and medicine.

> There is a 50–55 year-old woman, her blood pressure is usually high, so I gave her a referral card to go for

Table 5 Change in alcohol and smoking behaviour at baseline and follow-up

	Baseline				Follow-up			
	Intervention n=627		Control n=625		Intervention n=554		Control n=544	
	Frequency	%	Frequency	%	Frequency	%	Frequency	%
Consumption of alcoholic drinks								
Non-drinkers	476	61.7	527	84.3	448	80.9	448	82.4
<Three standard drinks per week	46	7.3	26	4.2	19	3.4	21	3.9
≥Three standard drinks per week	105	16.8	72	11.5	87	15.7	75	13.8
Tobacco use								
Never	387	61.7	436	69.8	329	59.4	360	66.2
Former	109	517.4	59	9.4	115	20.8	69	12.7
Current	131	20.9	130	20.8	110	19.9	115	21.4

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Table 6 Hypertension follow-up care seeking behaviour in the follow-up survey

	Intervention n=554		Control n=544		
	N	%	N	%	
When did you go to seek hypertension follow-up?					<0.01
Went within 6 months	327	59.0	393	72.2	
Went within 1 year	19	3.4	9	1.7	
Went more than a year ago	208	37.5	142	26.1	
If you sought follow-up care, where did you go?					<0.01
Public healthcare facilities below hospitals	23	6.6	33	8.2	
Public and private hospitals	231	66.6	109	27.2	
Private pharmacies	91	26.2	251	62.4	
Other	2	0.6	9	2.2	
Did you take your blood pressure log when you went for follow-up? (yes/no)					
Yes	30	5.7	NA	NA	
Did the healthcare provider review your blood pressure logs? (yes/no)					
Yes	27	90.0	NA	NA	

a checkup …but she never goes… in every visit her blood pressure is high ……she says she doesn't have the money to pay for her checkup. CHW5

More participants in the control arm reported going for hypertension follow-up (72.2% vs 59.0%), primarily to private pharmacies for blood pressure monitoring (62.4% vs 26.2%), whereas intervention participants relied more on home blood pressure monitoring. Very few participants in the intervention arm brought their blood pressure logs to follow-up visits (5.7%); however, when logs were presented, healthcare providers reviewed them in most cases (90.0%).

Health system capacity and readiness

Training of healthcare providers improved knowledge (mean scores increased from 48.3% pre-training to 88.5% post-training), strengthened record-keeping practices and enhanced trust between providers and the community. However, non-implementation of package for essential non-communicable diseases (PEN) protocols at the district level, along with persistent medication stockouts and unavailability of diagnostic and recording tools, limited the translation of training into effective service delivery.

Training supported us … for example, before we didn't register to record hypertension patients, now we maintain a register, and we follow the PEN training manual to treat patients. HW03

We try to help non communicable disease (NCD) patients, but there is always a shortage of medicine… also, the government doesn't supply reporting and recording tools for documenting NCD patients as the PEN programme is not implemented in this district. HW02

DISCUSSION

This process evaluation examined the implementation of a CHW-facilitated home-visit intervention aimed at reducing blood pressure levels. Although the reductions were modest, the findings provide valuable insights for designing, adopting and scaling similar programmes in resource-constrained settings by highlighting delivery processes, deviations and operational challenges. Participants perceived the intervention positively, with high reach, minimal dropouts and strong satisfaction regarding timing, duration, frequency and acceptability of home visits for counselling. These findings demonstrate the potential of delivering home-based hypertension support in community settings using trained and renumerated CHWs.

Compared with prior home visit interventions reporting lower completion rates, completion rates in this trial were high.[23] Although interruptions from unplanned visitors during home visits were common, as might be expected in Nepali households, CHWs typically paused the session, included the visitors in the discussion and completed the home visit as planned. Nevertheless, not all participants completed all six visits. In urban settings, with high population mobility, such as the study context, challenges in scheduling and retention are anticipated. The high visit completion rate may be attributed to widespread mobile phone access facilitating follow-up, the acceptability of home visits across socioeconomic groups and the logistical and informational support embedded within the intervention, including the provision of blood pressure monitoring device, which may have incentivised the participants.

High fidelity to home visits was anticipated given CHW's training, mentorship and use of a contextually informed manual. While visits largely adhered to the manual,

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minor deviations in duration and modality occurred to accommodate participants' needs. Most participants developed behavioural action plans; however, these often lacked specificity and shared responsibility. This limitation may reflect gaps in CHWs' training related to action planning. Behaviour change frameworks such as the Capability, Opportunity, Motivation- Behavioural (COM-B) model emphasise that specific, clearly defined goals enhance capability, motivation, accountability and sustained behaviour change.[24] Future interventions should integrate the COM-B model and Behavioural Change Wheel into CHW training to support the identification of behavioural barriers and development of collaborative, measurable action plans. CHWs could also benefit from practical guidance and opportunities to practise these skills through role-plays. For example, CHWs could support action plans such as: *'The participant will walk for 20min after dinner three times per week, with a family member joining at least once weekly for encouragement.'* Training manuals could include similar case scenarios illustrating shared responsibilities to address common barriers, informed by formative research and piloting.

The intervention improved access to hypertension-related information and activated some but not all pathways influencing blood pressure reduction. Participants' commitment to behaviour changes varied and was shaped by gender roles and age-related preferences, family support and CHWs' tailored counselling approach. Older adults, women and participants with limited literacy often required ongoing support, highlighting the need for strategies that do not include regular writing and documenting in low-literacy populations. Previous studies similarly report variation in care uptake along the hypertension cascade by gender, age and income status.[25]

The intervention facilitated the translation of some but not all dietary salt-related knowledge into healthier behaviour. CHWs combined information provision with demonstration of recommended intake (<5g/day) but it was not sufficient to achieve reductions to the required levels, suggesting that behavioural intervention should be complemented by environmental and policy measures to achieve meaningful reductions.[26]

The intervention improved home blood pressure monitoring, consistent with prior studies reporting high acceptability due to perceived privacy and accuracy.[9 27] However, the effectiveness of home monitoring depends on access to medication titration services.[28] In this study, contextual barriers beyond the influence of CHWs, including the absence of physicians, disrupted medication supply, limited drug options and out-of-pocket costs, undermined access to timely and cost-effective medication titration. These findings underscore that the success of community-based interventions is dependent on functional health systems. Addressing the persistent inadequate supply of free antihypertensive medications in public healthcare facilities across South Asia could substantially enhance the effectiveness of community-based hypertension interventions in the region.[29 30]

Although provider training improved knowledge and record-keeping practices, the lack of district-level implementation of PEN protocols limited translation into effective service delivery. This misalignment between community-level intervention and health system readiness likely diluted the intervention's impact on blood pressure outcomes. Patient preference for private providers and hospitals, driven by perceived quality gaps in public primary healthcare facilities, further weakened efforts to establish referral linkage to primary care.[15] Future interventions in low-income urban settings in LMICs should actively engage private providers, particularly pharmacies and local governments, to improve access to antihypertensive medication and community resources for lifestyle change. Participatory tools such as photovoice or short videos may strengthen communication efforts when advocating for system-level change.[31]

The WHO endorses the use of appropriately trained, supervised and remunerated CHWs for non c0mmunicable disease prevention and control, and this intervention provides a practical model for implementation.[32] Evidence from LMICs demonstrates that task sharing with CHWs can effectively reduce blood pressure, while bridging cultural and language barriers.[33–35] While concerns persist regarding unpaid CHW labour,[36] evidence from Nepal and other LMICs shows that salaried CHW models are cost-effective and improve health outcomes.[37–39] Recent municipal CHW programmes in Nepal addressing chronic conditions further support the potential for scale-up in similar LMIC settings.[40]

Our findings offer additional insights for scaling community-based interventions. Components such as home-based counselling, structured behavioural action plans and provision of monitoring devices may be readily transferable across settings, whereas CHW training, supervision and health system integration are more context dependent. The persistent preference for hospital-based care in this study also highlights structural constraints that CHW-facilitated interventions alone cannot address. This underscores the need to strengthen primary healthcare alongside community programmes to support effective hypertension management.

A key strength of this study is the use of multiple data sources, including extensive qualitative and quantitative data. A prespecified theory of change guided the examination of mechanism of impact[41] and triangulation using surveys, and routine monitoring, observation and interviews enhanced the rigour of the findings. To our knowledge, this is among the first published process evaluations from Nepal of a potentially scalable CHW-facilitated intervention for hypertension management.

There are several limitations. We were unable to quantitatively assess differences in representativeness between eligible individuals who participated and those who did not, due to the small number of eligible individuals declining participation. Similarly, we were unable to assess adherence to the PEN protocols by public healthcare providers because of the low number of patients

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visiting the healthcare facilities during the observation period. Self-reported satisfaction and probing for behaviour change during interviews may have elicited socially desirable responses, and interviewing intervention recipients and family members may have introduced courtesy bias. Observation data may also have been influenced by the Hawthorne effect, as CHWs could have altered their performance when observed. To mitigate these potential biases, data collection was conducted by researchers independent of the intervention. Additionally, salary provisions for CHWs and the intensity of supervision provided during the trial may limit scalability under routine programme conditions. Finally, because the intervention was implemented in a single urban municipality in Nepal and transferability is highly context dependent, the findings should be generalised cautiously to other settings with differing health system capacities and socio-economic contexts.

CONCLUSION

Hypertension patients were satisfied with the CHW-facilitated home visits, which promoted some, but not all behaviours required for optimal blood pressure control. Uptake of intervention-promoted behaviours varied by individual characteristics including education, age and gender and was further constrained by weak primary care capacity. Future interventions should be embedded within a functional primary healthcare system that ensures consistent access to medication titration and follow-up care, alongside strengthened CHW training to support patients in developing clear, feasible action plans. Such integration is essential to enhance patient self-efficacy, sustain behaviour change and improve hypertension outcomes in low-resource settings.

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