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RESEARCH ARTICLE

Health services intervention integrating HTN and HIV care improves long-term blood pressure control among people living with HIV in Uganda

[version 1; peer review: awaiting peer review]

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Abstract

Background

Globally, the prevalence of hypertension (HTN) among people with HIV (PWH) has increased dramatically over the last decade. In a cluster randomized trial, we evaluated the effect of a multicomponent intervention model on blood pressure (BP) control among PWH in rural Uganda.

Methods

The integrated HIV/HTN trial enrolled adults (≥18-years) with HIV from 52 health centres in 26 districts of Southwestern Uganda. The intervention included: 1) health-worker training on integrating HTN care into HIV services, 2) promoting HTN screening and treatment among providers; 3) availing essential equipment and consumables; and 4) WhatsApp messaging for coordination. Among intervention participants with previously diagnosed HTN (defined as BP measurement >140/90 mmHg)), we evaluated longitudinal changes in

the proportion with World Health Organization (WHO) defined control (<140/90 mmHg) from trial baseline to 12-months of follow-up. We further reported the proportions that achieved BP reduction by ≥10 mmHg.

Results

Of the 1200 intervention participants with HTN, 60% were female, with a median age of 49 years. At trial baseline, only 3.6% of participants had controlled BP. After 12 months of the intervention, 36.7% had achieved control, corresponding to an absolute increase of 33.1% (95%CI: 25.3–41.0%; $p < 0.001$). Significant improvements in BP control were observed across subgroups of age, sex and level of health centre. In addition, after 12 months, 70% of all participants had achieved at least 10 mmHg reduction in their BP, including 74% of participants with baseline Grade 2 HTN (160–179/100–109 mmHg) and 79% of participants with Grade 3 HTN (≥180/110 mmHg). Among participants without WHO-level control at 12-months, 54% achieved ≥10 mmHg reduction in BP.

Conclusion

This health services intervention to integrate HTN and HIV care in rural primary care facilities improved long-term BP control by 30% and most participants with baseline Grade 2 and 3 HTN achieved >10 mmHg reduction in their BP over the 12-month follow-up.

Keywords
Integrated care; non-communicable disease; Long-term follow-up; cohort; Hypertension; HIV; Co-morbidity; Blood pressure



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Introduction

Hypertension (HTN), a chronic condition characterized by high blood pressure (BP), significantly increases the likelihood of other cardiovascular and cerebrovascular diseases and stands as a leading, preventable risk factor for global mortality and morbidity.[1] High BP is defined as systolic (SBP) ≥140 mmHg or diastolic blood pressure (DBP) ≥90 mmHg.[2] In response to the 2011 United Nations declaration on non-communicable diseases (NCDs), countries committed to reducing premature mortality from four key NCDs by 25% by 2025. This commitment also included targets for reducing risk factors associated with NCDs.[3]

Worldwide, an estimated 1.28 billion adults aged 30–79 years have HTN, most (two-thirds) of these live in low- and middle-income countries.[4] With the advent of antiretroviral therapy (ART), many people with HIV (PWH) are living longer and consequently exposed to the epidemiologic transition that has seen the burden of NCDs, including HTN, diabetes and lipid disorders, match or even eclipse that of infectious diseases. The prevalence of HTN among PWH has increased dramatically over the last decade.[5] In this group of persons, the combined effect of HIV and HTN is thought to lead to early atherosclerotic cardiovascular disease, which is the main driver of major adverse cardiovascular events.[6] Traditional cardiovascular disease risk factors like smoking, combined with HIV infection and prolonged ART further elevate this risk.[7,8] In a systematic review of 15 trials (37,348 participants) between 1950 and 2011, Jicheng et al showed that intensive BP management lowered BP by an average of 7.5/4.5 mmHg more than less intensive strategies which achieved relative risk reductions of 11% for major cardiovascular events.[9]

However, interventions for tight BP control in the PWH have been sparse with more recent efforts targeted at integrating HIV and HTN care. In a facility-cluster randomized trial, we demonstrated that a multicomponent integrated care model improved the uptake of HTN screening by 55% compared to the standard of care group.[10] We also hypothesized that the intervention would lead to individual long-term improvements in BP control. in addition to the community screening targets. We therefore evaluated change in BP control and reductions in BP over time among PWH with a prior HTN diagnosis in the intervention arm.

Methods

Overall design

The design and the study protocol has been previously published.[11] Briefly, as part of the a cluster randomised trial, 52 health facilities from 26 districts in Southwestern Uganda were randomised into the intervention and a control arms. In facilities of the control arm, standard of care was maintained including access to HTN services. The intervention package was an integrated HIV/HTN care delivery model and included: 1) Training and capacity building on the integrated HIV/HTN model and NCD care; 2) Promoting HTN screening and care among providers in HIV clinics; 3) Health Management Information System (HMIS) enhancements through mentorship and coaching on the use of NCD registers and NCD patient cards, and capture of HTN data in the existing Electronic Medical Records (EMR) of Uganda; 4) WhatsApp messaging for data coordination and communication among providers, District Health Officers and the project staff.[11] The study was registered with the ClinicalTrials.gov. (Details: Clinical trial registration ID: NCT04624061, https://clinicaltrials.gov/study, and date of registration: 2022-11-04) The multicomponent care model was delivered by frontline healthcare professionals who were trained on the intervention package delivery. In addition, the healthcare providers had up to four coaching and mentorship sessions during the study period. As previously reported, the intervention significantly improved the proportion of PWH having undergone HTN screening within the past 6 months, as compared to the control and as assessed in consecutive cross-sectional surveys at baseline and 12 months.[10] In this paper, we describe longitudinal changes in HTN control (BP < 140/90 mmHg) and longitudinal reductions in BP from baseline to 12 months follow-up among PWH who had been diagnosed with HTN at or before baseline.

Study population

The study population comprised adults (≥ 18 years) PWH with at least one clinic visit at the intervention health facility between 01 November 2020 and 22 August 2023 and had a documented HTN diagnosis (defined as having an elevated blood pressure (BP > 140/90 mmHg) or HTN treatment prescription documented in their medical record prior to trial baseline). All eligible participants from each health facility were enrolled in the longitudinal cohort.

Data collection procedures

From medical records, the trained research assistants reviewed and collected data on basic demographics and BP measurements over follow-up. Specifically, we obtained the blood pressure measure every 3 follow-up months via the clinic record closest to and within 45 days of 0 (from enrolment), 3, 6, 9, and 12 months of follow-up. This review of medical records and data collection took place from 01 November 2020 to 22 August 2023.

Study outcomes & statistical analysis

We used descriptive statistics to summarize the sociodemographic and clinical characteristics of the participants at baseline. We evaluated changes in the proportions with BP control (<140/90 mmHg) from baseline to 12 months of follow-up, overall and within subgroups defined by sex, age group (18–40 years versus 41+ years), and level of health centre delivery (level III versus level IV). We excluded participants from the 12-month calculations if they did not have BP measurement recorded. We tested the null hypothesis of no changes in HTN control over follow-up with a two-sided test at the 5% significance level and accounted for clustering by facility. At 3, 6, 9, and 12 follow-up months, we also reported the proportions achieving 10+ mmHg reduction in systolic or diastolic BP from baseline, overall and by baseline HTN severity. Throughout, HTN severity was classified using the 2020 guidelines of the International Society of Hypertension: Normal: <140/90 mmHg; Grade-1 HTN: 140–159/90–99 mmHg; Grade-2 HTN: 160–179/100–109 mmHg; Grade-3 HTN:≥180/110 mmHg.[12] All the analysis was performed in *R* version 4.4.3.[13]

Ethical considerations:

This study was reviewed and approved by the ethics committees of Makerere University School of Medicine on September 8, 2020 (approval number: 2020–156), the London School of Hygiene and Tropical Medicine on September 2, 2020 (approval number 22196), and the Uganda National Council for Science and Technology on November 9, 2020 (approval number: HS979ES). All participants provided written informed consent for data extraction from existing records at the health facility. Strict confidentiality was upheld throughout the study. Unique numbers were used to identify eligible participants' records.

Results

We enrolled 1200 participants with both HIV and HTN from the 26 intervention health centres from 01 November 2020 to 22 August 2023. Over half (60%) were female and their median age 49 years (1st-3rd quartile: 40–58; Table 1). Roughly half (47.4%) of the participants came from health centre III and half (52.6%) were registered at health centre IV. At trial baseline, 43 (3.6%) participants had controlled HTN, 458 (38.2%) had Grade 1 HTN, 456 (38.0%) had Grade 2 HTN, and 243 (20.2%) had Grade 3 HTN. Furthermore, 85.1% of the participants had started on HTN medication at enrollment and 4.5% of the participants had already been on HTN medication for at least 6 months prior to enrollment. Nearly all (98.4%) had started on ART by the time of enrollment with a median duration on ART of 6.2 years (3.4,9.1). Few participants (3.7%) reported smoking in the past year whereas 17.9% reported alcohol use in the past month. Adequate physical activity, defined as at least 150–300 minutes of moderate-intensity aerobic physical activity, was reported by 42.2% of the participants. The median BMI of the participants was 23.1 (1st-3rd quartile: 20.7–26.4). Only 16 participants (1.3%) had diabetes mellitus. Of those who had problems at enrollment, vision problems were the most common (N = 62; 7.7%), followed by neurological problems (N = 30; 4.0%), and heart problems at (N = 23; 3.1%).

At baseline, only 3.6% of participants had HTN control. After 12 months of intervention, 36.7% had achieved control, corresponding to an absolute increase of 33.1% (95%CI: 25.3–41.0%; $p < 0.001$) from baseline. Significant improvements in BP control were observed within all subgroups: control among women improved from 4.1% to 38.1% and control among men improved from 2.9% to 34.6%. Improvements in HTN control were observed among younger participants aged 18–40 years, increasing from 2.4% to 37.3%, and among older participants aged 41+ years, increasing from 3.5% to 36.8%. By healthcare delivery level, HTN control increased from 3.2% at baseline to 40.6% at 12 months for participants at health center level III, and from 4.0% at baseline to 33.2% at 12 months for those at level IV. Table 2 shows the proportions of participants who reduced their systolic or diastolic BP by ≥10 mmHg over time. Overall, 70% of participants had reduced their baseline BP by ≥10 mmHg by 12 months. BP reductions were observed across all stages. For instance, BP reductions for participants in the baseline control group showed an initial increase from 23% at Month-3 to 30% at Month-6, then a slight dip to 26% at Month-9, followed by a significant jump to 53% at Month-12. Additionally, BP reductions for participants in the Baseline Grade 1 group showed a gradual increase from 50% at Month-3 to 64% at Month-9, with a slight decrease to 62% at Month-12. Further, BP reductions for participants in baseline Grade 2 group generally showed an increasing trend, starting at 65% at Month-3 and reaching 74% at Month-12. There was a slight dip at Month-9. And the BP reductions for participants in baseline Grade 3 group consistently showed the highest percentages among all baseline groups, starting at 75% at Month-3, increasing to 84% at Month-9, and then showed a slight decrease to 79% at Month-12. Importantly, among participants who did not achieve BP control by 12-months, more than half (54%) still reduced their BP by ≥10 mmHg from baseline.

Discussion

In this study, designed to determine if an integrated HIV/HTN care model led to longitudinal improvements BP management, we found a > 30% increase in the proportion of participants with BP control (<140/90 mmHg) after 12 months of the intervention. Although a substantial proportion remained uncontrolled, most participants with baseline Grade 2 and 3 HTN meaningfully reduced their systolic or diastolic BP over the 12-month follow-up period.

Table 1. Sociodemographic and clinical characteristics in N (% among measured), unless noted, of 1200 intervention participants with HIV and hypertension at baseline, overall and by sex.

Category	Men	Women	Overall
	N = 484	N = 716	N = 1200
Age, median [Q1,Q3]	49 [40.8,58]	50 [40,57]	49 [40,58]
Health centre III	221 (45.7%)	348 (48.6%)	569 (47.4%)
Systolic BP, median [Q1, Q3]	155 [146,165]	154 [144.8,167]	155 [145,166]
Diastolic BP, median [Q1, Q3]	98 [91,105]	99 [92,105]	99 [92,105]
Controlled HTN (<140/90 mmHg)	14 (2.9%)	29 (4.1%)	43 (3.6%)
Grade 1 HTN (140–159/90–99 mmHg)	200 (41.3%)	258 (36%)	458 (38.2%)
Grade 2 HTN (160–179/100–109 mmHg)	178 (36.8%)	278 (38.8%)	456 (38%)
Grade 3 HTN (≥180/110 mmHg)	92 (19%)	151 (21.1%)	243 (20.2%)
Started HTN medication at enrollment	175 (84.1%)	282 (85.7%)	457 (85.1%)
Started HTN medication 6+ months ago	11 (5.3%)	13 (4%)	24 (4.5%)
Started ART before enrollment	181 (98.9%)	257 (98.1%)	438 (98.4%)
Years on ART, median [Q1,Q3]	5.7 [2.8,8.6]	6.7 [3.6,9.6]	6.2 [3.4,9.1]
Smoking in past year	22 (5.5%)	14 (2.4%)	36 (3.7%)
Alcohol use in past month	112 (28.2%)	64 (10.9%)	176 (17.9%)
Adequate physical activity	160 (47.1%)	199 (39%)	359 (42.2%)
BMI, median [Q1,Q3]	22.2 [19.9,24.7]	23.7 [21.2,27.8]	23.1 [20.7,26.4]
With diabetes	4 (0.8%)	12 (1.7%)	16 (1.3%)
Vision problems	18 (5.5%)	44 (9.2%)	62 (7.7%)
Heart problems	9 (3%)	14 (3.1%)	23 (3.1%)
Kidney problems	0 (0%)	0 (0%)	0 (0%)
Foot problems	3 (1%)	5 (1.1%)	8 (1.1%)
Neurological problems	10 (3.3%)	20 (4.5%)	30 (4%)

Note: Q1: first quartile; Q3: third quartile; ART: antiretroviral therapy; BMI: body mass index.

Table 2. A table showing the proportion of participants reducing their blood pressure by at least 10 mmHg over time, overall and by baseline severity: control (<140/90 mmHg), Grade 1 (140–159/90–99 mmHg), Grade 2 (160–179/100–109 mmHg), and Grade 3 (≥180/110 mmHg).

	N	Month-3	Month-6	Month-9	Month-12
All	1200	61% (420/694)	65% (431/661)	69% (397/572)	70% (353/504)
Baseline control	43	23% (5/22)	30% (6/20)	26% (6/23)	53% (9/17)
Baseline Grade 1	458	50% (128/254)	53% (132/250)	64% (123/192)	62% (109/177)
Baseline Grade 2	456	65% (184/281)	71% (176/247)	70% (161/229)	74% (142/193)
Baseline Grade 3	243	75% (103/137)	81% (117/144)	84% (107/128)	79% (93/117)

Note: Denominator reflects the number of participants with blood measures available at the follow-up month.

Together these findings demonstrate that a health services intervention that integrates HIV and HTN care could lead to improvements in BP control among PWH. The adoption of this strategy in HIV clinics is likely to lead to a reduction in cardiovascular complications among PWH. The BP control improvements observed in this study are similar to what was observed in the SEARCH study conducted in 10 communities in rural Uganda, where BP control at follow-up visits over 3 years was 48% among the PWH.[14] Further, the improvement in BP control among PWH participants in this study is consistent with a recent study, which was conducted in a large urban HIV clinic, that achieved universal HTN screening among PWH at each visit, and showed improvement in BP control from 14.4% at baseline to 66.1% at 6 months.[15] These findings suggest that integration of HIV care in an HIV clinic is feasible and can improve clinical outcomes in diverse

settings in sub-Saharan Africa. Similar findings were seen in other studies in the region that evaluated chronic care interventions delivered at HIV clinics.[16,17]

In this study, 70% of all PWH had reduced their BP by ≥10 mmHg, although the participants did not achieve optimal BP control. Further, we observed blood pressure reduction of ≥10 mmHg was among participants who had Grade 2 HTN (74%) and Grade 3 HTN (79%) at baseline. Optimal BP control is often difficult to achieve among HIV populations due to health system factors such as poor adherence to antihypertensive medication due to limited supply, patient's lack of awareness, and low medication dosages.[18–27] The study team provided buffer stocks of antihypertensive medications to address supply chain issues, but these reserves were still inadequate to fully compensate for the ongoing shortages from Uganda's National Medical Stores. A modest BP reduction, on average, can lead to meaningful gains in reducing cardiovascular risk.[28,29] Among PWH, BP reduction can prevent cardiovascular diseases including stroke even if patients do not achieve normotensive BP levels.

Strengths and limitations

The study was conducted within routine HIV clinic workflows, reflecting real-world health system conditions, which strengthens its relevance. By capturing BP changes in PWH within the context of existing healthcare delivery challenges, the study offers practical insights for developing targeted HTN management programs in similar settings. This study also has limitations. This study's scope was restricted to the intervention arm. This was purposeful choice to ensure validity of findings, given the prevalent data collection inconsistencies observed the standard of care arm. Therefore, while this evaluation offers valuable insights into the intervention's effect on individual blood pressure, it lacks the ability to directly compare the intervention's effect against standard care practices among the PWH. However, in a randomized comparison, we previously showed the integrated multicomponent model improved the uptake of HTN screening by 55% compared to the standard of care group.[10] Additionally, there was reliance on routine data collection, which are subject to missingness but also reflective of real-world results, as compared to data collected solely for research purposes. Further, our results might be optimistic because we restricted to participants with BP measurements in the relevant follow-up windows; their outcomes may be different than participants who dropped out of care.

Conclusion

This health services intervention to integrate HTN and HIV care in many rural primary care facilities (the "integrated HIV/HTN care model") improved long-term BP control by 30% and most participants in WHO Grade 2 and 3 HTN achieved more than 10 mmHg reduction in their BP over the 12-month follow-up.

Description of the data and file structure

The data provided are in a comma-separated-value (CSV) file that includes variable names as column headers. The data file name is int_htn_long_shared.csv The corresponding data dictionary is an excel document filename is int_htn_long_dd.csv.

Supplemental Files: Supplemental files included in the archive is README.md.

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Data availability statement

The supporting data for this paper is available in the Dryad data repository: Dryad: "Health services intervention integrating HTN and HIV care improves long-term blood pressure control among people living with HIV in Uganda: https://doi.org/10.5061/dryad.63xsj3vdj.[30]

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