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2023-08-08
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Hypertension

ORIGINAL ARTICLE

Significant Improvement in Blood Pressure Levels Among Older Adults With Hypertension in Rural South Africa

Enrico G. Ferro, Shafika Abrahams-Gessel, David Kapaon, Brian Houle, Jacques Du Toit, Ryan G. Wagner, F. Xavier Gómez-Olivé, Alisha N. Wade, Chodziwadziwa W. Kabudula, Stephen Tollman, Thomas A. Gaziano

BACKGROUND: Sub-Saharan Africa is undergoing an epidemiologic transition from infectious diseases to cardiovascular diseases. From 2014 to 2019, sociodemographic surveillance was performed in a large cohort in rural South Africa.

METHODS: Disease prevalence and incidence were calculated using inverse probability weights. Poisson regression was used to identify disease predictors. The percentage of individuals with controlled (<140/90 mm Hg) versus uncontrolled hypertension was compared between 2014 and 2019.

RESULTS: Compared with 2014 (n=5059), study participants in 2019 (n=4176) had similar rates of obesity (mean body mass index, 27.5±10.0 versus 27.0±6.5) but higher smoking (9.1% versus 11.5%) and diabetes (11.1% versus 13.9%). There was no significant increase in hypertension prevalence (58.4% versus 59.8%; age adjusted, 64.3% versus 63.3%), and there was a significant reduction in mean systolic blood pressure (138.0 versus 128.5 mm Hg; $P<0.001$). Among hypertensive individuals who reported medication use in 2014 and 2019 (n=796), the proportion with controlled hypertension on medication increased from 44.5% to 62.3%. Hypertension incidence was 6.2 per 100 person-years, and age was the only independent predictor. Among normotensive individuals in 2014 (n=2257), 15.2% developed hypertension by 2019, with the majority already controlled on medications by 2019.

CONCLUSIONS: The hypertension prevalence and incidence are plateauing in this aging cohort. There was a statistically and clinically significant decline in mean blood pressure and a substantial increase in individuals with controlled hypertension on medication. The prevalence of cardiometabolic risk factors did not decrease over time, suggesting that the blood pressure decrease is likely due to increased medication access and adherence, promoted by local health systems. ***(Hypertension.* 2023;80:1614–1623. DOI: 10.1161/HYPERTENSIONAHA.122.20401.)** • **Supplement Material**.

Key Words: Africa south of the Sahara ■ developing countries ■ health services accessibility ■ hypertension ■ medication adherence

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Cardiovascular disease (CVD) disproportionally affects low- and middle-income countries, where 75% of global CVD deaths currently occur.[1,2] Hypertension is a silent yet ominous predictor of CVD: worldwide, 55% of deaths from stroke and coronary disease are caused by hypertension, accounting for 8.25 million deaths in 2017 alone.[3] Despite the established link between hypertension and CVD, it is alarming that the rates of hypertension detection remain low globally, with <10% of patients with hypertension achieving blood pressure (BP) control.[4]

See Editorial Commentary, pp 1624-1627

Sub-Saharan Africa (SSA) represents a particularly vulnerable region, as this area alone accounted for 5.5%

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Supplemental Material is available at https://www.ahajournals.org/doi/suppl/10.1161/HYPERTENSIONAHA.122.20401.
For Sources of Funding and Disclosures, see page 1622.

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NOVELTY AND RELEVANCE

What Is New?

While prior studies from Sub-Saharan Africa have traditionally identified the highest blood pressures and the lowest hypertension treatment rates worldwide, our longitudinal assessment found a significant drop in mean systolic blood pressure of 10 mm Hg and an increase in self-reported medication use.

What Is Relevant?

This study documents a decline in a hard outcome (ie, mean blood pressure in a large cohort), which is occurring without a concomitant decrease in cardiometabolic risk factors. Rather, the blood pressure decline is occurring while the South African government implements interventions to increase medication access and adherence, as well as salt reduction policies.

Clinical/Pathophysiological Implications?

Although the study results may not be immediately extrapolated to all other African regions, our cohort is a case study for other countries in Sub-Saharan Africa that are battling similar epidemics of hypertensive heart disease. Our results support the shift of health care resources toward primary care–based interventions that are integrated within the local communities and complement the historical agenda of infectious diseases with surveillance systems that can promptly diagnose and treat noncommunicable diseases.

Nonstandard Abbreviations and Acronyms

BP	blood pressure
CVD	cardiovascular disease
PY	person-year
SBP	systolic blood pressure
SSA	Sub-Saharan Africa

of global CVD deaths in 2013.[2] The expected CVD burden in SSA will exponentially increase due to an epidemiological transition from infectious diseases to coronary disease and heart failure—on top of a demographical transition with aging populations.[5] Within SSA, the prevalence and treatment rates of CVDs are heterogeneous, due to differences in each country's ability to generate epidemiologic data and deliver targeted interventions through local health care systems.[6]

South Africa is one of the most studied countries in SSA, generating cardiovascular epidemiologic data over 15 years and uncovering a rapidly advancing epidemic of hypertensive heart disease.[7–10] A growing body of evidence has challenged the traditional belief that hypertension is primarily the result of labor migration to urban areas and transition to the Western lifestyle, as similarly high rates of hypertension (≈55%) have been detected in urban and rural areas.[7,8,10] In fact, migrant workers who become ill or simply age in urban areas usually return to their rural communities to seek care, which makes rural health systems disproportionally affected by the clinical manifestations of hypertensive heart disease.[11]

For these reasons, in 2014, our group began studying the impact of hypertension and other CVDs in a cohort of ≈5000 elderly individuals in the rural Agincourt subdistrict in South Africa, which has undergone sociodemographic surveillance since 1992.[8,12] The first baseline assessment of this cohort in 2014 identified an alarmingly high prevalence of hypertension (58%), which seemed to be mostly uncontrolled, as evidenced by the significant association with end-organ damage such as left ventricular hypertrophy and diastolic dysfunction on electrocardiogram and echocardiogram.[8,13] These individuals were prospectively followed until 2019, when a second assessment was performed to (1) determine the updated prevalence and incidence of hypertension and other CVDs and (2) characterize the evolution in BP control within this cohort. Ultimately, this longitudinal assessment can identify opportunities for targeted interventions that can improve control of BP and other cardiometabolic risk factors and provide tangible insight for other parts of SSA that face a growing burden of CVD.

METHODS

Data Availability

The data that support the findings of this study are available from the corresponding author upon reasonable request. The HAALSI (Health and Aging in Africa: a Longitudinal Study of an INDEPTH Community) protocol has been described previously[8,12,14,15] and is available in the Supplemental Material. The study was approved by the Institutional Review Boards of the University of the Witwatersrand and Harvard T.H. Chan School of Public Health.

Study Design and Variable Definition

To provide internally consistent comparisons, all variable definitions in W2 were identical to W1, as described in the Supplemental Material.[8] The primary variable of this study, hypertension, was defined as a mean systolic BP (SBP) ≥140 mm Hg or mean diastolic BP ≥90 mm Hg or self-reported current use of hypertensive medications.[16,17] We detail the protocols used to measure BP in an accurate, precise, and reproducible manner in the Supplemental Material.

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Statistical Analysis

Analyses were conducted using the STATA, V 17.0, software (StataCorp, College Station, TX), with α=0.05 for statistical significance. Both unweighted and weighted values were calculated, with inverse probability weights applied to the latter to account for mortality, attrition, or refusal to provide data in W2.

The first goal of the analysis was to determine the updated prevalence and incidence of cardiovascular conditions. Age-adjusted hypertension prevalence was calculated for each wave in comparison to the rest of the HAALSI cohort. Due to the 4-year interval between the 2 assessments, the 439 participants <45 years of age in the baseline survey were excluded to create comparable estimates. As the date of diagnosis for incident conditions was unknown, we defined the exposure time for calculating incidence as half of the time elapsed between W1 and W2. Incidence rates are per 100 person-years (PY), along with 95% CIs. Poisson regression was used to create multivariate models to identify predictors of disease incidence. Univariate models, and tests of interaction between pairs of variables, were run to determine the most parsimonious multivariate models. Model covariates were selected if univariate associations were statistically significant (P<0.05) or had a P value <0.20 and were considered clinically relevant. Incidence rate ratios and 95% CIs are reported.

The second goal of the study was to characterize the evolution in BP control between W1 and W2. This analysis was limited to the subgroup of individuals who provided BP measurements and BP medication use in both waves. Based on these 2 pieces of information, individuals were assigned to 1 of 4 groups: normal BP not on medications (ie, normotensive), controlled hypertension on medications, uncontrolled hypertension on medications, and uncontrolled hypertension not on medications, where BP <140/90 mm Hg was used to indicate hypertension control. The percentage of individuals in each group, and their transition from one group to the other, was compared between W1 and W2 for the main cohort and stratified by sex. To explore systematic differences among survey nonresponders, BP values were calculated for participants who provided a W1 BP measurement but subsequently died or were lost to follow-up.

RESULTS

Updated Demographics and Prevalence of Cardiovascular Conditions

Of the 5059 participants who completed the baseline W1 survey in 2014 to 2015, 595 people (11.8%) died before the follow-up W2 survey that was conducted between October 2018 and November 2019. Therefore, the total number of participants who were alive and could be evaluated at follow-up was 4464. Of these, 4176 participants (93.5%) completed the follow-up survey, while 254 participants (5.7%) refused to participate in the W2 assessment and 34 participants (0.8%) could not be found at follow-up.

Compared with W1, the W2 participants were expectedly older (mean age, 65.1±12.6 versus 62.4±13.0 years; Table 1) but had similar sex distribution (55.4% versus 53.6% women) and weighted rates of obesity (mean body mass index, 27.0±6.5 versus 27.5±10.0), with significantly higher rates of smoking (9.1% versus 11.8%; P<0.001), diabetes (11.1% versus 13.7%; P<0.001), and combined CVD (defined as self-reported angina, myocardial infarction, heart failure, and stroke, 5.8% versus 8.7%; P<0.001). The hypertension prevalence did not significantly increase over time in unadjusted (59.8% versus 58.4%; P=0.39) and age-adjusted (64.3% versus 63.3%) analyses in the overall cohort and stratified by sex (men, 58.7% versus 57.24%; women, 69.2% versus 68.2%). There was a significant reduction in mean SBP (138.0 versus 128.5 mm Hg; P<0.001) and mean diastolic BP (82.1 versus 79.6 mm Hg; P<0.001).

Incidence and Predictors of Cardiovascular Conditions

In weighted analyses, there were 544 incident cases of hypertension between 2014 and 2019. The overall hypertension incidence rate was 6.2 per 100 PY (Table 2). With 353 and 148 events, the incidence rates for diabetes and combined CVD were 1.7 and 0.9 per 100 PY, respectively. In multivariate models, age was a significant predictor of incident hypertension and diabetes, and chronic kidney disease was a predictor of combined CVD (Table 3). Other predictors, like body mass index, positive HIV status, and higher education, had a significant association in univariate but not multivariate models.

BP Control Among Individuals With Known and New-Onset Hypertension

This analysis is limited to the subgroup of individuals who provided BP measurements and self-reported BP medication use in both waves.

Among individuals with known hypertension at baseline (n=796), the percentage who had controlled hypertension on medications increased from 44.5% to 62.3%, and their mean SBP declined from 124 to 118 mm Hg at follow-up (Figure 1). The percentage of individuals with uncontrolled hypertension on medications decreased (48.5%–32.2%), and mean SBP also declined from 165 to 156 mm Hg. Lastly, the percentage of individuals with uncontrolled hypertension not on medications was low (7.2%) and further declined (3%), without a meaningful change in SBP. While the mean diastolic BP declined in all subgroups from W1 to W2, the absolute changes were smaller.

Among normotensive individuals, that is, without a diagnosis of hypertension during the baseline assessment (n=2257), 84.8% remained normotensive at follow-up (n=1914). The mean SBP of normotensive individuals declined from 119 to 115 mm Hg (Figure 2). Among the few individuals who developed hypertension after the baseline assessment (n=343; 15.2% of the W1 subgroup), almost all (87.2%) were already on medications

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Table 1. Baseline Characteristics and Prevalence of Cardiovascular Comorbidities

Variable	Wave 1 (2014)		Wave 2 (2019)	
	Survey respondents, n	Mean or percentage	Survey respondents, n	Mean or percentage (weighted)
Survey respondents	5059	100%	4176	82.5%
Documented as dead	0	0%	595	11.8%
Lost to follow-up	0	0%	288	5.7%
Demographics				
Age, y (mean±SD)	5059	62.4±13.0	4176	65.1±12.6
Female sex, %	5059	53.6%	4176	55.4%
Current smoker, %	5059	9.1%	4176	11.5%
Current alcohol drinker, %	5059	23.1%	4176	20.6%
High fruit consumption	5059	23.6%	4176	28.7%
High vegetable consumption	5059	33.6%	4176	42.0%
Anthropometric and laboratory measurements				
SBP, mm Hg (mean±SD)	4895	138.0±23.3	3376	128.4±20.4
DBP, mm Hg (mean±SD)	4895	82.1±12.7	3376	79.4±11.7
Body mass index, kg/m^2 (mean±SD)	4680	27.5±10.0	3116	27.0±6.5
Waist-hip ratio (mean±SD)	4728	0.9±0.1	2931	0.9±0.1
Random blood glucose, mmol/L (mean±SD)	4626	6.7±2.1	3204	6.9±3.0
HIV positive, %	4576	22.9%	3110	23.9%
Cardiovascular comorbidities				
Hypertension, % (SBP ≥140, DBP ≥90, or medications)	4936	58.4%	3646	59.8%
Age-adjusted hypertension, %	4497	64.3%	3646	63.8%
Hypertension, % (SBP ≥130, DBP ≥80, or medications)	3746	74.0%	3646	75.0%
Obesity	4786	30.0%	3136	30.6%
Diabetes	5054	11.1%	4176	13.9%
Chronic kidney disease (self-reported)	5054	4.2%	4176	3.5%
Cardiovascular disease, combined (self-reported)	5059	5.8%	4176	8.7%
Angina	5055	2.4%	4157	3.6%
Myocardial infarction	5056	0.4%	4156	0.9%
Heart failure	5056	0.7%	4156	1.1%
Stroke	5056	3.0%	4175	4.6%

DBP indicates diastolic blood pressure; and SBP, systolic blood pressure.

at follow-up (n=299), and the majority of participants (62.7%) already had controlled hypertension (n=215). The same results were obtained after stratifying by sex (Figures S1 and S2). The distribution of risk factors like obesity or smoking remained stable or sometimes increased between W1 and W2 (Table S1). Lastly, the mean BP value at baseline for individuals who subsequently died or were lost to follow-up before the W2 assessment was not meaningfully higher compared with the individuals who were alive and provided W2 data (Table S1).

DISCUSSION

The goal of this study was to longitudinally follow a large prospective cohort of older individuals in rural South Africa, to understand the evolution in key cardiovascular conditions over a period of 5 years, from 2014 to 2019. Given the 60% hypertension prevalence previously documented in this cohort, our study had a particular focus on understanding the evolution in BP control and medication use. We had the following notable findings: (1) the prevalence of hypertension did not significantly increase between baseline and follow-up assessments; (2) there was a deceleration in the hypertension incidence rate over 5 years; (3) there was a clinically and statistically significant decline in mean SBP by ≈10 mm Hg in the entire cohort, together with a notable increase from 44% to 62% in the subgroup of hypertensive individuals who achieved hypertension control on medications.

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Table 2. Weighted Incidence of Cardiovascular Comorbidities

Variable	Events (weighted)	PYs	Incidence rate, weighted (events/100 PYs)	95% CI
Hypertension (SBP ≥140, DBP ≥90, or medications)	544	8780	6.2	5.6–6.9
Obesity	308	8476	3.6	3.2–4.2
Diabetes	353	20907	1.7	1.5–1.9
Cardiovascular disease, combined (self-reported)	148	15910	0.9	0.8–1.1

DBP indicates diastolic blood pressure; PY, person-year; and SBP, systolic blood pressure.

As in any prospective study of an aging population, one would expect an unavoidable increase in the prevalence of cardiovascular conditions, for which age alone is a risk factor. Furthermore, most end-organ outcomes (such as strokes and heart attacks) are irreversible events that accumulate over time. As such, it is unsurprising that the prevalence of cardiovascular conditions like diabetes or stroke increased in our cohort between 2014 and 2019. Considering these expected trends, however, it is even more important to highlight that the prevalence of hypertension in our cohort plateaued at around 60%. This is a particularly meaningful result in a country like South Africa, which has been at the forefront of the epidemic of hypertensive heart disease of SSA—a region that repeatedly reports the highest mean BPs worldwide and the lowest hypertension treatment rates.[4,10] This important result likely has a multifactorial explanation, and the current study provides the foundational evidence to further explore the interplay between the pharmacological and nonpharmacological forces that are acting on our cohort over the years.

As a first step, it is important to understand how the observed plateau in hypertension prevalence relates to hypertension incidence. Over the 5 years of our study, we found that 15.2% of individuals developed hypertension, generating a weighted hypertension incidence rate of 6.2 per 100 PY. Contextualizing these results is difficult, as there is scarcity of longitudinal studies on the development of hypertension in SSA (outnumbered by single cross-sectional assessments of hypertension prevalence).[10] The few available longitudinal studies are limited to people living with HIV, since countries like South Africa remain focused on an unfinished agenda of infectious diseases.[18] While these studies report a wide range of hypertension incidence rates throughout SSA (from 5.4 to 12 per 100 PY), they enrolled a younger population (mean age, 35–45 years) with lower baseline prevalence of hypertension (10%–20%).[18–20]

The 2 cohorts that studied all-comers (regardless of the HIV status) are based in South Africa and recruited normotensive adults from 2005 to 2010 and from 2010 to 2015, respectively.[9,10] Both studies found that 24% to 29% of participants developed hypertension over 5 years (generating an adjusted incidence rate of 8.4 per 100 PY), which are much higher than our results—even if they also recruited a younger population. One of these studies was conducted in the same rural subdistrict of Agincourt,[9] which favors a more direct comparison of our results. Taken together, these data suggest that the plateau in the hypertension prevalence may be partly driven by a decrease in hypertension incidence in this region. Importantly, people who died or were lost to follow-up before the W2 assessment did not have a significantly higher BP in W1; thus it seems less likely that the decreasing hypertension incidence were driven by survival or selection bias.

Despite the promising decline in hypertension incidence, our analyses did not consistently identify many predictors of cardiovascular conditions. This could be partly due to the fact that some variables may act both as risk and protective factors. For example, there have been contrasting results when studying HIV and hypertension in South Africa. On one hand, HIV-induced chronic inflammation and ART nephrotoxicity may promote hypertension; on the other hand, HIV-induced cachexia or the increased health care utilization may mitigate the risk of developing hypertension.[9,10,18–20] Statistical models may thus fail to predict which of these competing forces will ultimately drive the association between HIV and hypertension. For more established risk factors like hypertension and body mass index, perhaps a longer observation time is needed to unmask the effects of these variables on CVD.

As the next step, our analysis explored some mechanistic forces behind the plateauing prevalence and decelerating incidence of hypertension in our cohort. As traditionally defined, our composite definition of hypertension included both BP cutoffs and antihypertensive treatment.[8,16] These 2 variables suggest a synergistic interaction that seems clinically plausible: namely, the decrease in mean BP in our cohort was accompanied by an increase in the subgroup of individuals achieving BP while on medications. Of note, the opposite behavior of the 2 variables in our composite definition of hypertension explains why the hypertension prevalence did not drop even if mean BP decreased significantly: namely, because the majority of people newly diagnosed with hypertension had already achieved BP control due to medication initiation. This observational study does not allow for causal inference; however, it seems plausible that increased availability and utilization of BP medications may have played an important role in the BP drop of

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Table 3. Predictors of Cardiovascular Comorbidities

	Hypertension				Diabetes				Cardiovascular disease (combined)			
	Univariate associations		Multivariate associations		Univariate associations		Multivariate associations		Univariate associations		Multivariate associations	
Covariate	IRR (95% CI)	*P* value	AIRR (95% CI)	*P* value	IRR (95% CI)	*P* value	AIRR (95% CI)	*P* value	IRR (95% CI)	*P* value	AIRR (95% CI)	*P* value
Age, y	1.03 (1.02–1.04)	<0.001	1.03 (1.02–1.04)*	<0.001*	1.01 (1.00–1.02)	0.005	1.06 (1.00–10.3)*	0.026*	1.03 (1.02–1.04)	<0.001	1.01 (0.99–1.03)	0.17
Female sex	1.17 (0.95–1.43)	0.14	1.22 (0.99–1.54)	0.11	0.96 (0.74–1.25)	0.78	0.95 (0.69–1.29)	0.15	1.44 (0.99–2.08)	0.053	1.23 (0.81–1.87)	0.32
Body mass index (continuous)	1.02 (1.00–1.04)	0.017	1.04 (0.99–1.03)	0.17	1.03 (1.01–1.04)	<0.001	2.08 (1.47–2.94)*	<0.001*	1.00 (0.98–1.03)	0.84	0.98 (0.97–1.03)	0.86
Current smoker	0.85 (0.60–1.19)	0.34	…	…	0.69 (0.41–1.16)	0.16	…	…	0.81 (0.41–1.60)	0.55	…	…
Current alcohol drinker	1.03 (0.81–1.30)	0.84	…	…	0.76 (0.54–1.06)	0.10	…	…	0.96 (0.63–1.48)	0.87	…	…
HIV positive	0.64 (0.50–0.82)	<0.001	0.80 (0.61–1.05)	0.10	0.71 (0.50–1.00)	0.051	0.95 (0.64–1.40)	0.78	0.76 (0.48–1.20)	0.24	0.89 (0.54–1.47)	0.65
Diabetes	1.69 (1.21–2.34)	0.002	1.33 (0.93–1.89)	0.11	…	…	…	…	1.31 (0.76–2.25)	0.33	1.27 (0.72–2.26)	0.41
Hypertension	…	…	…	…	1.52 (1.15–2.00)	0.0030	1.25 (0.91–1.72)	0.20	1.33 (0.91–1.93)	0.14	1.10 (0.73–1.67)	0.41
Chronic kidney disease	1.31 (0.80–2.13)	0.28	…	…	0.76 (0.34–1.61)	0.47	…	…	2.72 (1.46–5.05)	0.002	2.68 (1.39–5.17)*	0.0032*
Education level	…	…	…	…	…	…	…	…	…	…	…	…
Primary education only	1.00 (0.80–1.26)	0.98	1.15 (0.88–1.50)	0.31	1.21 (0.90–1.62)	0.21	1.14 (0.81–1.62)	0.45	0.65 (0.43–0.99)	0.047	0.77 (0.48–1.22)	0.27
Completed high school	0.76 (0.56–1.03)	0.078	1.18 (0.82–1.71)	0.36	0.95 (0.64–1.41)	0.80	1.01 (0.61–1.68)	0.96	0.49 (0.27–0.88)	0.018	0.76 (0.39–1.48)	0.41
College and above	0.61 (0.39–0.98)	0.039	0.58 (0.32–1.06)	0.076	1.01 (0.64–1.83)	0.78	1.14 (0.62–2.12)	0.67	0.26 (0.08–0.83)	0.023	0.40 (0.12–1.33)	0.13
Wealth index (quintiles)	…	…	…	…	…	…	…	…	…	…	…	…
Second quintile (the lowest)	1.29 (0.94–1.78)	0.12	1.15 (0.81–1.63)	0.42	0.94 (0.60–1.47)	0.79	0.81 (0.50–1.31)	0.39	1.16 (0.67–2.00)	0.61	1.16 (0.63–2.11)	0.63
Third quintile	1.24 (0.90–1.71)	0.20	1.29 (0.91–1.83)	0.15	1.29 (0.85–1.96)	0.23	0.92 (0.58–1.48)	0.74	1.37 (0.81–2.34)	0.24	1.44 (0.80–2.59)	0.23
Fourth quintile	1.18 (0.84–1.65)	0.35	1.13 (0.78–1.65)	0.51	1.21 (0.80–1.85)	0.37	0.92 (0.58–1.48)	0.74	0.87 (0.48–1.58)	0.65	1.01 (0.53–1.94)	0.98
Fifth quintile (the highest)	1.36 (0.98–1.88)	0.066	1.38 (0.96–2.00)	0.086	1.50 (0.99–2.24)	0.053	1.11 (0.70–1.76)	0.67	0.80 (0.44–1.46)	0.47	1.03 (0.53–2.02)	0.93
High fruit consumption	0.97 (0.76–1.24)	0.84	…	…	1.29 (0.97–1.72)	0.084	…	…	1.08 (0.72–1.61)	0.72	…	…
High vegetable consumption	1.14 (0.91–1.42)	0.25	…	…	0.90 (0.68–1.19)	0.452	…	…	1.38 (0.96–1.98)	0.08	…	…

AIRR indicates adjusted incidence rate ratio; and IRR, incidence rate ratio.
*Denotes statistical significance.

our cohort. Therefore, we examined secular trends that may be temporally aligned with our observations.

One of the key system-level interventions may be the Central Chronic Medicines Dispensing and Distribution program, which was implemented throughout South Africa by the National Department of Health. Starting in 2014, this initiative shifted the distribution of medications for chronic diseases from traditional health facilities to convenient pickup points in local communities (commercial outlets, pharmacy chains, and churches).[21,22] This

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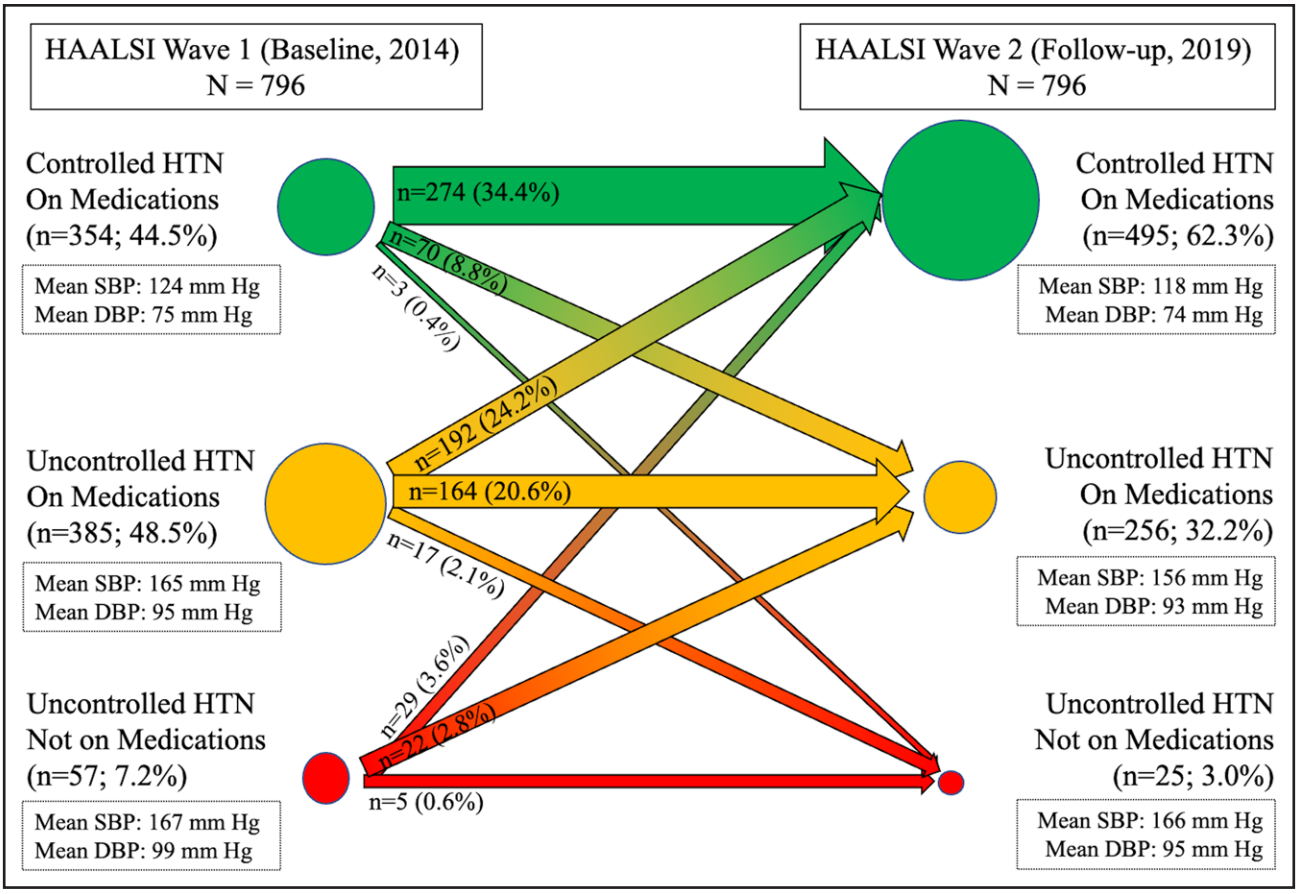


Figure 1. Blood pressure levels among individuals with known hypertension (HTN).
DBP indicates diastolic blood pressure; HAALSI, Health and Aging in Africa: a Longitudinal Study of an INDEPTH Community; and SBP, systolic blood pressure.

intervention aligns with the recent recommendations from the World Hypertension League, which encourages African governments to decentralize care and extend drug refills for stable patients.[23] The Central Chronic Medicines Dispensing and Distribution program likely helped address some of the barriers that are considered most critical in SSA, including the need for expensive travel to reach health facilities (where up to 70% of prescription orders may be backlogged), long queuing times, or the fear of exposure to contagious illnesses when collecting medications in traditional health care settings.[21,24]

Ultimately, this paradigm shift likely improved medication access and adherence and offers a credible explanation for 2 of the critical study findings: that the subgroup of hypertensive individuals achieving hypertension control on medication increased from 44.5% to 62.3% and that almost all (>85%) of the individuals who had newly diagnosed hypertension were already on medications, with the majority (>60%) achieving hypertension control. These findings are notable when compared with data from other low- and middle-income countries, where hypertension control rates are 20% to 30%.[25] Findings from our study are comparable to recent estimates from high-income countries like the United States, which report similarly high hypertension control rates around 60%.[26]

These encouraging results should be interpreted with cautious optimism, as they may represent an overestimation of the positive trends among hypertensive individuals in our cohort. Social desirability and selection bias influence which participants agree to record their BP or report medication use and thus affect subgroup analyses. The upward trend in hypertension control within this subgroup, however, is internally consistent with prior data from our cohort, where we identified a 45% control rate among hypertensive individuals in 2014.[24] Furthermore, the fact that the mean SBP of the entire cohort dropped by ≈10 mm Hg over 5 years is a hard outcome that supports the generalizability of our findings.

In addition to pharmacological interventions, our study explored some nonpharmacological trends that likely contributed to the BP drop. Notably, we did not find a decrease in the prevalence of lifestyle factors that could have contributed to the BP decline, like obesity or smoking. In fact, comorbidities like diabetes were on the rise, which would be expected to increase mean BP. At the same time, however, the fact that mean SBP also dropped by 4 mm Hg among normotensive individuals

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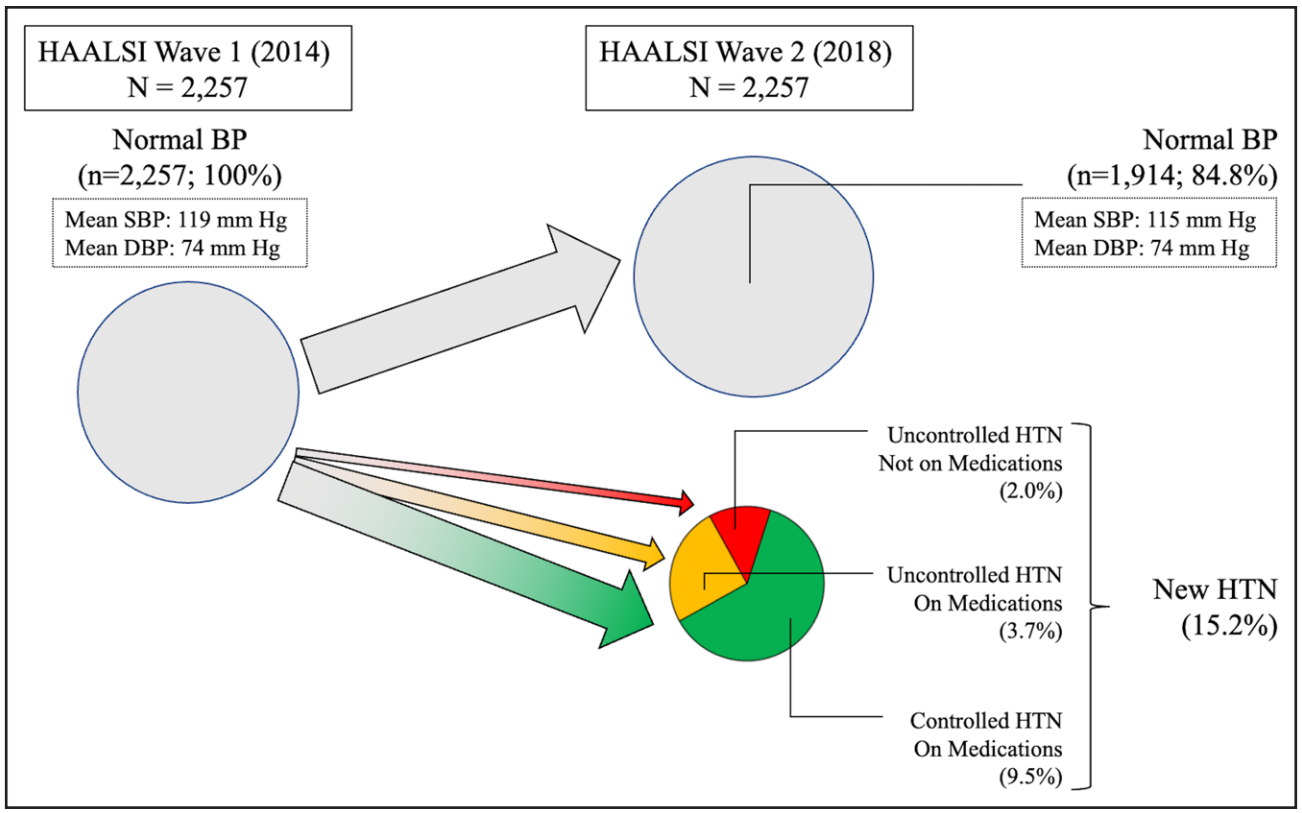


Figure 2. Blood pressure (BP) levels among individuals with new-onset hypertension (HTN).
DBP indicates diastolic blood pressure; HAALSI, Health and Aging in Africa: a Longitudinal Study of an INDEPTH Community; and SBP, systolic blood pressure.

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who did not have hypertension on either assessment (and thus never received medications) suggests that there may be other lifestyle factors that are benefitting the entire cohort. For example, vegetable consumption increased by 10%, which is a proxy for healthier lifestyles. Lastly, it is possible that the population health surveillance by itself, given its focus on hypertension (and referral to local clinics), may have also affected the observed outcomes. If this was true, it would suggest that adequate surveillance systems, when coupled with the availability of targeted health services, may be a particularly effective strategy to improve cardiovascular outcomes.

Study Limitations

While our study is one of the few longitudinal cohorts in SSA, our results are derived from a defined region of South Africa. Additional studies are needed to understand how to compare our findings to other parts of South Africa and African regions. With the currently available evidence, however, one could reasonably imply some degree of generalizability to other parts of South Africa, for example, because the Central Chronic Medicines Dispensing and Distribution program was disseminated throughout the country, where it may have produced similar results.

While some comorbidities like diabetes were assessed with objective biomarkers, others like chronic kidney disease were only self-reported. Nonetheless, cardiometabolic comorbidities would be expected to increase mean BP, which makes our study results (ie, BP decrease at the population level) even more significant. On the contrary, some of the uncaptured nonpharmacological variables may contribute to BP reduction and thus cause unmeasured effect modification. In future waves, we will expand our list of biomarkers and lifestyle factors like physical activity.

While American guidelines have lowered the hypertension cutoff to 130/80 mm Hg, the definition used in this analysis is 140/90 mm Hg. This is in agreement with the current European and South African guidelines[17]; it also maintains internal consistency with prior analyses from our group and throughout SSA. To establish a baseline for future research, we reported rates using the 130/80-mm Hg cutoff.

Perspectives

Our study documents the decline in a hard outcome (mean BP) in a large prospective cohort, which is occurring without a concomitant decrease in cardiometabolic risk factors. Rather, the BP decline is occurring while the South African government is implementing interventions, like the Central Chronic Medicines Dispensing

and Distribution program, designed to increase medication access. Although these results cannot be immediately extrapolated to other African regions, we believe our cohort may serve as a case study for other countries in SSA that are battling their epidemic of hypertensive heart disease. Our results support the shift of health care resources toward primary care–based interventions that are integrated within the local communities, together with surveillance systems that can promptly diagnose cardiometabolic disease.

While these results can begin to inform other African regions with similar epidemiologic transitions, forthcoming evidence from our cohort will provide a more granular understanding of how the mean BP reduction was achieved. From a pharmacological perspective, information on the number and type of antihypertensive medications could not be collected in W1. In W2, we were able to collect medication lists to prove medication possession for patients. Next, we will describe trends in medication regimens among W2 participants and compare those with wave 3 results, which will also perform pill counts to quantify adherence. From a nonpharmacological perspective, ongoing analyses are characterizing trends in urine salt excretion, which may have been affected by the recent South African regulations to reduce sodium in designated foodstuffs.[27] This is a priority for the World Hypertension League, which supports evidence-based policies on salt reduction.[23]

Our ultimate goal is to describe the interplay between pharmacological and nonpharmacological forces that are driving the BP drop in our rural cohort, which surpasses prior reports in SSA and aligns with estimates from high-income countries. In turn, this will help inform which features of our surveillance system can be scalable to address the epidemic of cardiometabolic diseases affecting SSA.

ARTICLE INFORMATION

Received November 21, 2022; accepted January 2, 2023.

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Sources of Funding

The Rural Public Health and Health Transitions Research Unit of the Medical Research Council (MRC), University of the Witwatersrand, South Africa (MRC/Wits) and Agincourt Health and Socio-Demographic Surveillance System is supported by the Department of Science and Innovation, the University of the Witwatersrand, the Medical Research Council, South Africa, and the National Institute of Aging at the National Institutes of Health (grant number 5P01AG041710- 07).

Disclosures

None.

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