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Prevalence of uncontrolled hypertension in people with comorbidities in sub-Saharan Africa: a systematic review and meta-analysis

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ABSTRACT

Background The burden of uncontrolled hypertension in sub-Saharan Africa (SSA) is high and hypertension is known to coexist with other chronic diseases such as kidney disease, diabetes among others. This is the first systematic review and meta-analysis to determine the burden of uncontrolled hypertension among patients with comorbidities in SSA.

Methods A comprehensive search was conducted on MEDLINE, Excerpta Medica Database (Embase) and Web of Science to identify all relevant articles published between 1 January 2000 and 17 June 2021. We included studies that reported on the prevalence of uncontrolled hypertension among people in SSA who report taking antihypertensive treatment and have another chronic condition. A random-effects meta-analysis was performed to obtain the pooled estimate of the prevalence of uncontrolled hypertension among patients with comorbid conditions while on treatment across studies in SSA.

Results In all, 20 articles were included for meta-analyses. Eleven articles were among diabetic patients, five articles were among patients with HIV, two were among patients with stroke while chronic kidney disease and atrial fibrillation had one article each. The pooled prevalence of uncontrolled hypertension among patients with comorbidities was 78.6% (95% CI 71.1% to 85.3%); I² 95.9%, varying from 73.1% in patients with stroke to 100.0% in patients with atrial fibrillation. Subgroup analysis showed differences in uncontrolled hypertension prevalence by various study-level characteristics

Conclusion This study suggests a high burden of uncontrolled hypertension in people with comorbidities in SSA. Strategies to improve the control of hypertension among people with comorbidities are needed.

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INTRODUCTION

Hypertension is an important risk factor for cardiovascular diseases and a leading contributor to death globally.[1] An estimated 1.4 billion people have hypertension globally with three quarter (75%) of this population living in low and middle-income countries.[2,3] Worldwide trend analysis based on a large data

Strengths and limitations of this study

► A published comprehensive protocol was used to identify all available evidence without language restriction, reporting in accordance with Preferred Reporting Items for Systematic reviews and Meta-Analyses guidelines, search using multiple electronic databases, searching grey literature, contacting experts in the field for additional data sources to reduce study selection bias and heterogeneity test by subgroup analyses and sensitivity analyses.

► The prevalence of uncontrolled hypertension in some comorbidities such as atrial fibrillation and chronic kidney disease was reported in single studies.

► Most of the studies included in the meta-analysis were hospital-based studies that used non-random sampling procedures.

► There was substantial heterogeneity between the studies.

set from multiple studies conducted between 1975 and 2015 in 200 countries showed no change in global mean blood pressure, but a substantial downward trend in high-income countries and a rise in low and middle-income countries.[4] Levels of hypertension awareness, treatment and control improved by 2.9% in high-income countries while in low–middle-income countries, negligible improvements in awareness, treatment and control were observed.[3,4] Africa is one of the regions in the world with the highest rates of uncontrolled blood pressure.[5] In a systematic review and meta-analysis on hypertension in sub-Saharan Africa (SSA), Ataklte *et al*[6] reported a (93%) high prevalence of uncontrolled hypertension (UHTN).

Hypertension often coexists with comorbidities such as chronic kidney disease, diabetes and hypercholesterolemia among others.[7–10] These comorbidities could explain part of the inadequacy in blood pressure control. Some studies conducted in Europe and the

USA found that patients with diabetes mellitus had a significantly increased risk of uncontrolled blood pressure.[11 12] Another study conducted in the UK has shown that achieving optimal blood pressure control in patients with hypertension and type 2 diabetes produces an important decrease in the risks associated with diabetes.[13]

In recent years, public health efforts to promote prevention, awareness and treatment of hypertension in SSA have intensified,[14–17] but hypertension control remains low.[18–22] Despite several studies conducted on UHTN in people with comorbidities, pooled estimations of the burden are not available for comorbidities such as diabetes, dyslipidaemia, stroke, HIV, obesity atrial fibrillation. From a clinical perspective, it is important to understand why patients on treatment are not attaining optimal blood control and whether their pre-existing comorbidities contribute to the lack of control of blood pressure. Therefore, to inform policy, practice and the development of guidelines for hypertension for integrated care among patients with comorbid conditions, it is critical to understand the burden of UHTN in people with comorbidities. The purpose of this review is to summarise the evidence on and estimate the prevalence of UHTN in patients with comorbidities in SSA and to explore factors associated with UHTN in people with comorbidities.

METHODS
Protocol and registration
The protocol for this systemic review and meta-analysis was registered on the International Prospective Register of Systematic Reviews and published.[23] The reporting was done according to the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) Protocols guidelines.[24]

Search strategy
We systematically searched MEDLINE via Ovid, Excerpta Medica Database (Embase) and Web of Science from 1 January 2000 to 17 June 2021. The search strategy included the following relevant terms: *uncontrolled hypertension, hypertension, uncontrolled blood pressure, high blood pressure, a list of comorbidities and sub-Saharan Africa (detailed search strategy list is attached as supplement* (online supplemental file S1). Additionally, the reference lists of the included studies were reviewed to identify other relevant studies.

Eligibility criteria
Studies were included if (1) they provided primary data on the prevalence of hypertension in accordance with the seventh report of the Joint National Committee among those who reported taking antihypertensive treatment and had a comorbid condition, (2) participants had been diagnosed with one of the comorbidities of interest— diabetes, dyslipidaemia, obesity, chronic kidney disease, stroke or transient ischaemic attack, coronary heart disease, heart failure, peripheral vascular disease, atrial fibrillation, depression and HIV (online supplemental table S1), (3) participants were 15 and above years, (4) the study was published in any language and (5) the study was conducted in an SSA. The following types of study designs were excluded: (1) case–control studies, commentaries, editorials, letters, qualitative studies and systematic reviews; (2) studies that included hypertension prevalence but did not report on the prevalence of hypertension among those on antihypertensive medication and (3) studies of pregnancy-related hypertension.

Study selection
Two researchers independently screened the titles and abstracts (SFM and MSA). Two researchers (SFM and MSA) also assessed full-text reviews of the articles independently for final inclusion. The reference lists of potentially relevant publications were manually searched for additional publications. Disagreements were resolved by consensus. For multinational studies, data were separated to show the estimate at the country level.

Data items and collection process
SFM and MSA independently screened the full texts of included studies. SFM extracted data from the selected studies and MSA checked the data for accuracy. A standardised data extraction table was created (table 1) and included the following data from all eligible articles: first author name, year of publication, language, country of the study, study design, sample size, study period, study setting, sampling method, the timing of data collection, data source, use of comorbidity-specific hypertension control cut-off, male proportion, age of participants (mean or median), type of comorbidity (diabetes, stroke, HIV, chronic kidney disease, atrial fibrillation) and main outcome of interest UHTN proportion or the data to cumpute it.

Risk of bias in individual studies
A tool developed by Hoy *et al*[25] for prevalence studies was adapted and used to assess the methodological quality of included studies by evaluating the extent to which they addressed bias in nine areas of internal and external validity (online supplemental table S2). Each of the nine areas was scored 1 if yes (high quality) and 0 if no (poor quality), and a total quality score was calculated by summing the individual scores. Total scores ranged from 0 to 9, with higher scores indicating higher quality. Studies were then classified as having a low (>8), moderate (6–8) or high (≤5) risk of bias. Two researchers (SFM and MKM) independently assessed each of the included publications and disagreements were resolved through discussion.

Patient and public involvement
This research was done without patient involvement. There was no involvement of patients or members of the public in the design, or conduct, or reporting or dissemination plans of this research.

Table 1 Characteristics of the included studies

Study	Country	Age (mean/median)	Study period	Study site	Sampling	Male %	Sample size	UHTN%	Risk of bias
Atrial fibrillation									
Jardine et al[37]	South Africa	67±13	February 2010–March 2011	Health centre	Consecutive	59.9	198	100.0	High
Chronic kidney disease									
Babua et al[33]	Uganda	42.8	June–February 2013	Hospital	Consecutive	51.2	191	76.0	Low
Diabetes									
Abera et al[30]	Ethiopia	56.3±10	August–January 2015	Hospital	Consecutive	59.9	382	85.0	Low
Adeniyi et al[31]	South Africa	61.3±11.8	July to November 2013	Hospital	Consecutive	28.3	265	75.5	Low
Agaba et al[32]	Nigeria	51±12	June–September 2004	Hospital	Consecutive	40.2	79	70.9	Moderate
Choukem et al[34]	Cameroon	56.6±13.3	6 months	Hospital	Consecutive	50.5	98	79.6	Low
Cohen et al[35]	Malawi	53.2±14.0	March–June 2007	Hospital	Consecutive	39.8	253	72.7	Low
Mwita et al[39]	Tanzania	51.6±11.2	February–September 2010	Health centre	Consecutive	38.0	67	66.0	Low
Pinchevsky et al[40]	South Africa	53.9±11.5	May–August 2015	Health centre	Consecutive	46.1	459	78.0	Low
Pinchevsky et al[41]	South Africa	63±11.9	July 2008–2009	Hospital	Random	44.6	567	54.2	Low
Rotchford[42]	South Africa	56.5±10.4	2 months in 1999	Hospital	Consecutive	26.9	129	86.0	Low
Soetedjo et al[43]	South Africa	53±9.9	December 2013–June 2016	Health centre	Consecutive	35.9	48	66.7	Low
Yameogo et al[46]	Senegal	58.2±9.2	Mar 2007–July 2008	Hospital	NR	25.5	52	80.8	High
HIV									
Fiseha et al[47]	Ethiopia	37±10.3	January–May 2018	Hospital	Consecutive	33.1	31	100.0	Low
Hyle et al[36]	South Africa	38.4±8.3	2015	Health centre	Consecutive	33.0	54	83.0	Low
Manavalan et al[48]	Tanzania	NR	October 2016–December 2018	Health centre	Consecutive	21.4	10	100.0	Low
Muddu et al[38]	Uganda	43.6±11.5	January 2014–January 2017	Health centre	Consecutive	39.4	91	41.8	Low
Steffen et al[44]	Malawi	36±9.3	Not indicated	Health centre	NR	42.8	35	77.1	Moderate
Stroke									
Abboud et al[29]	South Africa	63.5±11.3	January 2007–December 2008	Hospital	Random	58.5	217	88.0	Low
Wahab et al[45]	Nigeria	59±13.1	February 2009–April 2011	Hospital	Consecutive	60.9	284	60.2	Low

NR, not reported; UHTN, uncontrolled hypertension.

Synthesis of results

The statistical approach used in this meta-analysis followed the study protocol.[23] Crude numerators and denominators from the individual studies were used to recalculate the study-specific unadjusted prevalence estimates. Variances of the study-specific estimates were stabilised using the double arcsine transformation to minimise the effect of studies with very small or very large prevalence estimates on the overall estimate (16), and then a random-effects meta-analysis was performed (17) to determine the pooled estimate of the prevalence of UHTN among patients with comorbidities overall and also among people with diabetes, HIV and stroke separately while on antihypertensive treatment across the included studies in SSA. Prevalence estimates were also summarised by comorbidities, publication year, sample size, study setting, sampling, risk of bias, gender proportionmean age and geographic regions.

Heterogeneity was explored using Cochrane's Q and quantified by I^2 statistics.[26 27] Subgroup analyses were performed based on the following: gender proportion of participants, patient comorbidities, study design, study setting, sample size, use of recommended comorbidity-specific blood pressure control cut-offs, countries, regions (Eastern, Western, Central, and Southern Africa) and by gross national income (GNI) were performed to identify the possible sources of heterogeneity. Sensitivity analyses were performed to assess the robustness of the findings by excluding studies with a high risk of bias.

Funnel plots and Egger asymmetry test were used to assess publication bias, with $p < 0.10$ considered to be statistically significant for publication bias.[28] Inter-rater agreements between the researchers involved in study inclusion and those involved in the identification of risk of bias were assessed using κ Cohen's coefficient (20).

All analyses were performed using 'metaprop' routine using StataSE V.16 (StataCorp LLC).

RESULTS
Study selection

From the electronic database search, 8492 records were identified. An additional 35 articles were identified through reference tracing and from other sources. After duplicate removal, 5610 remained for the title and abstract screening. After screening, we found 5085 records to be irrelevant and excluded them. The full texts of 525 articles and reports were retrieved and assessed for eligibility, resulting in the inclusion of 20 studies for the meta-analysis (figure 1). The inter-rater agreement for study selection was 0.77.

Study characteristics

Table 1 and online supplemental table S3 provide detailed information on the included studies. In total, 3510 participants were included across 20 studies. Most of the studies were cross-sectional (19, 95%), in English (19, 95%), hospital-based (12, 60%), used consecutive sampling
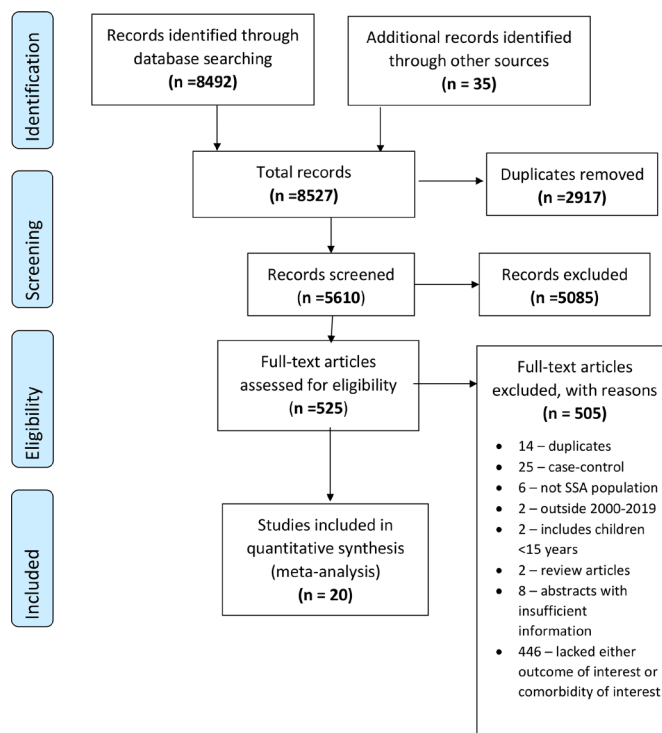

Figure 1 Study selection flow diagram.

(16, 80%) and prospectively collected data (14, 70%). The mean (SD) participant age from the 20 studies[29–48] providing this information was 56.8 (0.12) years. Study sample sizes ranged from 10 to 567 participants. The proportion of male participants in the included studies was reported in all studies and it ranged from 21.4% to 60.9%.[29–48] Of the included studies, 11[30–32 34 35 39–43 46] reported on diabetes, five[36 38 44 47 48] reported on HIV, two[29 45] reported on stroke and one each reported on chronic kidney disease[33] and atrial fibrillation.[37] None of the included studies reported on obesity, dyslipidaemia, coronary heart disease, heart failure, peripheral heart disease and depression.

Risk of bias assessment

The risk of bias was assessed in all included studies of the 20 included studies. Most studies were categorised as having some concern for bias with two (10%)[37 46] studies being deemed to have high risk of bias. Two studies[32 44] (11.1%) had a moderate risk of bias, while 16 studies[29–31 33–36 38–43 45 47 48] (80%) had a low risk of bias. The inter-rater agreement for the risk of bias assessment was 0.65. Additional details on the domains assessed are included in the risk of bias summary table in the online supplemental table S2.

Prevalence of UHTN among patients with comorbidities

Twenty publications reported on UHTN among patients with comorbidities (table 1). The majority of the studies were from South Africa (8, 40%).[29 31 36 37 40–43] Uganda,[33 38] Nigeria,[32 45] Malawi[35 44] Ethiopia[30 47] and Tanzania,[39 48] had two (10%) studies each while Senegal[46] and Cameroon[34] had one study (5%) each. The reported

prevalence of UHTN among people with comorbidities ranged from 41.8% (95% CI 32.2% to 52.0%) in Uganda to 100.0% (95% CI 98.1% to 100.0%) in South Africa. The pooled UHTN prevalence estimate in patients with comorbidities from the random-effects meta-analysis was 78.6% (95% CI 71.1% to 85.3%). Substantial heterogeneity (I^2=95.9%; p<0.0001) existed in the included studies (table 2). Absence of publication bias is suggested

Table 2 Meta-analysis results for the prevalence of uncontrolled hypertension in people with comorbidities in sub-Saharan Africa

	Prevalence (95% CI)	Number of studies	Number of participants	I^2 (95% CI)	$P^{heterogeneity}$
Overall	78.6 (67.9 to 83.0)	20	3510	96.1	<0.0001
By comorbidity					
Atrial fibrillation	100.0 (98.1 to 100.0)	1	198	–	–
Chronic kidney disease	75.9 (69.4 to 81.4)	1	191	–	–
Diabetes	74.5 (67.1 to 81.3)	11	2399	93.1	<0.001
HIV	83.7 (56.0 to 99.5)	5	221	94.4	<0.001
Stroke	73.1 (69.1 to 76.9)	2	501	–	–
By region					
Eastern	80.8 (64.6 to 93.1)	6	772	94.7	<0.001
Western	69.8 (57.0 to 81.2)	3	415	–	–
Central	79.6 (70.6 to 86.4)	1	98	–	–
Southern	79.8 (68.1 to 89.4)	10	2225	97.3	<0.001
By risk of bias					
Low	76.4 (69.3 to 82.8)	16	3146	94.4	<0.001
Moderate	72.0 (63.3 to 80.0)	2	114	–	–
High	99.0 (97.1 to 100.0)	2	250	–	–
By study size					
Small studies	77.6 (66.0 to 87.4)	10	565	88.6	<0.001
Large studies	79.5 (69.0 to 83.0)	10	2945	97.7	<0.001
By period of publication					
Before 2015	79.4 (66.5 to 89.9)	10	1851	97.3	<0.001
After 2015	77.3 (68.0 to 85.4)	10	1659	93.1	<0.001
By gender proportion					
More females	75.4 (67.6 to 82.5)	14	2140	92.5	<0.001
More males	84.1 (69.5 to 94.7)	6	1370	97.6	<0.001
By sampling					
Consecutive	76.1 (67.6 to 83.7)	18	2639	95.6	<0.001
Random	64.5 (61.1 to 67.9)	2	784	–	–
By setting					
Hospital	78.4 (69.8 to 86.0)	12	2548	95.3	<0.001
Health centre	79.4 (60.7 to 93.4)	8	962	96.8	<0.001
By comorbidity HTN target					
Comorbidity target used	70.7 (61.3 to 79.2)	13	1776	93.3	<0.001
Comorbidity target not used	83.0 (72.4 to 91.4)	7	1734	96.3	<0.001
By gross national Income					
Below SSA average	78.6 (68.2 to 87.4)	9	1179	91.9	<0.001
Above SSA average	78.3 (66.1 to 88.4)	11	2331	97.3	<0.001

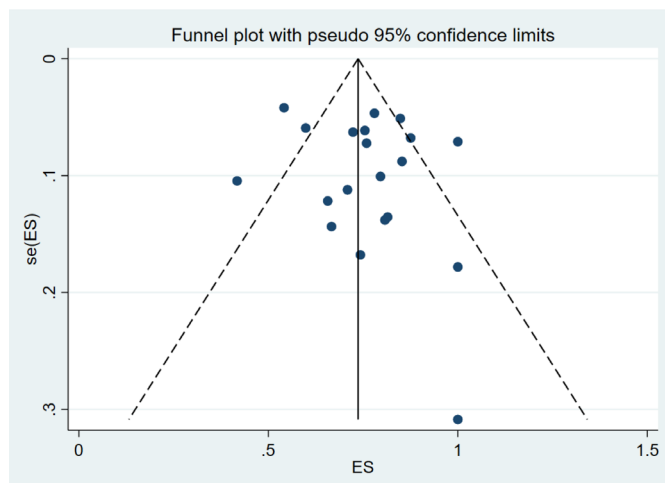P^{egger}=0.381
SSA, sub-Saharan Africa.

Figure 2 Funnel plot of the prevalence of uncontrolled hypertension in people with comorbidities in sub-Saharan Africa.

by the symmetrical visual inspection of the funnel plot, confirmed by the Egger's test (p<0.001) (figure 2).

Subgroup analysis revealed differences in UHTN prevalence by comorbidity (figure 3). Adults with atrial fibrillation reported the highest UHTN estimate (100.0% (95% CI 98.1% to 100.0%)), followed by adults with HIV (83.7% (95% CI 56.0% to 99.5%)). The lowest pooled UHTN prevalence estimate was found in adults

with stroke (73.1% (95% CI 69.1% to 76.9%)). Pooled UHTN prevalence differed by geographic regions; studies conducted in the Eastern, Southern and Central region reported higher prevalence's (80.8% (95% CI 64.6% to 93.1%)), (79.8% (95% CI 68.2% to 89.3%)) and (79.6% (95% CI 70.6% to 86.4%)), respectively, than studies conducted in the Western region (69.8% (95% CI 57.0% to 81.2%)). Prevalence varied by sample size; large studies reported a slightly higher prevalence (79.5% (95% CI 69.1% to 88.2%)) compared with small studies (77.6% (95% CI 66.0% to 87.4%)) (table 2). Studies that used the recomended hypertension control value for each comorbidity reported lower pooled prevalence of UHTN (75.8 (95% CI 66.4 to 84.1)) compared with those who did not use the recomemded comorbidity-specific blood pressure control value (83.0 (95% CI 72.4 to 91.4)).

In the univariable analysis, heterogeneity was explained by being woman (11.3%), risk of bias (18.4%), by regions (15.8%), comorbidities (3.5%) and using target blood pressure (21.3%) (online supplemental table S4). However, only comorbidities and risk of bias were significant at 10%, and these were added to the multivariable meta-regression analysis. The results from the multivariable meta-regression were not statistically significant. Sensitivity analysis conducted by excluding studies that had high risk of bias from the analysis did not show any
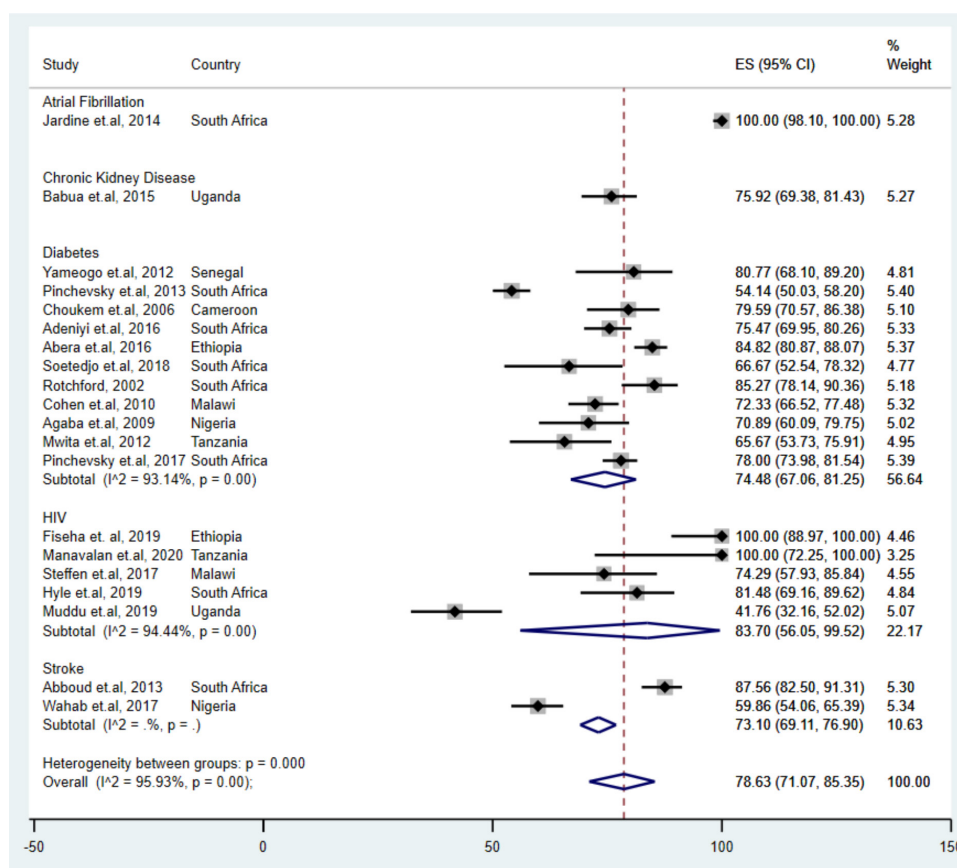

Figure 3 Pooled prevalence of uncontrolled hypertension in people with comorbidities in sub-Saharan Africa, by comorbidities.
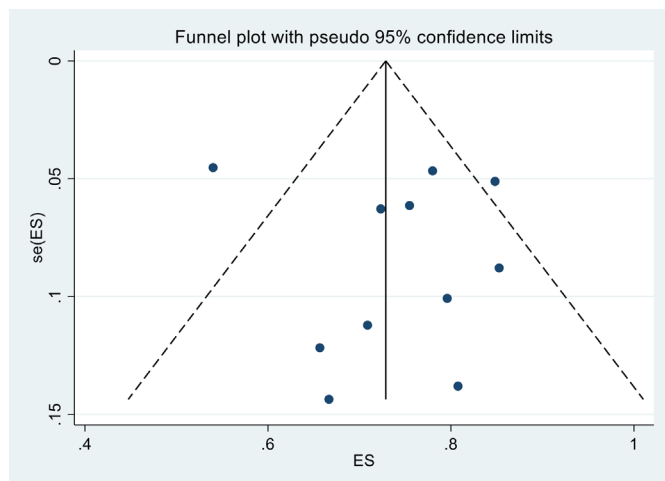
Figure 4 Funnel plot of the prevalence of uncontrolled hypertension in people with diabetes in sub-Saharan Africa.

influence on the robustness of the findings in the pooled analyses.

Sensitivity analysis done by excluding studies with high risk of bias from the analysis did not show any influence on the robustness of the findings in the pooled analysis.

Prevalence of UHTN among patients with diabetes

The prevalence of UHTN prevalence estimate among patients with diabetes was reported in 11 studies,[30–32 34 35 39–43 46] with a total of 2399 participants. UHTN prevalence in this group ranged from 54% (95% CI 50% to 58%) to 85% (95% CI 78% to 90%), with a pooled estimate of 74.5% (95% CI 67.1% to 81.3%) (table 2). Substantial heterogeneity (I^2=93.1%; p<0.001) was observed in the included studies (figure 2). Publication bias was not evident from the visual inspection of the funnel plot (figure 4).

Subgroup analysis revealed differences in UHTN prevalence among people with diabetes (table 3). There were differences noted by sample size; large studies reported a higher prevalence (75.5% (95% CI 67.1% to 81.3%)) compared with small studies (73.3% (95% CI 68.2% to 79.3%)) (table 2). Pooled UHTN prevalence differed by geographic regions; studies conducted in the Eastern reported the highest pooled prevalence (82.5% (95% CI 80.4% to 87.1%)) while studies conducted in the Southern region reported the lowest pooled prevalence (72.5% (95% CI 62.0% to 81.8%)). Gender differences were also noted; studies with more male participants had higher pooled prevalence (72.5% (95% CI 64.4% to 79.9%)) compared with studies with more female participants. Studies conducted after 2015 had higher pooled prevalence of UHTN among people with diabetes compared with studies conducted before 2015. Studies that used the recommended diabetes hypertension cut-off (BP <130/85 mm Hg) to define blood pressure control reported lower UHTN prevalences compared with those who did not use the recommended hypertension control value. Studies that had below the average

SSA GNI reported a higher prevalence of UHTN (77.3 (95% CI 69.7 to 84.2)) compared with studies with above the average SSA GNI (72.3 (95% CI 61.0 to 82.3)).

In the univariable analysis, the use of the recomended hypertension control value for diabetes explained the most of the heterogeneity (56.7%) observed while sampling explained 100% of the heterogeneity (online supplemental table S5). In the final multivariable model, the sampling method used was associated with UHTN and explained most of the heterogeneity.

DISCUSSION

To our knowledge, this is the first systematic review and meta-analysis on the pooled prevalence of UHTN among patients with comorbidities in SSA. Our findings indicate that more than three quarters of the hypertensive people with comorbidities have UHTN. These findings support the literature describing the challenges in controlling blood pressure among those on treatment and living with comorbidities while highlighting the fact that recognition of patient comorbidities should be a core aspect of the care and support offered to patients with hypertension.

The prevalence of UHTN varied with the type of comorbidity. The highest pooled UHTN prevalence estimate (83.7%) was observed in people with HIV (83.7%), chronic kidney disease (75.9%) and diabetes (74.5%). A systematic review and meta-analysis on the prevalence of hypertension among people with HIV showed that about 25% of people with HIV had hypertension.[49] Also, important to note is that the majority of people living with HIV are in SSA. Similarly, a UK study found reduced risk associated with diabetes in people who achieved optimal blood pressure.[13] Another study conducted in Kenya found that 80% of diabetic patients from rural and semi-urban areas had hypertension.[50] Since hypertension is common among people with comorbidities, there is need to focus on integrated care for comorbidities and hypertension. These findings support literature describing the challenge in blood pressure control among those on treatment and with comorbidities.

The high prevalence of UHTN in people with comorbidities is concerning and requires further understanding. There are several factors affecting UHTN among patients on treatment. Non-adherence to antihypertensive is an important cause of UHTN. A systematic review conducted by Abegaz et al found 45% of patients on antihypertensive were non-adherent to medications with a higher proportion (84%) being among those with uncontrolled blood pressures.[51] Barriers to adherence are mainly related to limited accessibility to medications, medication side effects, low perception of the risks involved with having uncontrolled blood pressure, out-of-pocket costs and pill burden due to comorbidities. Provider related factors also affect the UHTN rates. A study conducted by Rose et al concluded that inadequate treatment regimens are to blame for a majority of UHTN.[8] Provider lack of adherence to hypertension guidelines in regards to dose

Table 3 Meta-analysis results for the prevalence of uncontrolled hypertension in people with diabetes in sub-Saharan Africa

	Prevalence (95% CI)	Number of studies	Number of participants	I^2 (95% CI)	$P^{heterogeneity}$
Overall	74.5 (67.1 to 81.3)	11	2399	93.1	<0.001
By region					
Eastern	82.5 (78.8 to 85.9)	2	449	–	–
Western	75.0 (67.1 to 82.1)	2	131	–	–
Central	79.6 (70.6 to 86.4)	1	98	–	–
Southern	72.5 (62.0 to 81.8)	6	1721	94.9	<0.001
By risk of bias					
Low	74.2 (65.8 to 81.9)	9	2268	94.4	<0.001
Moderate	70.9 (60.1 to 78.8)	1	79	–	–
High	80.8 (68.1 to 89.2)	1	52	–	–
By study size					
Small studies	73.25 (66.8 to 79.3)	5	344	40.6	0.15
Large studies	75.5 (64.82 to 84.8)	6	2055	96.4	<0.001
By period of publication					
Before 2015	72.9 (62.4 to 82.3)	4	1245	92.4	<0.001
After 2015	78.0 (71.9 to 83.6)	7	1154	79.6	<0.001
By gender proportion					
More females	72.5 (64.4 to 79.9)	9	1919	92.2	<0.001
More males	83.9 (80.4 to 87.1)	2	480	–	–
By sampling					
Consecutive	76.7 (72.3 to 80.9)	9	1780	75.2	<0.001
Random	54.1 (50.0 to 58.2)	1	567	–	–
By setting					
Hospital	75.7 (66.0 to 84.3)	8	1825	94.9	<0.001
Health centre	71.6 (61.5 to 80.8)	3	574	–	–
By comorbidity HTN target					
Comorbidity target used	70.1 (57.4 to 81.5)	5	863	90.1	<0.001
Comorbidity target not used	78.2 (73.1 to 82.9)	6	1536	79.3	<0.001
By gross national Income					
Below SSA average	77.3 (69.7 to 84.2)	5	852	81.1	<0.001
Above SSA average	72.3 (61.0 to 82.3)	6	1547	94.9	<0.001

P^{egger} <0.001.
HTN, hypertension; SSA, sub-Saharan Africa.

escalation and use of multiple drug regimens are barrier to hypertension control. Chow *et al* revealed that the use of multiple drug regimens to treat hypertension was lower in low-income countries compared with the higher, upper middle or the lower middle-income countries.[10]

The prevalence of UHTN has declined significantly in studies published after 2015 compared with those published before 2015 probably because of adherence to the changing guidelines promoting tighter blood pressure control for people with comorbidities. However, despite the observed decline, the prevalence of UHTN among people with comorbidities is very high and needs further research to understand the interventions that can reduce the UHTN rate, so it can be adapted in other countries.

Our findings have the potential to inform public health strategies to reduce the burden of UHTN in SSA. Addressing the barriers identified is essential in achieving optimal blood pressure levels. The WHO's global target on hypertension control action plan recommends integrated care programmes for the management of hypertension and comorbidities, a recommendation supported by the results of the current study.[1]

Strengths and limitations

Strengths of our systematic review and meta-analysis include the use of a published comprehensive protocol[23] to identify all available evidence without language restriction, reporting in accordance with PRISMA guidelines, search using multiple electronic databases, searching grey literature, contacting experts in the field for additional data sources to reduce study selection bias and heterogeneity test by subgroup analyses and sensitivity analyses.

This study should, however, be interpreted in the context of the following limitations. First, it is important to note that control of hypertension among those on treatment was not the main outcome of most of the included studies. Second, the prevalence of UHTN in some comorbidities such as atrial fibrillation and chronic kidney disease were reported in single studies probably because these conditions are understudied in SSA, thus limiting the generaliseability of such findings. Fourth, most of the studies included in the meta-analysis were hospital-based studies (60%) that used non-random sampling procedures (80%). Therefore, population-based studies are warranted. Finally, we found substantial heterogeneity between the studies and conducted meta-regression analysis, which did not explain the heterogeneity. The lack of uniformity and variance in the blood pressure cut-off points for the different comorbidities may have resulted in this heterogeneity.

CONCLUSION

In conclusion, the prevalence of UHTN is high in people with comorbid conditions in SSA, particularly among people with diabetes. These findings strengthen the case for action to implement integrated care in the control of hypertension more effectively in African populations and other low-income and middle-income countries. Such efforts include improved access to blood pressure testing among people with comorbidities, strategies to improve adherence, reviewing treatment guidelines and training of healthcare workers in managing people with hypertension comorbidities and monitoring blood pressure control among all patients on treatment.

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