

# Systematic Review of Hypertension and Diabetes Burden, Risk Factors, and Interventions for Prevention and Control in Malawi

## The NCD BRITE Consortium

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### ABSTRACT

Recent studies have found an increasing burden of noncommunicable diseases in sub-Saharan Africa. A comprehensive search of PubMed, Medline, EMBASE, and the World Health Organization Global Health Library databases was undertaken to identify studies reporting on the prevalence, risk factors, and interventions for hypertension and diabetes in Malawi. The findings from 23 included studies revealed a high burden of hypertension and diabetes in Malawi, with estimates ranging from 15.8% to 32.9% and from 2.4% to 5.6%, respectively. Associated risk factors included old age, tobacco smoking, excessive alcohol consumption, obesity, physical inactivity, high salt and sugar intake, low fruit and vegetable intake, high body mass index, and high waist-to-hip ratio. Certain antiretroviral therapy regimens were also associated with increased diabetes and hypertension risk in human immunodeficiency virus patient populations. Nationwide, the quality of clinical care was generally limited and demonstrated a need for innovative and targeted interventions to prevent, control, and treat noncommunicable diseases in Malawi.

Noncommunicable diseases (NCDs)—including cancer, diabetes, cardiovascular diseases, and chronic lung diseases—account for >80% of all premature NCD deaths [1]. This burden is likely to become larger over the next decade as urbanization and lifestyle changes progress and the mean age of the population increases [2]. In sub-Saharan Africa, NCDs are projected to account for almost 50% of all deaths by 2030 [3], presenting a major barrier to development [2].

NCDs and their risk factors are becoming major public health problems in Africa [4]. Recent data in Malawi show a high burden of hypertension, diabetes, and their risk factors (including tobacco, alcohol, and physical inactivity, all of which are increasing in prevalence) in both urban and rural areas [5,6]. Increasingly, hypertension and diabetes has been affecting individuals of younger ages and of relatively low or normal body mass index [5]. Complications of hypertension and diabetes, such as heart failure, stroke, myocardial infarction, hyperglycemia, and renal failure, are common reasons for admissions to medical departments in Malawi [7].

As in other countries in Africa, Malawi lacks reliable data to accurately quantify the burden of NCDs and their risk factors to design context specific interventions. However, a number of research initiatives have been set up recently to respond to these emerging concerns. Among these is the NCD BRITE (Building Research capacity, Implementation, and Translation Expertise)—a transdisciplinary consortium consisting of key institutions in Malawi aimed at building research capacity, implementation, and translation expertise. In this systematic and narrative review, we critically synthesize available literature from Malawi on the burden, risk factors, and interventions that have been implemented for their prevention and control. The review has focused on hypertension and diabetes, as they are important in the local setting. Here, we draw together available data from Malawi to identify implementation research strategies to tackle these NCDs.

### METHODS

#### Search strategy and selection criteria

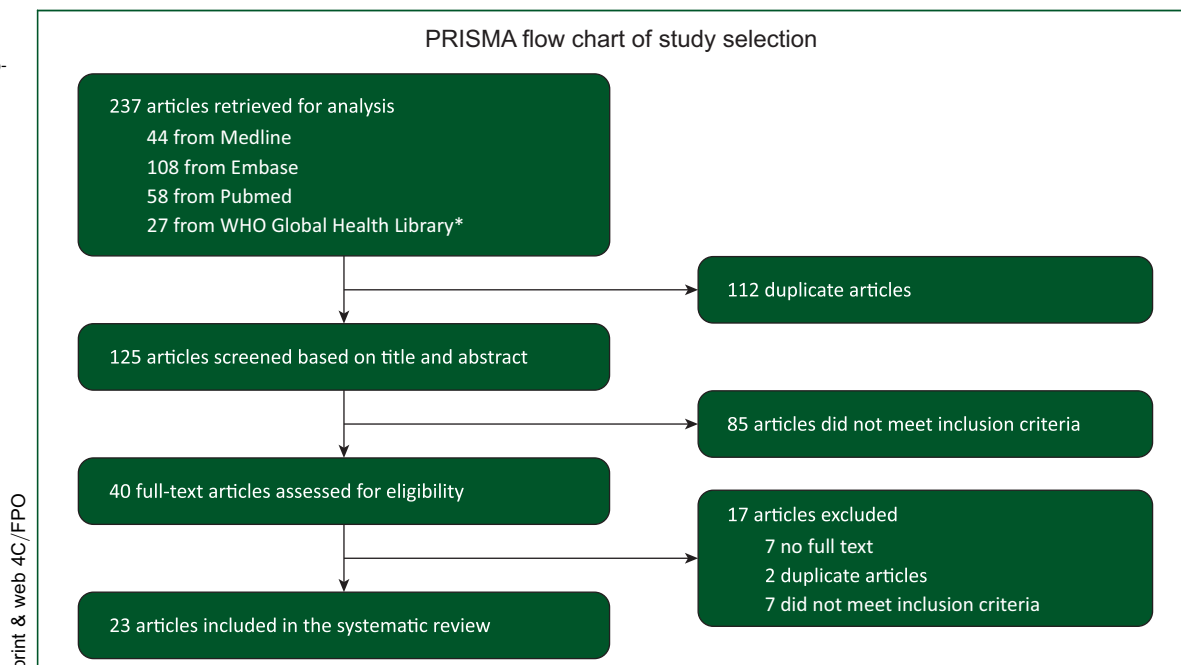
This systematic review follows the guidelines of Preferred Reporting Items for Systematic Reviews and Meta-Analyses



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**FIGURE 1.** WHO Global Health Library databases include the African Index Medicus, Medline, World Health Organization Library Information System (WHOLIS), and Scientific Electronic Library Online (SciELO).

[8]. PubMed, Medline, EMBASE, and the World Health Organization Global Health Library databases were searched in June 2018 using Medical Subject Headings and free text terms to identify eligible studies ([Online Appendix](#)). Studies from January 2008 to June 2018 were retrieved without language restriction. The search strategy was tailored to each database to allow for variations in structure and terminology. Detailed search parameters are available in the [Online Appendix](#).

Two authors (S.H.L. and D.J.) independently reviewed each title and abstract for inclusion, followed by a comprehensive full-text screening. Any disagreement was resolved by joint review of the article with a third reviewer (A.A.). All studies conducted in Malawi that reported on the prevalence of hypertension, diabetes, or their associated risk factors and interventions for prevention and control were included. No restrictions were placed on population, age, or language. Owing to the paucity of research in this setting, all study designs were made eligible for inclusion, with the exception of commentaries and editorials.

### Data extraction

Study data were extracted from all included studies in a pre-formulated table. Extracted data included the first author's name, condition studied, study location, study setting (population based or hospital-based), study design (cross-sectional, case-control, cohort, or case study), year of study, study population, methods used to diagnose diabetes and hypertension, point prevalence estimates, mean or median age of the population, proportion of male

and female individuals, and study results. Risk factors relating to hypertension and diabetes were collated using a narrative synthesis approach. Two investigators (S.H.L. and D.J.) independently extracted data from individual studies, and extracted data were re-evaluated by a third investigator (A.A.), with disagreements being resolved through consensus.

### Quality assessment

The methodological quality of included studies was evaluated independently by 2 authors (S.H.L. and D.J.) using an adapted version of the National Heart, Lung, and Blood Institute Quality Assessment Tool for Observational Cohort and Cross-Sectional Studies [9]. The detailed quality assessment tool and results are available in the [Online Appendix](#). Inter-rater agreement between investigators for study inclusion and methodological quality assessment were assessed using Cohen's kappa coefficient.

## RESULTS

### Review process and study characteristics

A total of 237 publications met the inclusion criteria. After elimination of 112 duplicates, 125 articles were screened based on title and abstract, 23 of which were included in the systematic review after careful screening of search results. Among the included studies, 12 (52.2%) were rated as high quality, 6 (26.1%) were rated as medium quality, and 5 (21.7%) were rated as low quality. Inter-rater agreement (Cohen's kappa) was 0.78 for the title and

abstract screening and 0.80 for the full text screening. Detailed search results are summarized in the Preferred Reporting Items for Systematic Reviews and Meta-Analyses flow chart (Fig. 1).

### Descriptive overview of included studies

Of the 23 included studies, 6 reported on point prevalence estimates of hypertension or diabetes, 5 reported on the status of diabetes care (primary care approach, patient experience, peer support program, diabetes control and complications, and quality of life), 1 reported uptake of care and retention of hypertension and diabetes care, 3 reported an integrated hypertension or diabetes and human immunodeficiency virus (HIV) model of care, 2 reported implementation of policies and strategies for NCD care, and 8 provided information on risk factors associated with hypertension and diabetes. Studies spanned both urban and rural settings and included 17 cross-sectional studies (78%), 4 case studies or lesson learned (17%), 1 case-control study (4%), and 1 policy brief (4%). A detailed overview of all included studies is shown in Table 1.

### Prevalence of hypertension and diabetes

Prevalence of hypertension was reported in 6 studies. Estimated rates of hypertension varied widely, ranging from 15.8% to 32.9%; the majority were undiagnosed and therefore untreated (Table 2) [5,6]. One isolated study using routinely collected facility-based electronic medical records data reported a 53% prevalence of hypertension [10]. The only large and rigorous population-based study in Malawi [5] reported a crude prevalence of hypertension of 14.7% in urban areas and 13.6% in rural areas, with a weighted age-standardized national prevalence of 15.8%. Although one study took place solely in an urban setting and one took place solely in a rural setting, the majority contained data from both, with only one nationally-representative survey. Mean participant age ranged from 36.6 to 51.5 years and sample size ranged from 356 to 28,871 persons (Table 2). There was no clear trend in the prevalence estimates over the past 10 years.

Prevalence of diabetes was reported in 5 independent studies, with estimates ranging from 1.7% to 5.6% (Table 2) [5,11], with an isolated facility based study reported an 18% prevalence of diabetes [10]. Urban settings presented a higher prevalence compared with rural areas. In a nationwide WHO STEPwise approach to Surveillance (STEPS) survey, the prevalence of diabetes was reported to be 5.4% in urban areas and 4.4% in rural settings [11]. The only large and rigorous population-based study in Malawi [5] reported a crude diabetes prevalence of 2.4% overall (3.0% in urban areas and 1.7% in rural areas), representing a national prevalence of 2.6% (weighted for urban vs. rural population distribution). Sample size ranged considerably between studies, from 356 in a rural study in Chiradzulu

district [12] to 28,871 in a 2-site population-based survey by Price et al. [5]. Of the included studies, only one was a nationally covered survey whereas most others took place in both rural and urban settings. Mean participant age ranged from 36.6 to 51.5 years, with the majority of studies presenting a greater proportion of female participants (Table 2). No studies specifically reported the prevalence of type 1 diabetes.

### Risk factors for hypertension and diabetes

Risk factors for diabetes and hypertension in Malawi were reported in 8 independent studies (Table 3). Reported risk factors for hypertension included old age, obesity, high body mass index (BMI), high waist-to-hip ratio (WHR), tobacco smoking, excessive alcohol consumption, physical inactivity, low fruit and vegetable intake, and in 1 isolated study, television ownership [6,13,14] (Table 3). For HIV-infected individuals, a current antiretroviral therapy (ART) regimen of zidovudine/lamivudine/nevirapine was shown to be a risk factor for hypertension [15]. Among the most commonly cited risk factors for diabetes mellitus were old age, tobacco smoking, excessive alcohol consumption, obesity, physical inactivity, low fruit and vegetable intake, high BMI, and high WHR [10,14,15]. For HIV-infected individuals, a current ART regimen other than tenofovir/lamivudine/efavirenz and zidovudine/lamivudine/nevirapine was shown to be a risk factor for diabetes in 1 study [15]. HIV-infected patients had a 2-fold higher prevalence of diabetes than negative control participants [12] (Table 3).

### Clinical care of patients with hypertension and diabetes

Clinical care of diabetes and hypertension were thematically synthesized based on intervention strategies. The 3 types of clinical studies included in this review examined the quality of clinical care of diabetes and hypertension at a primary health care facility, the components of innovative models of care, and the efficacy of self-management and peer-support programs which aim to support formal care in Malawi. A summary of the barriers and facilitators to implementing hypertension and diabetes interventions and clinical care in Malawi is shown in Table 4.

### Clinical care

Clinical care takes place in specialized diabetes clinics, general hypertension or NCD clinics in district hospitals, central hospitals, or health centers [16]. Uptake of clinical care among patients referred for care was 61%; higher in rural areas (72%) than in urban areas (51%) [17]. The quality of clinical management was generally reported as low, with poorly trained personnel, a persistent shortage of supplies and medication, poor patient record-keeping, low

**TABLE 1.** Characteristics of included studies on HTN and diabetes in Malawi

First Author (Ref. #)	Year	Study Design	Study Type	Setting(s)	Site(s)	Condition(s)	Description(s)	Quality Rating
Allain T [7]	2017	Cross-sectional	Facility based; single site	Urban	Blantyre	DM; HTN	Risk factors; morbidity and mortality patterns among admitted patients	High
Allain T [22]	2011	Case study	Facility based; single site	Urban	Blantyre	DM	Lesson learned from DOTS TB on diabetes M & E program	Medium
Assayed A [30]	2014	Cross-sectional	Facility based; single site	Rural	Mangochi District	DM	Primary health care approach for diabetes care; opinion	Low
Bui D [26]	2014	Case study	Facility based; single site	Urban	Lilongwe	DM	Peer support program for diabetes care	Low
Chikowe I [16]	2018	Cross-sectional	Facility based; multisite	Rural	Nationwide	DM	Facility audit; diabetes care in rural health centers	Medium
Cohen D [31]	2010	Cross-sectional	Facility based; single site	Urban	Blantyre	DM	Diabetes control and complications	Medium
de Ramirez [13]	2010	Cross-sectional	Population based; multisite	Rural	Mwandama	HTN	Prevalence; risk factors	High
Divala O [15]	2016	Cross-sectional	Facility based; multisite	Both	Zomba District	DM; HTN	Prevalence, risk factors	High
Lupafya P [29]	2016	Cross-sectional	Facility based; multisite	Both	Nationwide	DM; HTN	Implementation of policies and strategies for NCD care	Low
Manjomo R [10]	2016	Cross-sectional	Facility based; single site	Urban	Lilongwe	DM; HTN	Prevalence; primary health care clinic	Medium
Mitambo C [32]	2017	Review	Policy brief	Both	Nationwide	HTN	Screening and treatment of HTN among HIV patients; implementation strategies	High
Msyamboza K [6]	2011	Cross-sectional	Population based; nationwide	Both	Nationwide	DM; HTN	Prevalence, risk factors	High
Msyamboza K [11]	2014	Cross-sectional	Population based; nationwide	Both	Nationwide	DM	Prevalence, risk factors	High
Mudie K [14]	2018	Cross-sectional	Population based; multisite	Both	Lilongwe; Karonga	DM; HTN	Risk factors	High
Musicha C [17]	2016	Cross-sectional	Population based; multisite	Both	Lilongwe; Karonga	DM; HTN	Uptake and retention to HTN and DM care	High
Ogunrinu T [25]	2017	Cross-sectional	Facility based; single site	Rural	Thyolo District	DM	Patient experience on diabetes care	Low
Patel P [20]	2018	Case study	Facility based; lessons learned	Urban	Lilongwe	HTN	Integrated care HTN and HIV care	High
Pfaff C [33]	2017	Cross-sectional	Facility based; 2 districts	Both	Northern districts	HTN	Facility audit; integrated HTN and HIV care	Medium
Price A [5]	2018	Cross-sectional	Population based; multisite	Both	Lilongwe; Karonga	DM; HTN	Prevalence, risk factors	High
Rucker S [12]	2018	Cross-sectional; case-control	Facility based; multisite	Rural	Chiradzulu	DM; HTN	Prevalence, risk factors	High
Wood R [18]	2015	Cross-sectional	Facility based; multisite	Both	Dedza District	DM; HTN	Facility audit; quality of NCDs care	Medium
Wroe E [21]	2015	Case study	Facility based; lessons learned	Rural	Neno District	DM; HTN	Lesson learnt; integrated chronic care clinic; leveraging HIV platform	High
Yassin A [19]	2016	Cross-sectional	Facility based; single site	Urban	Lilongwe	DM; HTN	Status of diabetes care; comorbidities and quality of life	High

DM, diabetes mellitus; DOTS, Directly Observed Treatment Short Course; HIV, human immunodeficiency virus; HTN, hypertension; M & E, monitoring and evaluation; NCD, noncommunicable disease; TB, tuberculosis.

**TABLE 2.** Description of the study characteristics and prevalence of HTN and diabetes

Condition	First Author (Ref. #)	Study Year	Site	Region	Setting	Sample Size	Male (%)	Female (%)	Age (yrs)*	Urban Prevalence (%) <sup>†</sup>	Rural Prevalence (%) <sup>†</sup>	Male Prevalence (%)	Female Prevalence (%)	Overall Prevalence (%)	Diagnosis
DM	Msyamboza K [11]	2009	Both	Nationwide	Household	3,056	29.8	70.2	25–64	5.4 (2.4–8.4)	4.4 (2.8–5.9)	6.5	4.7	5.6	FBS >6.1 mmol/l or currently on medication for DM
DM	Price A [5]	2013–2016	Both	Karonga District, Lilongwe	Household	23,973	38.3	61.7	≥18	3.0	1.7	2.4	2.3	2.4	FBS >7.0 mmol/l or self-report of a previous diagnosis of diabetes
DM	Manjomo R [10]	2014–2015	Urban	Lilongwe	Health center	1,135	34	66	≥0	18	N/A	N/A	N/A	18	Unclear; FBS >7.0 mmol/l [126 mg/dl]
DM	Rucker S [12]	2015–2016	Rural	Chiradzulu District	Hospital	356	26.7	73.3	≥30	N/A	3.1 (1.7–5.5) HIV–; 6.6 (4.5–9.6) HIV+	N/A	N/A	3.1 (1.7–5.5) HIV–; 6.6 (4.5–9.6) HIV+	HbA1c ≥6.5% or self-reported history or use of antidiabetic medication
DM	Divala O [15]	2014	Both	Zomba	HIV clinic	952	28.3	71.7	43.0 (≥18)	4.8 (3.2–7.1)	3.4 (2.1–5.5)	3.7	4.3	4.1	FBS >7.0 mmol/l or BS >11.1 mmol/l on 2 separate measurements, or currently on medication for DM.
HTN	Msyamboza K [6]	2009	Both	Nationwide	Household	3,910	32.8	67.5	25–64	27.9 (23.5–32.3)	32.0 (30.5–33.6)	37.2	29.2	32.9	SBP ≥140 mm Hg or DBP ≥90 mm Hg or currently on medication for high BP
HTN	Price A [5]	2013–2016	Both	Karonga District, Lilongwe	Household	28,871	38.3	61.7	≥18	14.7	13.6	14.9	13.8	15.8	SBP ≥140 mm Hg or DBP ≥90 mm Hg or currently on medication for high BP
HTN	Rucker S [12]	2015–2016	Rural	Chiradzulu District	Hospital	356	26.7	73.3	≥30	N/A	25.8 (21.6–30.7) HIV–; 19.5 (15.6–23.6) HIV+	N/A	N/A	25.8 (21.6–30.7) HIV–; 19.5 (15.6–23.6) HIV+	SBP ≥140 mm Hg or DBP ≥90 mm Hg or currently on medication for high BP. BP = average of 2 consecutive BP measurements
HTN	de Ramirez [13]	2007	Rural	Mwandama	Household	408	40	60	38.4 (≥18)	N/A	23	25	22	23	SBP ≥140 mm Hg or DBP ≥90 mm Hg or currently on medication for high BP. BP = average of consecutive measurements separated by 3 min

(continued)

TABLE 2. Continued

Condition	First Author (Ref. #)	Study Year	Site	Region	Setting	Sample Size	Male (%)	Female (%)	Age (yrs)*	Urban Prevalence (%) <sup>†</sup>	Rural Prevalence (%)	Mae Prevalence (%)	Female Prevalence (%)	Overall Prevalence (%)	Diagnosis
HTN	Divala O [15]	2014	Both	Zomba	HIV clinic	952	28.3	71.7	43.0 (≥18)	26.5 (22.7–30.6)	21.0 (17.5–24.9)	24.5	23.4	23.7	SBP ≥140 mm Hg or DBP ≥90 mm Hg or currently on medication for high BP. BP = mean of first 3 BP measurements and confirmed at 2 follow-up visits within 2 weeks
HTN	Manjomo R [10]	2014–2015	Urban	Lilongwe	Health center	1,135	34	66	≥0	53	N/A	N/A	N/A	53	Unclear; SBP ≥140 mm Hg or DBP >90 mm Hg

BP, blood pressure; BS, blood sugar; DBP, diastolic blood pressure; FBS, fasting blood glucose; HbA1c, glycosylated hemoglobin; N/A, Not available; SBP, systolic blood pressure; other abbreviations as in Table 1.  
 \*Listed as mean, range, or mean (range).  
 †Range in parentheses.

patient education, and poorly defined protocol for care delivery [16,18,19].

### Innovative models of care

Innovative models of care involved leveraging HIV clinical service delivery facilities to provide a platform for NCDs screening and treatment [20,21]. The studies documented that integration of hypertension and diabetes screening and care into an HIV clinic is feasible despite various challenges including frequent stock out and dispensing of NCD drugs, workload, and issues related to data monitoring and evaluation. Applying an electronic monitoring and evaluation system to routinely monitor and report these patients for efficient rational drug forecasting and planning of logistics and staffing has been recommended [22].

### DISCUSSION

This systematic review of the literature revealed a high burden of hypertension and diabetes in Malawi, with estimates ranging from 15.8% to 32.9% and 1.7% to 5.6%, respectively. Most cases of hypertension and diabetes remain undiagnosed, untreated, or inadequately controlled. Risk factors associated with these NCDs include increasing age (older age), tobacco smoking, excessive alcohol consumption, obesity, physical inactivity, low fruit and vegetable intake, high BMI, and high WHR. Selected ART regimens were also associated with increased diabetes and hypertension risk in HIV patient populations.

Among the included studies, discrepancies exist in the prevalence and distribution of hypertension between urban and rural settings. While the nationwide STEPS survey reported a higher rural prevalence of 32.0% compared with an urban prevalence of 27.9% [6], studies by Price et al. [5] and Divala et al. [15] report lower estimates, with rural prevalence estimates of 13.6% and 21.0% compared with urban estimates of 14.7% and 26.5%, respectively. For diabetes, higher burden has consistently been reported in urban compared to rural settings, specifically in studies by Price et al. [5], Divala et al [15], and Msyamboza et al [23]. Studies with older population samples generally reported higher prevalence of diabetes and hypertension when compared with younger populations [5,11], which is consistent with previous studies reporting older age as a risk factor for diabetes and hypertension [7].

Our review also found a wide variability in prevalence estimates of both hypertension and diabetes across Malawi with no clear time trend, and is more pronounced for hypertension than diabetes estimates. The substantial heterogeneity found between studies was mainly explained by issues related to study methodology, including variation in the diagnosis criterion, the use of different cutoff measures, study settings, data source (primary vs. routinely collected facility-based data), relatively smaller sample sizes, unclear participant selection, and larger proportion of missing outcome data.

**TABLE 3.** Risk factors for diabetes and hypertension in Malawi

Condition	First Author (Ref. #)	Study Year	Site	Region	Setting	Comorbidities	Sample Size	Male (%)	Female (%)	Age (yrs)*	Risk Factors
DM	Allain T [7]	2013–2014	Urban	Blantyre	Hospital	N/A	10,191	50.2	49.8	≥16	Old age, HIV comorbidity
DM	Divala O [15]	2014	Both	Zomba	HIV clinic	HIV	952	28.3	71.7	≥18	Old age, current ART regimen other than tenofovir/lamivudine/efavirenz and idovudine/lamivudine/nevirapine
DM	Mudie K [14]	2013	Both	Karonga, Lilongwe	Household	N/A	27,880	39.7	60.3	35.9 (±15.1)	High BMI and WHR
DM	Msyamboza K [11]	2009	Both	Nationwide	Household	N/A	3,056	29.8	70.2	25–64	Tobacco smoking, excessive alcohol consumption, physical inactivity, obesity, low fruit and vegetable intake
DM	Manjomo R [10]	2014–2015	Urban	Lilongwe	Health center	N/A	1,135	34	66	≥14	Tobacco smoking, high alcohol consumption, obesity
DM	Price A [5]	2013–2016	Both	Lilongwe, Karonga	Household	N/A	28,891	38.3	61.7	36.6 (≥18)	Physical inactivity, tobacco smoking, high alcohol consumption, high salt and sugar intake
DM	Rucker S [12]	2015–2016	Rural	Chiradzulu District	Hospital	HIV	356	26.7	73.3	51.5 (≥30)	ART regimen >10 yrs
HTN	Allain T [7]	2013–2014	Urban	Blantyre	Hospital	N/A	10,191	50.2	49.8	≥16	Old age, HIV comorbidity
HTN	de Ramirez [13]	2007	Rural	Mwandama	Household	N/A	408	40	60	38.4 (≥18)	Old age, high BMI, television ownership, physical inactivity, frequent meat and fat intake
HTN	Divala O [15]	2014	Both	Zomba	HIV clinic	HIV	952	28.3	71.7	43.0 (≥18)	Old age, obesity, current ART regimen zidovudine/lamivudine/nevirapine, and presence of proteinuria
HTN	Mudie K [14]	2013	Both	Southern Karonga, Lilongwe	Household	N/A	27,880	39.7	60.3	35.9 (±15.1)	High BMI and WHR
HTN	Msyamboza K [6]	2009	Both	Nationwide	Household	N/A	3,910	32.8	67.5	39.7 (25–64)	Tobacco smoking, excessive alcohol consumption, physical inactivity, obesity, low fruit and vegetable intake
HTN	Manjomo R [10]	2014–2015	Urban	Lilongwe	Health center	N/A	1,135	34	66	≥14	Tobacco smoking, high alcohol consumption, obesity
HTN	Price A [5]	2013–2016	Both	Lilongwe, Karonga	Household	N/A	28,891	38.3	61.7	36.6 (≥18)	Physical inactivity, tobacco smoking, high alcohol consumption, high sugar intake
HTN	Rucker S [12]	2015–2016	Rural	Chiradzulu District	Hospital	HIV	356	26.7	73.3	51.5 (≥30)	ART regimen >10 yrs

ART, antiretroviral therapy; BMI, body mass index; WHR, waist-to-hip ratio; other abbreviations as in Tables 1 and 2.  
\*Listed as mean, range, or mean (range).

**TABLE 4.** Barriers and facilitators to implementing hypertension and diabetes interventions and clinical care in Malawi

Barriers	Facilitators
<ul style="list-style-type: none"> <li>• Underfunding of NCD prevention and treatment care programme</li> <li>• Lack of comprehensive hypertension and diabetes disease screening at the population-level</li> </ul>	<ul style="list-style-type: none"> <li>• Active Ministry of Health participation and engagement helps bring together stakeholders across disciplines</li> <li>• Various stakeholders working together with the Ministry of Health policy and strategy development allows leveraging of future opportunities</li> </ul>
<ul style="list-style-type: none"> <li>• Limited public awareness of hypertension and diabetes symptoms and disease management</li> <li>• Lack of basic health commodities for the screening, diagnosis and treatment of hypertension and diabetes at primary health care facilities</li> </ul>	<ul style="list-style-type: none"> <li>• Development of a National Action Plan for prevention and management of NCDs</li> <li>• Development of innovative models of care including integrated models of care (i.e., NCD treatment at HIV clinic) to improve access to treatment</li> </ul>
<ul style="list-style-type: none"> <li>• Lack of specialists and/or specialist NCD clinics</li> <li>• Lack of standardized protocols for care delivery</li> </ul>	<ul style="list-style-type: none"> <li>• Task shifting initiatives to other health cadres to mitigate human resource shortages</li> <li>• Initiatives by stakeholders in Malawi to build NCD focused implementation research capacity</li> </ul>
<ul style="list-style-type: none"> <li>• Poorly trained personnel and staff shortages</li> <li>• Supply shortages (i.e., drugs, laboratory assays, diagnostic equipments)</li> <li>• Limited access to care (i.e., distance to clinics, lack of follow-up)</li> <li>• Poor patient record-keeping</li> </ul>	<ul style="list-style-type: none"> <li>• Implementation of electronic medical records system to keep track of patient data and standardize care</li> </ul>

Abbreviations as in [Table 1](#).

Our review demonstrated that there is an increased risk of hypertension and diabetes at a younger age and often in individuals with relatively low or normal BMI [5]. The mechanism is not understood but may be related to early life risk factors including low birth weight and undernutrition. Traditional risk factors including tobacco, alcohol, and physical inactivity in Malawi appear to be increasing [5,6], with at least 1 in 4 men smoking tobacco, 1 in 5 men drinking alcohol excessively, and at least 1 in 4 women were overweight or obese [5,6]. More than one-half of the individuals in urban and rural Malawi reported a consumption of salt exceeding the 5 g/day recommended limit set by the World Health Organization [5]. The use of more than an equivalent of 6 teaspoons of sugar per day in sweetened drinks was also common [5]. The higher burden of hypertension and diabetes in younger age groups and the relative increase in traditional risk factors emphasizes that context-based interventions should start early in the life course.

In this systematic review, clinical care of hypertension and diabetes in Malawi were examined based on 3 categories: typical clinical care, innovative models of care, and external patient support strategies. Given limited human and financial resources, innovative models of care are required to mitigate the growing burden of NCDs in Malawi. More broadly, we identified 2 innovative models of care integration across Malawi [20,21]. The first model of care in southern Malawi is an integrated chronic care clinic that utilizes an HIV program as a platform for various

chronic care screening and treatment (hypertension, diabetes, asthma, and epilepsy, regardless of HIV status) [21]. This model of care allows patients with chronic conditions or HIV to be screened and treated at a single facility during a single visit. The second model of care from central Malawi reported leveraging an HIV service platform for the screening and treatment of hypertension [20]. These studies documented that the integration of hypertension and diabetes screening into an HIV clinic is feasible despite various challenges including frequent stock out and dispensing of NCD drugs, patient flow, workload, and issues related to data monitoring and evaluation [20,21]. A recent NCD model of care review in sub-Saharan Africa also revealed that leveraging existing human resources, decentralization of NCD care to primary health facilities, task redistribution including to lay health cadres, designing patient-centered quality of care, and continued training and mentorship are key to successes of NCD treatment and control [24]. Although community screening and sensitization on the need for NCD care is critical, strategies are needed to ensure better linkage and retention into care [17].

In our review, patient-centered diabetes care has been explored in 2 studies [25,26]. Management strategies external to formalized clinical settings include self-management and peer-support programs [25,26]. Self-management centers around patient education regarding their condition to better manage their own care [25]. Peer-support programs leverage the geographic proximity of



patient groups to develop a supportive care network outside of the clinic setting [26].

Malawi's 2011 to 2016 Health Sector Strategic Plan [27] included NCDs, and an NCD Control Program was established with the development of the 2013 National Action Plan for prevention and management of NCDs [28]. Currently, a new Strategic Plan is under development. Although Malawi has begun to address the emerging burden of NCDs, our review of policy implementations for NCD prevention and control showed gaps in terms of provision of quality clinical care and lack of comprehensive active screening, prevention, community awareness, and outreach activities [29]. In terms of financial support, although NCDs are included in district implementation plans, most of the planned activities are unfunded and therefore unexecuted [29].

Although a nationwide STEPS survey was conducted in 2009 [6] and a subsequent large-scale population-based study was conducted in urban and rural Malawi in 2016 [5] to assess the prevalence and risk factors of hypertension and diabetes in Malawi, there remains a dearth of high-quality literature to support those research findings. To provide reliable data, standardized survey and measurement protocols must be developed and employed. Robust data are needed regarding the burden and risk factors for NCDs, particularly with attention to relative contributions of subtypes of conditions (e.g., causes of cardiovascular disease) and risk factors related to living in poverty. Moreover, this systematic review uncovers a need for a greater amount of high-quality research related to NCDs, particularly among children and adolescents in Malawi as well as among the poor, which may permit a better estimate of the national trends of chronic disease conditions. Phase 4 Translation research is also warranted to assess the implementation of the different innovative models of NCD care, including the cost effectiveness of various approaches to provide information for scaling up. The contribution of nontraditional risk factors for NCDs, including infections and undernutrition, were not explored in Malawi and requires future study.

This systematic review should be interpreted in the context of its limitations. We have only considered literature published in the last 10 years, which precludes data from earlier reports. We included 23 studies, among which 12 (52.2%) were rated as high quality, 6 (26.1%) were rated as medium quality, and 5 (21.7%) were rated as low quality. Prevalence data reported in this review span quite a wide range. The heterogeneity of reported data may be attributed to low sample sizes, differing population demographics, insufficient control for confounders, and the usage of variable diagnostic criteria and measurement techniques between studies. Despite these limitations, this study is the first systematic review of hypertension and diabetes disease burden and risk factors in Malawi providing a clear summary of the existing knowledge on these conditions. Moreover, the review summarized the

various models of clinical care currently underway in Malawi.

## CONCLUSIONS

The prevalence of and risk factors for hypertension and diabetes is high in Malawi, which is consistent with findings from other settings in sub-Saharan Africa. As treatment of priority conditions such as HIV continues to improve in these settings, NCDs are increasingly being recognized as the next frontier in health. This preliminary review puts the currently available literature into context and elucidates critical gaps of research in the field.

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