Towards improved knowledge and optimization of health care for non-communicable diseases in Lesotho

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ACRONYMS

ASSIST	Alcohol, Smoking and Substance Involvement Screening Test
aOR	Adjusted odds ratios
BP	Blood Pressure
CI	Confidence interval
ComBaCaL	Community-based Chronic Care Lesotho
CORIAL	Causes of Respiratory Infections in Adults in Lesotho
COVID-19	Coronavirus Disease 2019
CVDs	Cardiovascular diseases
CVDRFs	Cardiovascular disease risk factors
DALYs	Disability-adjusted life-years
DBP	Diastolic blood pressure
DHIS2	District Health Information Software 2
DHS	Demographic and Health Survey
GAD-7	Generalized Anxiety Disorder-7 questionnaire
HB1aC	Glycosylated hemoglobin
HIV	Human Immunodeficiency virus
IQRs	Interquartile ranges
MistraL	Mitigation strategies for communities with COVID-19 transmission in Lesotho using artificial intelligence on chest x-rays and novel rapid diagnostic tests
MOU	Mental Health Observation Unit
NCDs	Non-communicable diseases
PHQ-9	Patient Health Questionnaire-9
PC-PTSD-5	Primary Care Post-Traumatic Stress Disorder screener
PTSD	Post-traumatic stress disorder
RBG	Random blood glucose
RCT	Randomized control trial
SARS-CoV-2	Severe acute respiratory syndrome coronavirus 2
SBP	Systolic blood pressure
STEPS	STEPwise Approach to Surveillance
PTSD	Post-traumatic stress syndrome
TB	Tuberculosis
WHO	World Health Organization
YLD	Years lived with a disability

CONTENTS

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The Guest House
This being human is a guest house.
Every morning a new arrival.

A joy, a depression, a meanness,
some momentary awareness comes
as an unexpected visitor.

Welcome and entertain them all!
Even if they're a crowd of sorrows,
who violently sweep your house
empty of its furniture,
still treat each guest honorably.
He may be clearing you out
for some new delight.

The dark thought, the shame, the malice,
meet them at the door laughing,
and invite them in.

Be grateful for whoever comes,
because each has been sent
as a guide from beyond.

Jalal ad-Din Muhammad Rumi (1207-1273)

SUMMARY

Lesotho is undergoing notable changes in its population and epidemiology, mirroring patterns observed in the sub-Saharan region. These changes are characterised by an increasing and aging population, as well as a growing prevalence of non-communicable diseases. At the start of my PhD thesis, updated data on frequency and distribution of cardiovascular risk factors and mental health problems in the Lesotho's adult population was lacking. The studies included in this thesis aimed to cover this gap by providing up-to-date measures of prevalence and characterizing the quality of care for a selection of cardiovascular risks and mental health problems the country. Furthermore, I reviewed existing evidence to inform the design of a community-based hypertension care intervention that will be tested in hard-to-reach areas of the country.

These studies shed light on the high prevalence rates of tobacco use, elevated blood pressure, overweight, and diabetes among adults in Lesotho. Trauma and excessive alcohol use emerged as prevalent mental health problems, with a considerable proportion of individuals not seeking help for their symptoms. Additionally, notable disparities in terms of age, socioeconomic status, and the treatment gap for the above conditions were identified. The availability of a diverse health workforce providing health services in the country indicates the potential to test and scale task-shifted and task-shared interventions to mitigate the impact of such health risks in the adult population. In this regard, feasibility of community-based approaches for hypertension care in sub-Saharan Africa was confirmed in a scoping review, although, the quality of the evidence was poor.

This thesis provides valuable insights into the health landscape of Lesotho and underscores the need for comprehensive interventions to address cardiovascular risks and mental health problems in most-at-risk groups.

1. BACKGROUND

1.1 Demographic and epidemiological transitions in Sub-Saharan Africa

The sub-Saharan region is undergoing a profound demographic transition, characterized by a decrease of birth and death rates. This shift is driven by improvements in health care, sanitation, and changes in social attitudes towards family size[1–3]. As a result, the population in this region is projected to increase from 1.2 billion people in 2022 to 2.1 billion by 2050, and the percentage of adults over 65 years will rise from three per cent in 2022 to almost five per cent in 2050[4]. As a consequence of aging, the last decades have already seen an increase in non-communicable diseases (NCDs) in the region. The Global Burden of Diseases, Injuries, and Risk Factors Study, estimated that the proportion of total disability-adjusted life-years (DALYs) attributed to NCDs in sub-Saharan Africa increased from 37.8% in 1990 to 66.0% in 2019, with most countries observing an increase of numbers of years spent with poor health in their citizens[5].

Cardiovascular diseases (CVDs) are significant contributors to the NCD burden in sub-Saharan Africa. In 2017, estimates indicated that this group of conditions, including coronary heart disease, cerebrovascular disease, and peripheral arterial disease, contributed to 22,9 million DALYs lost in adults, and had an increasing trend in the region[6]. CVDs appear as a result of accumulation of cardiovascular risk factors (CVDRFs), such as elevated blood pressure (BP), use of tobacco, physical inactivity, overweight, and diabetes. These health risks are also on the rise driven by changes in lifestyle, with higher rates of urbanization, changes in diet (increased consumption of salt, processed foods and fats, decreased consumption of fresh food), and sedentary habits[7]. In sub-Saharan Africa elevated BP is the most prevalent CVDRF in adults[8–11], followed by overweight and use of tobacco[12,13], whereas the prevalence of diabetes significantly increased, especially in women[14], but varies across the region from 2.0% in Gambia, to as high as 14.8% in Mauritius[15–20].

Likewise, mental health and substance use problems make a notable contribution to NCDs in the sub-Saharan region. It is estimated that these conditions account for 19% of all years lived with a disability (YLD) in the region, of which major depressive disorders make the largest contribution, accounting for approximately 40% of mental health attributed YLDs[21]. Such increased prevalence of mental health problems in the region is attributed to poverty and inequality, civil unrest, displacement, stigma, and discrimination related to other health

conditions, such as HIV or tuberculosis (TB), or to mental health conditions themselves. These socio-economic circumstances and health conditions contribute to chronic stress, post-traumatic stress syndrome (PTSD), depression, anxiety, or increased use of alcohol and other substances[22].

In order to effectively respond to such evolving healthcare needs in this region, there is a need to adapt the available health services in an environment of financial and human resources scarcity[23,24]. Some proposed strategies to scale up health care for cardiovascular risks and mental health problems in this population are: i) strengthening health information systems, to understand the prevalence of such conditions and evaluate interventions, ii) increasing awareness, within the society, health workers and governments, to increase prevention and early care, iii) expanding and equipping the health workforce to provide services, and iv) providing services through task-shifted, integrated, primary health and community-based approaches[25–27].

1.2 The evolving disease profile in Lesotho

Lesotho is a landlocked country within South Africa hosting 2.1 million people that is influenced by the same drivers and healthcare needs than other countries in the region. Classified as a lower-middle income country, about one third of the population lives in (peri-)urban areas and the rest in rural areas[28]. In 2021, the Human Development Index was 0.51 and poverty affected 34.7% of the population. Despite an important economic migration, the population is expected to grow to 2.5 million by 2040[29–31]. The disease profile was traditionally dominated by infectious diseases and maternal and child conditions. However, the past decades have witnessed important programmatic progress in the prevention and management of these conditions. With regards to HIV, in 2021 there were 232,439 adults and children on antiretroviral treatment, annual rates of new HIV infections had decreased 61% compared to 2010, and the country was close to meeting the 95-95-95 targets in relation to testing, treatment initiation and suppressed viral load[32]. TB incidence decreased from 1,240 to 654 cases per 100,000 in the period of 2008 to 2019[33], and under-five mortality rates dropped from 116 to 73 per 1,000 live births in the period between 2006 to 2021[34].

The most recent data on prevalence of CVDRFs in Lesotho comes from the 2012 STEPwise Approach to Surveillance (STEPS) survey[35], that reported estimates based on a national

representative sample of 2310 adults between 25 and 64 years[36]. The results of this survey showed that up to 20% of adults smoked tobacco daily, 31% had elevated BP, 6% had raised blood glucose levels, and 6% had elevated total cholesterol levels in 2012[37]. By 2014, 68.5% and 70.0% of adults living with hypertension and diabetes were on treatment, respectively[38]. Hypertension and diabetes are the only CVDRFs for which health services are routinely available in the public sector, however, quality of care indicators are not routinely collected, nor used to influence programmatic improvements. in 2016 Mugomeri, *et al.* reported that in a sample of 212 study participants in Lesotho, close to 67% of those diagnosed with hypertension were not controlled, despite being on treatment, 36% had inadequate knowledge about their condition, and 44% had inadequate knowledge about their medication. Similarly, Thinyane, *et al*. found in a hospital-based sample of 150 adults living with diabetes, that up to 52.4% of them defaulted appointment dates while 64.6% failed to take their medications as prescribed at least once[39,40]. Available data also highlight frequent late diabetes diagnosis due to suboptimal screening. Among those diagnosed, quality of care is usually poor, with insufficient glycemic control and high rates of complications[41–43]. In 2014, the Lesotho Demographic and Health Survey (DHS) reported the most recent information on treatment rates for adults living with hypertension and diabetes, from a sample of 12,333 participants, ranging between 50% to 70% [38].

Existing estimates for different mental health problems can be extracted from studies from 1990, that had small and selected samples, and which mostly did not use validated questionnaires. At that time major depression and generalized anxiety were common both at community (12.4%, 6.2%) and general outpatient settings (21.7%, 27.9%), respectively[44,45]. Today, trauma, sexual and interpersonal violence, alcohol use and abuse represent important health problems[46–49]. Nonetheless, updated information about frequency, distribution, and health services gaps related to depression, anxiety, suicidal thoughts, trauma, and use of substance problems was not available[50]. In addition, mental health services in Lesotho are scarce and underfunded. Referral services are available at the National Psychiatric Hospital and at each District Hospital there is a Mental Health Observation Unit (MOU), headed by a nurse who is trained in basic mental health care. Heath care workers at primary health centers refer patients to MOUs and further to the referral psychiatric hospital. General counseling and few treatment options are provided for depression, suicidality, substance abuse, and

relationship trauma. Limited services are available in the private sector and there is a fundamental gap in the identification and use of validated screening and treatment tools for most of the conditions, questioning the availability of reliable data[51,52].

1.3 Cardiovascular and mental health global responses and my PhD

Global NCD responses have intensified in the last years. In 2018, the 3rd United Nations High-Level Meeting on the Prevention and Control of Non-Communicable Diseases renewed the commitment of national governments to prevent and treat NCDs, while incorporating laws and fiscal measures to protect people from consumption of tobacco, unhealthy foods, and alcohol advertising[53]. Around that time, the World Health Organization (WHO) released policy guidelines for national NCD programmes to identify and invest on cost-effective and feasible "Best Buy" strategies[54]. In 2021, the Roadmap 2023–2030 for the Global Action Plan for the Prevention and Control of Noncommunicable Diseases for the African Region was released[55], and the Lesotho government started adapting some of these initiatives[56,57].

In 2020 the research group that I was part of, led by Prof. Niklaus Labhardt, successfully acquired the TRANSFORM grant from the Swiss Agency for Development and Cooperation, and created the ComBaCaL project[58]. This initiative aims to develop, test, and share innovative approaches to expand good quality NCDs prevention and care in rural Lesotho. This group has a well-stablished research collaboration with the Ministry of Health in Lesotho and SolidarMed, a Swiss non-governmental organization that supports health projects in the Butha-Buthe and Mokhotlong districts in the country. During my time as a PhD student in the group, I took part in the project proposal preparation, funding acquisition, and the initial steps of the ComBaCaL project, while some of its components became the objectives of my PhD thesis.

2. OVERALL PhD AIM

The ultimate aim and specific objectives of my doctoral studies underwent changes over time. This section summarizes the projects outlined in the original PhD proposal and those that finally constituted this thesis.

2.1 Initial research aim and objectives

The original aim of my PhD was to measure the prevalence and characterize the care cascades for a selection of chronic health and infectious conditions. Furthermore, to contribute to the design of a community based NCDs care model in rural Lesotho. The specific objectives included:

1. ***Measure the prevalence of CVDRFs and selected mental health problems in a population-based survey in two districts in rural Lesotho.***

   This objective was maintained and unpacked in the three first objectives of this thesis.

2. ***Perform a scoping review on community-based models of care for hypertension in Sub-Saharan Africa.***

   This objective was maintained and constitutes the fourth objective in this thesis.

3. ***Pilot and evaluate an e-health tool to support the provision of long-term CVD care in an integrated, community-based, and lay worker-led service delivery model in rural Lesotho.***

   I did not tackle this project, as the other projects became large in scope.

4. ***Determine causes of respiratory infections, other than TB and SARS-CoV-2, among adults presenting with symptoms of respiratory infection in a rural hospital in Lesotho (CORIAL).***

   This project was started, however, as I came to the completion of this thesis, it was in the phase of data analysis. Therefore, it was not included in this thesis.

2.2 Final research aim and objectives

The definitive aim of my PhD was to provide up-to-date measures of prevalence and characterize the quality of care for a selection of cardiovascular risks and mental health problems in Lesotho. Furthermore, I contributed to formative work that informed the design of a community-based hypertension care model to be implemented in hard-to-reach areas of the country.

This section outlines the four specific objectives and the scientific outputs where I was first author.

1. ***Measure contemporary prevalence data and identify determinants of a selection of cardiovascular risk factors in Lesotho***

   Manuscript submitted to International Health Journal in May 2023 (approved for publication July 2023)

Objective: To report prevalence of tobacco use, overweight, elevated BP, diabetes, dyslipidemia, and their determinants using data from a population-based survey conducted in 2021 to 2022 in northern Lesotho.

Measured outcomes: Tobacco use was measured using the WHO Alcohol, Smoking and Substance Involvement Screening Test (ASSIST). Body mass index (BMI) was defined as weight (kg) divided by height (m2) and classified as underweight (<18.5 kg/m^2), normal weight (18.5-24.9 kg/m^2), overweight (≥25 kg/m^2), and obesity (≥30 kg/m^2). Elevated BP was defined as systolic blood pressure (SBP) ≥140 mmHg and/or diastolic blood pressure (DBP) ≥90 mmHg, using the average of the last two out of three readings. Confirmed diabetes was defined as random blood glucose (RBG) ≥ 5.6mmol/L and confirmatory glycated hemoglobin (HbA1c) ≥ 6.5%, or an RBG ≥ 11.1mmol/L, or presenting normal RBG values while taking antidiabetic drugs. A total of 36 participants that had an RBG result between 7.0 and 11.0 mmol/L and missing HbA1c values were labelled as "unconfirmed diabetes". Dyslipidemia was defined as measured total cholesterol level ≥5.2 mmol/L, low-density lipoprotein (LDL-Chol) ≥4.1 mmol/L, or high-density lipoprotein (HDL-Chol) <1.0 mmol/L in men and <1.3 mmol/L in women. Participants characteristics were summarized as counts with frequency and median with interquartile ranges (IQRs). Prevalence figures were reported with 95% Wald confidence intervals (CIs). We used univariable and multivariable logistic regression models and reported

adjusted odds ratios (aOR) with 95% CI derived from logistic regression models to assess associations of participants' characteristics with the assessed CVDRFs.

2. **Inform health policy makers about the gaps in awareness, treatment, and control among adults living with arterial hypertension or diabetes mellitus in Lesotho**
   Manuscript submitted to Scientific Reports in July 2023

Objective: to measure the hypertension and diabetes care cascade, and to identify factors associated with being on treatment and reaching treatment targets using data from a population-based survey conducted in 2021 to 2022 in northern Lesotho.
Specific outcomes: in each cascade we assessed the following three steps: being aware of the condition, being on treatment for the condition, and being controlled for the condition (i.e., reaching treatment targets). A participant was categorized as "being aware" of their condition if they stated that a health care worker had previously told them they had arterial hypertension and/or diabetes mellitus. "On treatment" was defined as participants stating they were taking medication along with a written proof of anti-hypertensive or anti-diabetic medication prescription, respectively, in their health booklet. Hypertension control was defined as SBP <140mmHg and DBP <90 mmHg on the day of the survey. Diabetes control was defined as HbA1c ≤ 8.0% on the day of the survey. Participants' characteristics were described using frequency and median with IQR. The number of participants diagnosed with hypertension or diabetes was set as the denominator for all other steps of the respective care cascade. For each step of the care cascades, we reported frequencies with Wald 95% CIs. We reported adjusted aORs with 95% CIs derived from logistic regression models to assess the association of patient characteristics with the different steps in the care cascades.

3. **Measure contemporary prevalence of mental health, substance use problems, and access to mental health services in Lesotho**
   Manuscript to be submitted to the International Journal of Mental Health & Addiction in August 2023

Objective: to examine, in adults living in two rural districts in Lesotho, (1) the prevalence of depression, anxiety, lifetime trauma and post-traumatic stress, suicidal ideation, and substance use; (2) the cascades of care and the healthcare gaps; and (3) the profile of

individuals who reported moderate/severe MH or SU problems and had considered accessing health services for these conditions.

Specific outcomes: The Patient Health Questionnaire-9 (PHQ-9) assesses symptoms of major depression and suicidal ideation. Symptoms were categorized following the standardized cut-offs of the instrument: “none/minimal risk” (score 0–4), “low risk” (5–9), and “moderate/high risk” (10-27). The Generalized Anxiety Disorder-7 (GAD-7) questionnaire was used to assess symptoms of anxiety. We used the same standardized symptom severity categorizations as PHQ-9. We used the Primary Care Post-Traumatic Stress Disorder screener (PC-PTSD-5) questionnaire to assess the presence of lifetime trauma and subsequent symptoms of post-traumatic stress. Participants who reported a traumatic event were screened for the five symptoms of post-traumatic stress disorder (PTSD). A score of ≥3 indicated a possible PTSD. Traumatic events were categorized based on previously reported trauma episode type. The ASSIST questionnaire was used to explore the use of ten substances: tobacco, alcohol, cannabis, cocaine, amphetamine-type stimulants, inhalants, sedatives, hallucinogens, opioids, and other drugs. Scores were grouped into “low risk” (score <11 for alcohol and <4 for other substances), “moderate risk” (score between 11-26 for alcohol, and 4-26 for all other substances), or “high risk” (score ≥ 27 for all substances). We measured the need and use of care services using a questionnaire adapted from the World Mental Health Surveys[59] in participants who reported moderate/severe mental health symptoms or moderate/severe substance use symptoms. These participants were asked whether they felt they needed professional treatment for their reported symptoms/behaviors (“awareness gap”), whether they actually had access to care (“treatment gap”), and who provided the care. Participants characteristics were summarized as frequency or median with interquartile IQRs. We provided 95% Wald CIs for the prevalence of moderate/severe depression and anxiety symptoms, PTSD, suicidal ideation, and alcohol and cannabis use. We reported ORs and aORs with 95% CI derived from univariable and multivariable logistic regression models to assess sociodemographic correlates in participants who had considered accessing services for the reported conditions.

For these three objectives, I was centrally involved in the conceptualization of the studies, the design of data tools, and the training of the field team on survey procedures. Further, I was actively involved in the analysis of data, and wrote the first drafts of the manuscripts. The results of these studies were presented in different forums with health professionals in

Lesotho and Switzerland, and in a poster session at the World Non-Communicable Diseases Congress 2023[60].

4. **Synthesize peer-reviewed knowledge on community-based care models for arterial hypertension management in non-pregnant adults in sub-Saharan Africa**

   Manuscript published in BMC Public Health, 2022: https://doi.org/10.1186/s12889-022-13467-4

Objective: to catalogue, describe, and appraise community-based care models for management of arterial hypertension in sub-Saharan Africa. Additionally, to develop a framework for the design and description of service delivery models for long-term hypertension care.

Specific outcomes: following the standard scoping review methods, we summarized each study's outcomes and, where possible, we pooled outcomes and reported average, range and/or median values. If models of care were similar, we grouped results by intervention type and reported common features, such as health care worker providing the service, location of delivery and frequency, use of e-Health, or integration with other chronic conditions. We assessed the quality of the included cohort and case–control studies using the Newcastle–Ottawa Scale. Randomized controlled trials (RCTs) were evaluated using the Cochrane Collaboration's tool to assess individuals RCTs and cluster RCTs. We abstracted the main elements that integrate the models of care, as described by the authors. These elements constituted the "building blocks" of each care model (cadre of health care provider, target population, location of service delivery, components of the service package, information systems, and the timing of service delivery) that we proposed can be used to design or analyze care models for hypertension and other CVDs.

For this study, I was actively involved in the protocol design, I coordinated the team who screened and judged the studies for inclusion (including two MSc. students) and created the data tools. I also led data compilation and analysis and wrote the first manuscript draft. This study opened the opportunity for a short collaboration with the NCDs Department at the WHO, through the Integrated Service Delivery Unit: one technical officer co-authored the resulting publication and I took part of preliminary discussions that eventually led to the release of a guidance document entitled "WHO Implementation Guidance to INTEGRATE Noncommunicable Disease Services" (in publication process)[61].

2.3 Additional research output

2.3.1 The Mistral Project: COVID-19 response and clinical research in Lesotho

In my role as a Research Manager at SolidarMed during the time as PhD student, I was the project manager of the MistraL project (Mitigation strategies for communities with COVID-19 transmission in Lesotho using artificial intelligence on chest x-rays and novel rapid diagnostic tests)[62], supporting administrative and scientific tasks. Although not linked to my PhD objectives, there were substantial scientific outputs where I was involved. This project was led by Dr. Klaus Reither (PhD Further Advisor) and represented a collaboration between SolidarMed and the Swiss Tropical and Public Health Institute. Mistral was designed during the Coronavirus Disease of 2019 (COVID-19) global emergency response and aimed to mitigate the effects of the epidemic in Lesotho, while becoming a platform to evaluate the performance of screening and diagnostic tools for SARS-CoV-2. In collaboration with the project team, I contributed to set up an integrated, one-stop-shop, nurse-led, and same-day screening and testing model for COVID-19, HIV and TB in two rural hospitals in Lesotho. The project was active from December 2020 to August 2022, and documented two epidemic waves and three periods of low COVID-19 incident cases in the region. Adults, children above 5 years, and hospital staff attending these facilities were pre-screened for COVID-19 and TB symptoms. If found to have symptoms, they were offered to enroll in a service model that included clinical evaluation, artificial intelligence-aided chest radiography, SARS-CoV-2, TB, and HIV testing. Participants diagnosed with COVID-19, TB, or HIV were contacted after 28 days to evaluate their health status and linkage to HIV and/or TB care services. While, similar service models were promoted to scale up diagnosis for COVID-19, and sustaining HIV and TB diagnosis and linkages to care in Sub-Saharan Africa, evidence on their impact measured by diagnostic yields or capacity to sustain services was scarce[63–65]. I conducted a study to document the integrated screening and testing service model, to evaluate the yield of additional diagnosis, and to assess the outcomes after diagnosis for the three conditions. Of the total 179,160 participants screened, 6623 (3.7%) pre-screened positive, and of these, 4371 (65.9%) were enrolled in this service model, yielding a total of 458 diagnoses. Of the 321 (82.9%) participants contacted after 28 days of diagnosis, 304 (94.7%) reported to be healthy. Of the individuals that had been newly diagnosed with HIV or TB, a total of 18/24 (75.0%) and 46/51 (90.1%) had started treatment.

For this study, I led the design, manuscript writing, and process to publication (accepted for publication at PLOS GHP in July 2023, last author). Results were also presented at the World Conference on Lung Health 2022[66] (oral abstract session) and the Science Summit at United Nations General Assembly (UNGA78)[67] (oral session on e-health solutions). I also co-authored other two publications linked to this project: a head-to-head comparison of nasal and nasopharyngeal sampling using SARS-CoV-2 rapid antigen testing[68] and a proof-of-concept study for diagnosis of SARS-CoV-2 infection from breath[69].

Additionally, under the umbrella of MistraL and in collaboration with Prof. Niklaus Labhardt, I set up the CORIAL (Causes of Respiratory Infections in Adults in Lesotho) study, with the objective to describe the causes of respiratory infections, other than TB and SARS-CoV-2, among adults presenting with symptoms of respiratory infection at the two study hospitals. This was an exploratory study and a first attempt to gather data on incidence and seasonality of respiratory infections caused by different viral and bacterial pathogens. Nested in this study, and led by Dr. Klaus Reither, we also piloted the collection of breath samples for diagnosis of respiratory infections. Both these studies are currently in the phase of data analysis.

3. SCIENTIFIC MANUSCRIPTS

3.1 Prevalence and determinants of cardiovascular risk factors in Lesotho

This is the file accepted in the journal for publication

Prevalence and determinants of cardiovascular risk factors in Lesotho: a population-based survey

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Abstract

Introduction

There are no recent data on the prevalence of cardiovascular risk factors (CVDRFs) in Lesotho. This study aims to assess CVDRFs prevalence and their determinants.

Materials and methods

We conducted a household-based, cross-sectional survey among adults ≥18 years in 120 randomly sampled clusters in two districts.

Results

Among 6061 participants, 52.2% were female, and their median age was 39 years (inter-quartile range 27-58). Overall prevalence of overweight, diabetes, elevated blood pressure (BP), and tobacco use was 39.9%, 5.3%, 21.6%, and 24.9%, respectively. Among participants, 34.6% had none, 45.2% one, and 20.2% two or more CVDRFs. Women were more likely to have two or more CVDRFs (20.7% vs 12.3%). Overall, 7.5% participants had elevated total cholesterol, 52.7% had a low HDL-cholesterol, and 1.6% had elevated LDL-cholesterol results. Among younger participants (18-29 years), 16.1% reported tobacco use, 28.6% were overweight, 1.5% had diabetes, and 3.5% had elevated BP. Household wealth positively correlated with prevalence of elevated BP, overweight, and diabetes, whereas tobacco use was higher among people in the lowest three wealth quintiles.

Conclusions

CVDRFs are highly prevalent in Lesotho across age and sex groups, underlining the importance of strengthening prevention and care programs in Lesotho and similar settings in Southern Africa.

Keywords

DIABETES, DYSLIPIDEMIA, HYPERTENSION, NON-COMMUNICABLE DISEASES, OVERWEIGHT, TOBACCO

Introduction

Cardiovascular diseases (CVDs) are the leading cause of mortality and are a major contributor to disability globally. In 2019, CVDs accounted for 17.9 million deaths globally of which 75% occurred in low- and middle-income countries[1,2]. In the sub-Saharan African region, the traditional modifiable CVD risk factors (CVDRFs), such as tobacco use, elevated BP, diabetes, dyslipidemia, overweight, physical inactivity, and poor dietary habits are rising[3]. Associated disability and mortality have increased by more than 50% in the past decades, and are occurring at younger age[2,4–6]. Projections by 2030 show that in the sub-Saharan region, CVDs alone will cause more deaths than infectious diseases, maternal and perinatal conditions, and nutritional disorders combined[7].

For Lesotho, a landlocked country surrounded by South Africa, the most recent data on CVDRFs prevalence comes from the 2012 STEPwise Approach to Surveillance (STEPS) survey[8], that included 2310 adults between 25-64 years[9]. In this survey, 20% of participants smoked tobacco, 31% had elevated BP, 6% had raised blood glucose levels, and 6% elevated total cholesterol levels[10]. Since then, CVDRF prevalence data have not been updated. Thus, for the national non-communicable diseases programme, there is a need for updated CVDRF data in the country.[11]

We report prevalence of tobacco use, overweight, elevated BP, diabetes, and dyslipidaemia and their determinants from a population-based survey conducted from 2021 to 2022 in Northern Lesotho.

Methods

Study design and setting

This study is part of ComBaCaL (Community-Based Chronic Care Lesotho, www.combacal.org), a five-year project addressing non-communicable diseases in Lesotho. We conducted a population-based survey in the districts of Butha-Buthe and Mokhotlong, Northern Lesotho, from 1st of November 2021 to 31st of August 2022. These districts have one central town each, and wide areas that are mostly rural with poor transport infrastructure and hard-to-reach villages. There is a combined population of approximately 250,000 people. The Butha-Buthe district has an urban area in, and around Butha-Buthe town with a population of about 25,000 inhabitants and 354 rural villages that are scattered over a surface of 1767km^2. It hosts an estimated 125,000 inhabitants. The Mokhotlong district has an urban area around Mokhotlong town, hosting around 30,000 inhabitants, and 323 rural villages hosting around 90,000 inhabitants[12].

Sampling

We randomly sampled population clusters that corresponded to administrative entities (urban and peri-urban areas or rural villages) in the two districts. We considered the population clusters as primary sampling units and household members as secondary sampling units. The study team obtained a list of all 1011 administrative entities in the two districts, from the Ministry of Health, based on the Lesotho Census list 2016. Where possible, the study team merged villages with less than 30 households located next to each other to one cluster. In rural areas, we excluded villages that were smaller than 30 households and could not be clustered with a nearby village, had been abandoned by its inhabitants, were only settlements by government staff (e.g., military/police base), or were part of the area in Mokhotlong that is expected to be flooded by the Polihali dam construction in the years to come. After these modifications, the list consisted of 785 clusters with at least 30 households each. These clusters were stratified by district (Mokhotlong vs. Butha-Buthe), settlement (urban vs rural) and accessibility (hard-to-reach vs easy-to-reach). Hard-to-reach clusters were defined as needing to cross a mountain, or river, or travel more than ten kilometers to reach the closest health facility. From this list, an independent statistician provided the computer-generated final list with the random sample of 120 clusters that were included in the survey. A household was defined as one or more individuals who resided in a physical structure (e.g., compound, homestead) and shared housekeeping arrangements. A household member was defined as any individual who was acknowledged by the head of household as such. All household members, both absent and present, of all ages were enumerated.

Participants and sample size

Any selected cluster where the village chief provided verbal consent was eligible. Households were eligible if the household head or an adult representative gave verbal consent. Household members were randomly selected by an algorithm considering age, sex and settlement, programmed in the Open Data Kit (ODK) data collection software[13]. Selected household members were eligible if they provided written informed consent. The sample size calculation for individual enrolment was based on the STEPS sample size calculator that considers estimated proportion of the population who would meet the criteria for the primary conditions of interest (elevated BP, diabetes), and included 2000 adults between 18-30 years, and 4000 adults ≥30 years[14] (annex 1).

Field procedures

A study team was usually composed of eight members and included nurses, nursing assistants, and lay health workers. After arriving at a cluster, the team sought oral approval from the village chief, before visiting the households. Upon consent from the household head, the team collected sex and age information of all present and absent household members. If a present household member was randomly selected by the algorithm and provided written informed consent, the study team proceeded to collect the study data, including demographic characteristics, anthropometric and laboratory measurements.

Collected data

Socio-demographic and medical characteristics

The following information was collected: GPS location of household, sociodemographic characteristics (gender, age, marital status, level of education completed, employment), past medical and family history (self-reported, or described in the participants' health booklet).

Anthropometric measurements

Standing height to the nearest millimeter was measured using Seca® 213 portable stadiometer with participants barefoot or wearing thin socks. Weight was measured using a digital Beurer® scale. Abdominal circumference was measured using an appropriate tape placed midway between the iliac crest and the lowest rib and was taken at the end of a normal expiration. BP was measured using the Watch BP Office ABI® with participants sitting after resting for 15 minutes. BP and pulse rate measurements were automatically repeated two more times at 2-minute intervals each. The mean of the last two measurements was used to calculate the final average for the systolic BP (SBP), diastolic BP (DBP), and pulse.

Laboratory measures

Venous blood was collected in EDTA tubes. This sample was used to perform all point-of-care tests. When blood draw was unsuccessful, finger-prick was done for point-of-care tests. Random blood glucose (RBG) was measured using Accu-chek Active®. Participants with RBG ≥ 5.6 mmol/L received a glycosylated hemoglobin (HbA1c) measurement using the Jana Care Aina station® or the A1CNow+ Professional system®. Total cholesterol, high-density lipoprotein cholesterol (HDL-Chol), low-density lipoprotein cholesterol (LDL-Chol), and triglycerides were measured in participants who were 30 years or older, using the Jana Care Aina station® or the Abbott Automated Affinion® Analyzer.

Household Wealth

Household wealth was computed for each household using the Demographic and Health Survey (DHS) Program wealth index questions for Lesotho. The DHS wealth index was calculated based on a questionnaire that assesses housing construction characteristics, household assets and utility services, including country-specific assets that are viewed as indicators of economic status[15,16].

Definition of study outcomes

Current use of tobacco was defined as participant reporting consumption in the previous three months, following the WHO Alcohol, Smoking and Substance Involvement Screening Test (ASSIST)[17]. Body mass index (BMI) was defined as weight (kg) divided by height (m^2) and classified as underweight (<18.5 kg/m^2), normal weight (18.5-24.9 kg/m^2), overweight (≥25 kg/m^2), and obese (≥30 kg/m^2). Abdominal obesity was defined as abdominal circumference ≥ 80cm in women and ≥94cm in men[20]. Elevated BP was defined as SBP ≥140 mmHg and/or DBP ≥90 mmHg, using the average of the final two out of three readings.

Confirmed diabetes was defined as a RBG ≥ 5.6mmol/L and confirmatory HbA1c ≥ 6.5%, or an RBG ≥ 11.1mmol/L, or presenting normal RBG values while taking antidiabetic drugs. We opted for HbA1c to confirm diagnosis of diabetes because remoteness of clusters made it difficult to sample two blood sugar measurements at two different days and many participants encountered during the survey may not fulfill criteria for fasting blood glucose. HbA1c has been recommended as alternative to fasting blood glucose for diagnosis of diabetes with high specificity in community-settings.[18,19] A total of 36 survey participants had a blood sugar measurement between 7.0 and 11.0 mmol/L with missing HbA1c values (technical error), whom we labelled as “unconfirmed diabetes”. Dyslipidemia was defined as measured total cholesterol level ≥5.2 mmol/L, LDL-Chol ≥4.1 mmol/L, or HDL-Chol <1.0 mmol/L in men and <1.3 mmol/L in women[20]. Cholesterol/HDL ratio was defined abnormal when ≥4.0 in women and ≥4.5 in men[21]. Due to technical difficulties during data collection, lipid panel results were

only measured in a subsample of participants. We thus decided to report on these results in separate tables (S1 and S2).

Data was collected on electronic tablets, using ODK Collect, and routinely uploaded to the ODK Central server hosted by the Swiss Tropical and Public Health Institute in Switzerland. Data access was restricted to the study team members involved in data management and analysis. Data monitoring included routine data quality checks on completeness and coherence. Additionally, the study team held regular meetings, and retraining of the field team was done when data quality issues appeared or when modifications to field procedures were made. At the end of recruitment, duplicates were dropped, and outliers were set to missing values.

Statistical analysis

Participant characteristics are summarized as counts with frequency and median with interquartile ranges (IQR). Prevalence figures are given with 95% Wald confidence intervals (CIs). We used univariable and multivariable logistic regression models to assess associations of participants' characteristics for each assessed outcome variable (CVDRFs). For the logistic regression analysis, participants with elevated RBG but without HbA1c value (unconfirmed diabetes) were merged with the confirmed diabetes group. All analyses were done using Stata (version 16.1, College Station, Tex: StataCorp LP, 2007). Graphs were generated using Microsoft Corporation (2018)- Microsoft Excel and Power Point.

Results

Participant characteristics

Enrolment of participants is detailed in figure 1. In the 120 clusters, the teams visited 3498 households with 7412 household members who were present and eligible. Of these, 6061 participants were 18 years or older and included in this analysis. Fully documented results are available in 6048, 5638, 6054, 5929, and 1483 participants for BP, RBG, tobacco use, BMI, and lipid panel, respectively.

Median age of participants was 39 years (interquartile range (IQR) 27-58), 3164 (52.2%) were female, and 3163 (52.9%) lived in urban or peri-urban settings. More than half had no or only primary school education, were married, or were living in a stable relationship. About half of the participants reported having a regular income. A total of 924 (15.2%) participants reported living with HIV and of those, 912 (98%) reported intake of antiretroviral therapy (ART). Overall, 815 (13.4%), 135 (3.2%), and 15 (0.2%) participants reported prior diagnosis of elevated BP,

diabetes, or an episode of angina pectoris or stroke, respectively. First degree family history of elevated BP and diabetes was reported by 1302 (21.5%) and 541 (8.9%) participants respectively. Personal and family history of CVD was more frequently reported by women (table 1).

Prevalence of measured risk factors

Table 2 displays the frequency of measured risk factors disaggregated by age group, sex, and rural vs. (peri-urban) setting. Overall, tobacco use was reported by 1511 of 6048 participants (24.9%, 95%CI 23.9-26.1%), with higher use in men compared to women (40.2% vs. 10.9%). Elevated BP measurements were found in 1308 of 6048 participants (21.6%, 95%CI 20.5-22.6%), more frequently in women (27.1% vs. 15.3%). Rates of elevated BP were particularly high in participants over 60 years old (49.9%) and were higher in (peri-)urban, than rural areas (25.3% vs. 17.6%). Median abdominal circumference for participants who were 30 years or older was 89.0 cm (80.0-99.0) in women and 80.0 cm (IQR 73.0-86.0) in men, 1537 (75.8%) of women and 202 (10.3%) of men had abdominal obesity. Median BMI was 23.5 kg/m^2 (IQR 20.5-27.9). Overall, 2371 of 5929 participants (39.9%, 95%CI 38.7-41.2%) had overweight. Overweight was more frequent in women (57.0% vs. 19.6%), in participants 30 years and older (28.1% vs. 44.3%), and in those living in (peri)-urban settings (44.0% vs. 33.8%). Median RBG was 5.0 mmol/L (IQR 4.5-5.5 mmol/L). A total of 255 of 5513 participants (4.6%, 95%CI 4.1-5.2%) had confirmed, and 36 of 5513 participants (0.1%, 95%CI 0,4-0.9) had unconfirmed diabetes. Diabetes was more frequent in women than men (6.6% vs. 2.8%) and in (peri-)urban vs rural areas (6.2% vs. 3.3%).

Among younger participants (18-29 years), 312 of 1937 (16.1%, 95%CI 14.4-17.7%) participants reported tobacco use; 546 of 1907 (28.6%, 95%CI 26.6-30.6%) had overweight; 28 of 1770 (1.5%, 95%CI 1.0-2.1%) participants had diabetes; and 69 of 1934 (3.5%, 95%CI 2.7-4.3%) participants had elevated BP.

Results for the complete lipid panel, including total cholesterol, HDL-cholesterol, LDL-cholesterol and triglycerides, were available in only 1483 (36.0%) of the 4122 eligible participants. The demographic characteristics and lipid panel results of this subgroup are shown in tables S1 and S2. Overall, 112 (7.5%) participants had elevated total cholesterol, 782 (52.7%) had a low HDL- cholesterol, and 24 (1.6%) had elevated LDL- cholesterol results. A total of 377 (25,4%) had an elevated total cholesterol/HDL cholesterol ratio, elevated triglycerides were found in 432 (29.1%) participants.

Overlap of cardiovascular risk factors

Figure 2 displays the frequency of overlapping CVDRFs across age groups, sex, and settlement. It includes a total of 5396 participants with available information of BMI, tobacco

use, diabetes, and BP. Overall, one in three participants did not present any CVDRF, almost half of the participants had one CVDRF, and one in five participants presented two or more CVDRFs. Overlap of two or more CVDRFs increased in older age groups, occurring in one in five participants between 30-59 years, and in one in three participants ≥60 years. Women had higher rates of two or more overlapping CVDRFs (26.7% vs. 14.8%).

Socio-demographic determinants of reported risk factors

Figure 3 shows the prevalence of overweight, tobacco use, diabetes, and elevated BP, disaggregated by household wealth quintiles (a) and attained level of school education (b). Frequency of elevated BP, overweight, and diabetes generally increased from the lowest to highest wealth quintile, whereas reported tobacco use was higher among participants in the lowest wealth quintiles. Overweight increased with level of education achieved, whereas tobacco use decreased with level of education.

Table 3 displays uni- and multivariate analysis of participants' characteristics and their association to the CVDRFs assessed. Female sex was associated with overweight (adjusted odds ratio (aOR) 7.43 95%CI 6.47-8.52), elevated BP (aOR 2.29, 95%CI 1.96-2.66), and diabetes (aOR 2.55, 95%CI1.93-1.38). Older age was associated with overweight (aOR 3.03 95CI% 2.52-3.65), elevated BP (aOR 29.8, 95%CI 22.45-39.68), and diabetes (aOR 8.17, 95%CI 5.21-12.80). Living in (peri-)urban areas was associated with overweight (aOR 1.19 95CI% 1.04-1.36), elevated BP (aOR 1.63, 95%CI 1.40-1.90), and diabetes (aOR 1.48, 95%CI 1.12-1.96). Living in a wealthier household was associated with overweight (aOR 1.90 95%CI 1.57-2.32), elevated BP (aOR 1.60 95%CI 1.35-1.89), and diabetes (aOR 1.53 95%CI 1.22-1.93), Participants who had completed secondary or tertiary education (aOR 0.69, 95%CI 0.60-0.81), lived in a wealthier household (aOR 0.59, 95%CI 0.48-0.74), or had regular income (aOR 0.83, 95%CI 0.72-0.95) were less likely to report tobacco use.

Discussion

This study provides contemporary estimates of prevalence for tobacco use, elevated BP, overweight, diabetes, and dyslipidemia in adults living in two districts in Lesotho. Our results show high frequency of tobacco use in men, whereas elevated BP, overweight, and diabetes are more prevalent in women. One in five adults had two or more overlapping CVDRFs, and this increased with age and household wealth. We found a non-negligible frequency of overweight, tobacco use, diabetes, and elevated BP in adults younger than 30 years.

The results of our study show similar results as the Lesotho STEPS 2012 survey (limited to adults between 25-64 years), with some notable differences. We found similar rates of tobacco use with overall one in five adults, and 40% men reporting tobacco consumption. However, we found a substantially higher proportion of women reporting tobacco use (10.9%) than STEPS in 2012 (0.7%). Prevalence of overweight remained similar in women (57.0% vs 58.2% in STEPS 2012) and men (19.6% vs 24.8% in STEPS 2012). We estimated a lower, but still important prevalence of elevated BP (21.6 vs 31% in STEPS 2012). Prevalence of diabetes was slightly lower (overall 5.3% vs 6.3% in STEPS 2012), which might be due to different diagnostic algorithms applied, and inclusion of adults from 18 years. While we used a combination of RBG and HbA1c, STEPS 2012 reported on a single fasting blood glucose measurement.

Our results are similar to the ones found in other countries in sub-Sahara Africa, summarized in recent reviews, and confirm a rising prevalence of CVDRFs and the epidemiological transition in the region[2,7]. For example, the South African National Health and Nutrition Examination Survey[22] in 2012 reported that a total of 17.6% participants smoked tobacco (males 29.2% and females 7.3%). A recent review of the burden of elevated BP in South Africa using national 2012 and 2016 data[23] found rates of elevated BP that increased from 38.4% in 2012 to 48.2% in 2016. In this study, the risk of elevated BP was significantly higher in KwaZulu-Natal and Mpumalanga (two provinces close to the Lesotho border) and was significantly higher among males and urban participants. In a recent review on diabetes prevalence using the South African Demographic Health Survey 2016 data[24], a total of 10% of females and 6% of males were found to have diabetes.

This transition to an increased burden of cardio-vascular diseases in sub-Sahara Africa is driven by complex interactions between environmental, economic, sociocultural and individual factors, including lifestyle and dietary habits[25,26]. The persisting high rates of tobacco use, although lower than in surrounding South Africa, are linked to socioeconomic conditions and may be related to a lack of effective policies that aim at a reduction of smoking in the population. [27,28]. The stabilizing HIV prevalence and increased antiretroviral coverage in the

region may contribute to the rise of some CVDRFs, such as overweight. This hypothesis needs, however, to be explored further[29–31]. Facing the epidemiologic context of raising CVDRF prevalence, health systems will have to generate adapted responses. Responses may include but are not limited to allocation of financial resources, implementation of preventive policies, adaptation of monitoring tools, capacity strengthening among professional and lay health care personnel aiming for integrated primary health care services that include CVDRF prevention and treatment.

Compared to other CVDRF surveys, our study is strengthened by its relatively large sample size, with a high level of participation (≥85%) among the surveyed population. The diagnostic algorithm for diabetes in this survey included a confirmatory HbA1c measurement, adding specificity to the diagnosis. There are, however, several limitations to be considered. Firstly, even though we followed the WHO STEPS protocol to measure BP in population studies, the prevalence of elevated BP is likely to be overestimated due to measurements on a single day[32]. Secondly, household members who were not present on the day of the survey were not included, potentially leading to a selection bias. Thirdly, due to technical problems, lipid panel results are available only for a third of eligible participants, mostly covering those living in (peri-) urban areas. Fourthly, self-reported variables, such as personal medical history or HIV status, must be interpreted with caution, due to possible recall or reporting bias. Finally, the findings of this study may be limited in their applicability to the area where the survey was conducted, CVDRF prevalence may be different in other parts of Lesotho, i.e. in the capital Maseru.

Conclusion

CVDRFs are highly prevalent among adults in Lesotho. Overall, women and individuals from wealthier households have a higher CVDRF prevalence. These data align with regional trends, confirming a high burden of CVDRFs, even in rural areas in Lesotho. The findings underline the importance of comprehensive cardiovascular risk prevention and treatment strategies tailored to different age and sex groups in this setting.

Declarations

Author Contributions

LGF, EF, AA and NDL conceptualized the study and design. LGF, EF, TL, FC performed analysis. LG and NDL drafted the manuscript. EF, RG, PM, MK, MM, MB, TL, FC, FG, MW, TL, IA, and AA reviewed the manuscript draft. AA and NDL are the Co-Principal investigators of the ComBaCaL project. All authors reviewed the results and approved the final version of the manuscript.

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Patient and public involvement

This survey is part of the Community-based chronic care project Lesotho (ComBaCaL). It was designed together with the ComBaCaL steering committee that includes a community representative, as well as representatives from the Ministry of Health of Lesotho. The survey was discussed with local authorities (village chiefs, local Ministry of Health), who were engaged throughout the survey.

Ethics

All procedures were carried out in line with the ethical standards laid out in the Declaration of Helsinki. Participants received information on the clinical procedures in Sesotho and gave written informed consent. Those participants who were illiterate gave consent by thumbprint and a witness signature. Once the informed consent process was completed, a signed copy of the form was retained by study staff and a copy was given to participants. This study was reviewed by the Ethics Committee Northwest and Central Switzerland (ID AO_2021-00056) and approved by the National Health Research Ethics Committee in Lesotho (ID139-2021).

Availability of data and materials

If the manuscript is accepted, we will deposit an anonymized dataset with key data presented in the manuscript on zenodo.org

Competing interests

The authors declare no conflicts of interest

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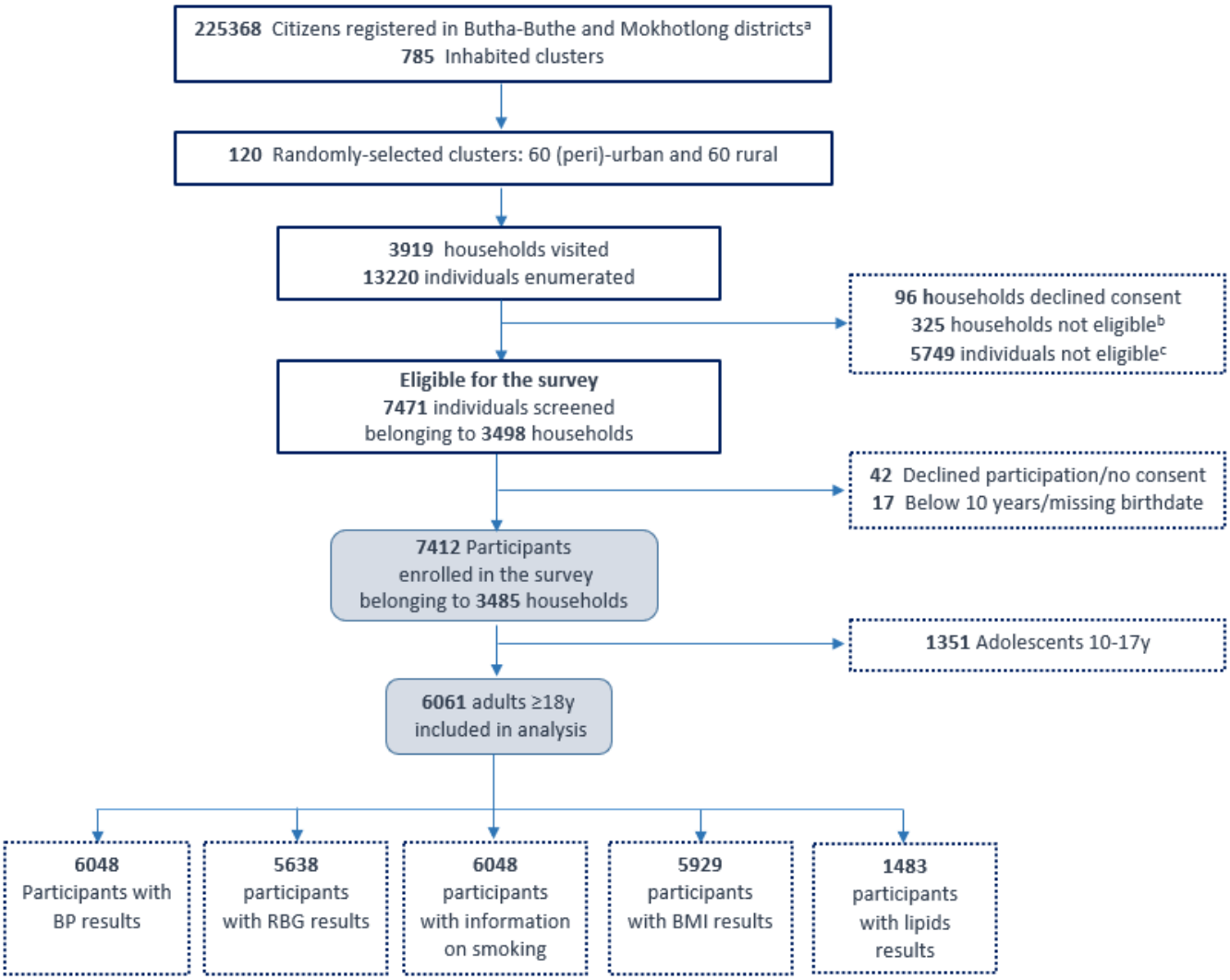
Figure 1. Study flow and participant enrolment



a Lesotho - Subnational Population Statistics-UNFPA: https://data.humdata.org/dataset/cod-ps-lso

b None of the household members present was eligible for survey

c Individuals were enumerated but not present at the time of the survey or were not eligible

Acronyms: BP: blood pressure; RBG: random blood glucose; BMI: body mass index

Figure 2. Overlapping cardiovascular risk factors in the survey population, including overweight, tobacco use, diabetes, and elevated blood pressure. Participants include all those with information available on all the four risk factors (n=5396).

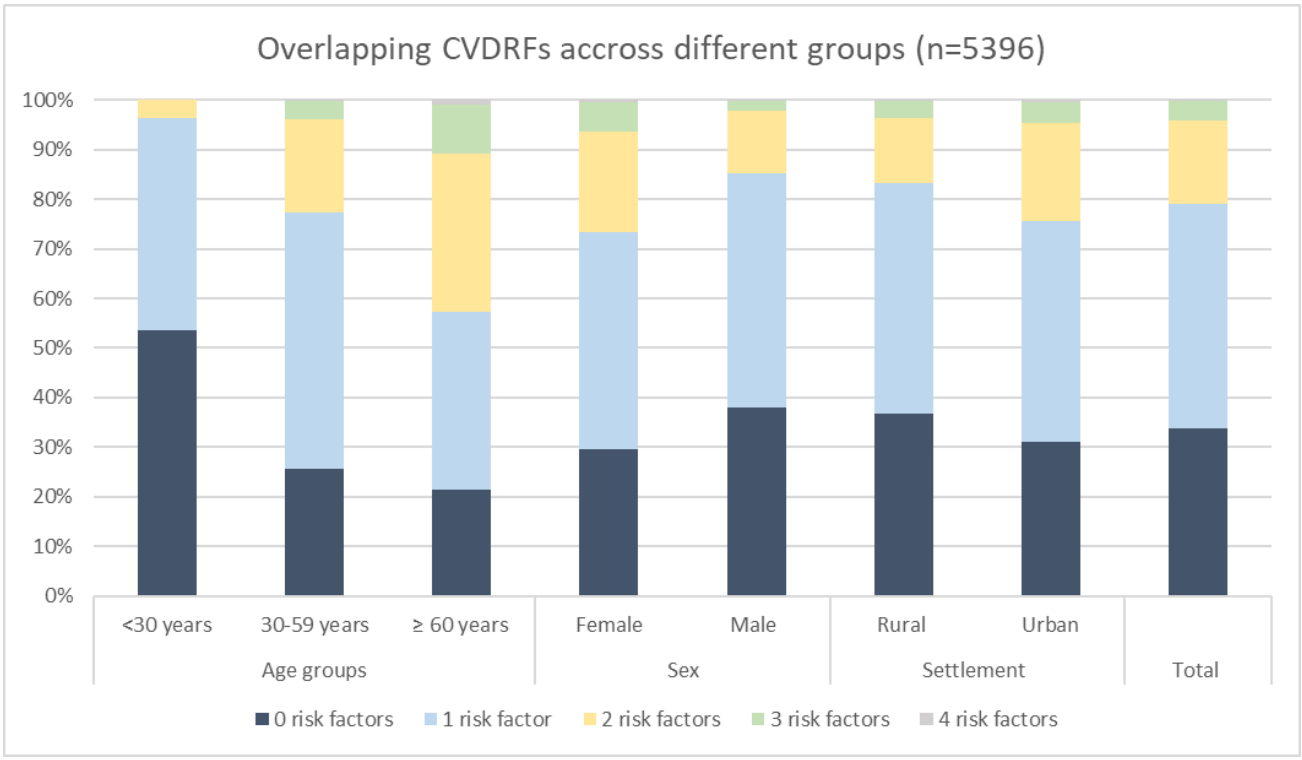
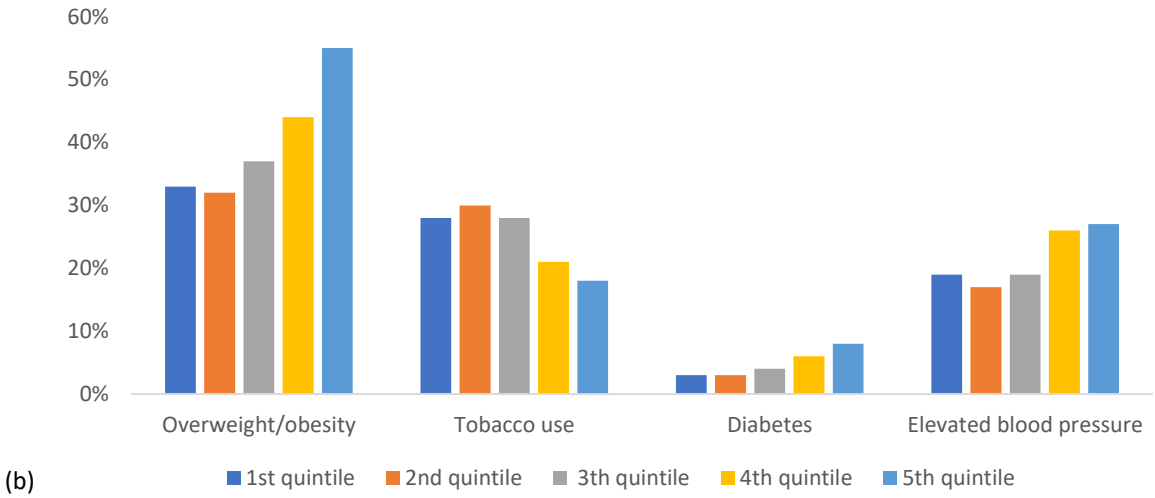


Figure 3. Prevalence of overweight, tobacco use, diabetes, and elevated blood pressure, disaggregated by wealth quintiles (a) and level of education attained (b)

(a)



(b)

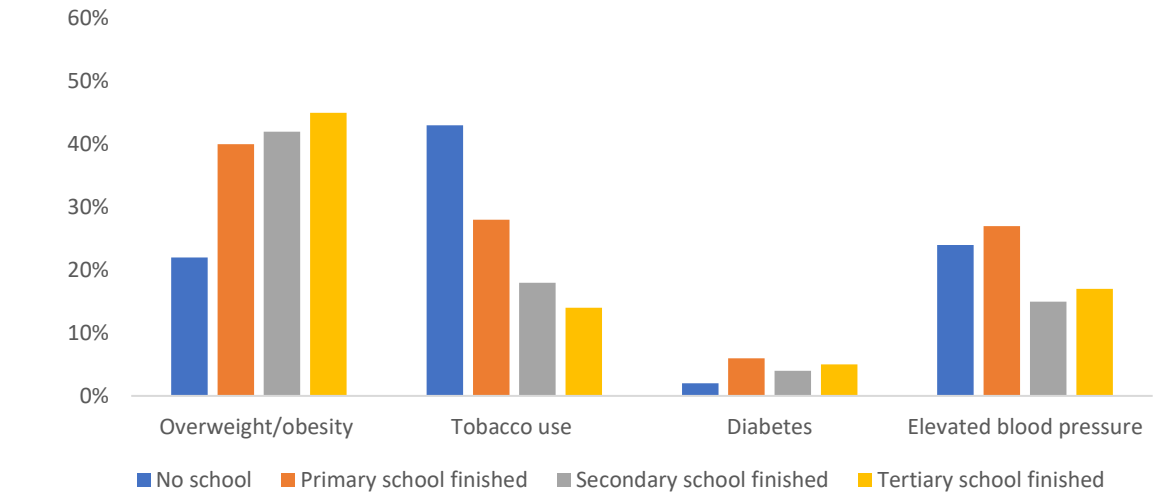


Table 1 –Characteristics of study participants, disaggregated by sex

		Females N(%)	Males N(%)	Total N(%)
Total participants		3164 (52.2)	2897(47.8%)	6061 (100)
	Sociodemographic characteristics			
Age (years)	Age median (IQR)	39 (26-59)	40 (27-57)	39 (27–58)
	<30 years	1075 (34.0)	864 (29.8)	1939 (32.0)
	30-59 years	1312 (41.5)	1401 (48.4)	2713 (44.8)
	≥ 60 years	777 (24.5)	632 (21.8)	1409 (23.2)
District	Butha-Buthe	1726 (54.55)	1455 (50.22)	3.181 (58.48)
	Mokhotlong	1438 (45.45)	1442 (49.78)	2880 (47.52)
Setting	Urban/peri-urban	1662 (52.5)	1501 (51.8)	3163 (52.9)
	Rural	1502 (47.5)	1396 (48,2)	2898 (47.1)
Relationship status	Married/in a relationship	1813 (57.3)	1730 (59.7)	3543 (58.4)
	Single/divorced/widowed	1348 (42.6)	1165 (40.2)	2513 (41.4)
	Missing	3 (0.1)	2 (0.1)	5 (0.2)
Educational level	No schooling	153 (4.8)	460 (15.8)	613 (10.1)
	Primary school	1476 (46.5)	1349 (46.5)	2825 (46.6)
	Secondary	1315 (41.5)	864(29.8)	2179 (35.9)
	Tertiary	219 (6.9)	224 (7.7)	443 (7.3)
	Missing	1 (0.03)	0 (0)	1 (0.02)
Employment status	(Self-) Employment/regular income	1016 (32.1)	2059(71.0)	3075 (50.7)
	No employment/no regular income	2132 (67.4)	830 (28.6)	2962 (48.9)
	Missing	16 (0.5)	8 (0.4)	24 (0)
	Medical characteristics			
Pregnancy (self-reported)	Yes	99 (3.1)	-	-
	No	3044 (96.3)	-	-
	Missing/unknown	21 (0.6)	-	-
HIV status*	Known HIV positive	582 (18.4)	342 (11.8)	924 (15.2)
	Negative ≤12 m ago	1344 (42.5)	1064 (36.7)	2408 (39.7)
	Negative >12 m ago	529 (16.7)	570 (19.7)	1099 (18.1)
	Missing/unknown	709 (22.4)	921 (31.8)	1630 (27.0)
Taking ART among those known HIV positive*	Yes	576 (99.0)	336 (98.2)	912 (98.7)
	No	6 (1.0)	6 (1.8)	12 (1.3)
	Missing/unknown	0 (0)	0 (0)	0 (0)
Previous diagnosis of hypertension /prior treatment*	Yes	599 (18.9)	216 (7.5)	815 (13.4)
	No	2544 (80.4)	2660 (91.8)	5204(85.9)
	Missing/unknown	21 (0.6)	21 (0.7)	42 (0.7)
Previous diagnosis of diabetes /prior treatment*	Yes	106 (3.3)	29 (1.0)	135 (3.2)
	No	3046 (96.3)	2853 (98.5)	5899 (97.3)
	Missing/unknown	12 (0.4)	15 (0.5)	27 (0.6)
History of angina/ stroke episode*	Yes	13 (0.4)	2 (0.1)	15 (0.2)
	No	3142 (99.3)	2889 (99.7)	6031 (99.5)
	Missing/unknown	9 (0.3)	6 (0.2)	15 (0.3)
Family history of hypertension (1st degree)*	Yes	750 (23.7)	552 (19.3)	1302 (21.5)
	No	2239 (70.8)	2143 (74.0)	4382 (72.3)
	Missing/unknown	175 (5.5)	202 (6.7)	377 (6.2)
Family history of diabetes (1st degree)*	Yes	298 (9.4)	243 (8.4)	541 (8.9)
	No	2678 (84.6)	2438 (84.1)	5116 (84.4)
	Missing/unknown	188 (0.6)	216 (8.5)	404 (6.7)

ART: antiretroviral therapy

*Self-reported or recorded in participants' health booklet

Table 2. Summary of observations on tobacco use, overweight/obesity, elevated blood glucose, diabetes mellitus, and elevated blood pressure in study participants, disaggregated by age groups, sex, and settlement

		Total n=6061 (100%)	18–29 y n=1939 (32.0)	30-59 y n=2713 (44.8)	≥60 y n=1409 (23.2)	Women n=3164 (52.2%)	Men n=2897 (47.8%)	Rural n=2898 (47.8%)	Urban/ peri-urban n=3163 (52.2%)
Tobacco use (past 3 months)	Yes	1511 (24.9)	312 (16.1)	827 (30.5)	372 (26.4)	344 (10.8)	1167 (40.3)	778 (26.8)	733 (23.2)
	No	4537 (74.8)	1625 (83.8)	1881 (69.3)	1031 (73.2)	2815 (89.0)	1722 (59.4)	2119 (73.1)	2420 (76.5)
	Missing/unknown	13 (0.2)	2 (0.1)	5 (0.2)	6 (0.4)	5 (0.2)	8 (0.3)	1 (0.1)	10 (0.3)
Abdominal obesity[a] (n=3992) (Abdominal circumference)	Abd. Circumference median (IQR)	83.0 (76.0-93.0)	NA	82.0 (75.0-92.0)	84.2 (77.4-95.0)	89.0 (80.0-99.0)	80.0 (73.0-86.0)	80.0 (74.0-89.0)	86.0 (78.0-96.5)
	Yes	1739 (28.7)	NA	1076 (39.7)	663 (49.1)	1537 (48.6)	202 (7.0)	712 (24.6)	1027 (32.5)
	No	2253 (37.2)	NA	1567 (57.8)	686 (50.5)	490 (15.5)	1763 (60.9)	1215 (41.9)	1038 (32.8)
	Unknown/Missing	2069 (34.1)	NA	70 (2.5)	60 (0.4)	1137 (35.9)	932 (32.1)	971 (33.5)	1098 (34.7)
BMI	BMI median (IQR)	23.5 (20.6-27.9)	22.3 (20.2-25.7)	24.3 (21.0-29.6)	24.2 (20.7-28.6)	26.4 (22.7-31.2)	21.4 (19.5-24.2)	22.8 (20.2-26.9)	24.2 (21.0-29.2)
	<18.5 Kg/m^2	499 (8.2)	182 (9.5)	191 (7.1)	138 (9.8)	117 (3.7)	382 (13.2)	283 (9.8)	216 (6.8)
	18.5–24.9 Kg/m^2	3059 (50.5)	1191 (61.5)	1273 (46.9)	595 (42.2)	1151 (36.4)	1908 (65.9)	1553 (53.6)	1506 (47.6)
	25–29.9 Kg/m^2	1287 (21.2)	361 (18.3)	595 (21.9)	342 (24.3)	860 (27.2)	427 (14.7)	592 (20.4)	695 (22.0)
	≥30Kg/m^2	1084 (17.9)	198(10.3)	632 (23.3)	256 (18.2)	943 (29.8)	141 (4.9)	387 (13.3)	697 (22.0)
	Missing	132 (2.2)	7 (0.4)	22 (0.8)	78 (5.5)	93 (2.9)	39 (1.3)	83 (2.9)	49 (1.6)
Random blood sugar[b] (N= 5638)	Median RBG (IQR)	5.0 (4.5-5.5)	5.0 (4.5-5.5)	5.0 (4.4-5.5)	5.3 (4.7-6.1)	5.2 (4.7-5.7)	4.9 (4.4-5.5)	5.1 (4.6-5.5)	5.0 (4.5-5.6)
	RBG <5.6mmol/L	4350 (71.8)	1474 (76.0)	1986 (73.2)	890 (63.2)	2155 (68.1)	2195 (75.7)	1991 (68.7)	2359 (74.6)
	RBG 5.6-6.9 mmol/L	803 (13.3)	267 (13.8)	336 (12.4)	200 (14.1)	485 (15.3)	318 (11.0)	352 (12.1)	451 (14.3)
	RBG 7.0-11.1 mmol/L	409 (6.7)	66 (3.4)	164 (6.0)	179 (12.7)	242 (7.7)	167 (5.8)	163 (5.6)	246 (7.8)
	RBG ≥ 11.1 mmol/L	76 (1.2)	1 (0.0)	33 (1.3)	42 (3.0)	72 (2.0)	14 (0.5)	23 (0.8)	53 (1.6)
	Missing	423 (7.0)	131 (6.8)	194 (7.1)	98 (7.0)	220 (6.9)	203 (7.0)	369 (12.8)	54 (1.7)
HbA1c[c] (N= 1151)	Median HbA1c (IQR)	5.2 (5.0-5.7)	5.1 (4.9-5.5)	5.2 (4.9-5.8)	5.4 (5.0-6.1)	5.3 (5.0-5.9)	5.2 (5.0-5.6)	5.2 (4.9-5.5)	5.3 (5.0-5.9)
	HbA1c <6.5%	1013 (88.0)	288 (95.4)	410 (87.8)	312 (82.5)	612 (86.0)	401 (91.3)	437 (92.6)	576 (84.8)
	HbA1c ≥6.5%	138 (12.0)	14 (4.6)	57 (12.2)	67 (17.5)	100 (14.0)	38 (8.7)	35 (7.4)	103 (15.2)
Diabetes[d]	HbA1c ≥6.5% or on antidiabetic treatment (confirmed diabetes)	255 (4.2)	23 (1.2)	106 (3.9)	126 (8.9)	190 (6.0)	65 (2.2)	81 (2.8)	174 (5.5)
	RBG 7.0-11.0mmol/L, HbA1c missing (unconfirmed diabetes)	36 (0.6)	5 (0.3)	16 (0.6)	15 (1.0)	21 (0.6)	15 (0.6)	14 (0.5)	22 (0.7)
	No diabetes	5222 (86.2)	1742 (89.8)	2339 (86.2)	1141 (81.0)	2669 (84.4)	2553 (88.1)	2373 (81.9)	2849 (90.1)
	Missing	548 (9.0)	169 (8.7)	252 (9.3)	127 (9.1)	284 (9.0)	264 (9.1)	430 (14.8)	118 (3.7)
Blood pressure[e]	Median SBP (IQR)	122 (113-131)	118 (111-125)	122 (113-131)	128 (116-138)	121 (112-131)	123 (115-130)	120 (112-129)	123 (114-132)
	Median DBP (IQR)	77 (70-83)	74 (69-79)	79 (72-85)	78 (71-85)	77 (70-84)	77 (71-83)	76 (70-82)	77 (71-84)
	SBP ≥ 140/DBP ≥ 90mmHg	**1308 (21.6)**	**69 (3.6)**	**537 (19.9)**	**702 (49.9)**	**858 (27.1)**	**450 (15.3)**	**509 (17.6)**	**799 (25.3)**
	SBP <120/DBP <80 mmHg	2218 (36.6)	911 (47.0)	936 (34.5)	371 (26.3)	1259 (40.0)	959 (33.2)	1131 (39.0)	1087 (34.4)
	SBP 120–129/DBP 80–84 mmHg	1753 (29.0)	651 (33.6)	793 (29.2)	309 (21.9)	811 (25.6)	942 (32.5)	871 (30.0)	882 (27.9)
	SBP 130–199/DBP 85–89 mmHg	1411 (23.2)	323 (16.7)	684 (25.2)	404 (28.7)	709 (22.4)	702 (24.3)	672 (23.2)	739 (23.4)
	SBP 140–159/90–99 mmHg)	396 (6.6)	36 (1.9)	189 (7.0)	171 (12.1)	221 (7.0)	175 (6.0)	139 (4.8)	257 (8.1)
	SBP 160–179/ DBP 100–109 mmHg)	172 (2.8)	9 (0.5)	67 (2.5)	96 (6.8)	102 (3.2)	70 (2.4)	48 (1.7)	124 (4.0)
	SBP ≥180/≥110 mmHg	98 (1.6)	4 (0.2)	41 (1.5)	53 (3.8)	54 (1.7)	44 (1.5)	31 (1.1)	67 (2.0)
	Missing	13 (0.2)	5 (2.7)	3 (0.1)	5 (0.4)	8 (0.2)	5 (0.1)	6 (0.2)	7 (0.2)

BMI: body mass index; DBP: diastolic blood pressure; HbA1c: glycosylated hemoglobin; IQR: interquartile range; mmHg: millimeters of mercury; RBG: random blood glucose; SBP: systolic blood pressure

[a] Measured in adults ≥ 30 years, defined as ≥ 80cm in women and ≥94cm in men. Total number of participants with measurements is 3992

[b] RBG measured in mmol/L

[c] Hb1Ac reported in %

[d] Confirmed DM is defined as RBG≥ 5.6 mmol/L and HbA1c ≥ 6.5%, or RBG≥ 11.1 mmol/L in the absence of a HbA1c measurement or being on anti-diabetic treatment.

[e] Measured in mmHg; values calculated on the average of last two measurements

Table 3. Univariate and multivariate analysis for measured risk factors.

	Elevated BP 1308/6048		**Diabetes** 291/5638		**Overweight/obesity** 2371/5929		**Tobacco use** 1511/6058	
	OR (95%CI)	aOR$ (95%CI)	OR (95%CI)	aOR (95%CI)	OR (95%CI)	aOR (95%CI)	OR (95%CI)	aOR (95%CI)
Sex (female)	2.02 (1.78-2.30)	2.29 (1.96-2.66)	2.51 (1.93-3.27)	2.55 (1.93-1.38)	5.73 (5.10-6.44)	7.43 (6.47-8.52)	0.18 (0.15-0.20)	0.19 (0.17-0.22)
Age group								
<30y	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference
30-59y	6.68 (5.16-8.65)	7.34 (5.59-9.64)	3.21 (2.12-4.87)	2.55 (1.93-3.38)	2.09 (1.84-2.37)	3.04 (2.60-3.55)	2.29 (1.98-2.65)	1.86 (1.58-2.19)
≥ 60y	26.9 (10.73-35.0)	29.8 (22.45-39.68)	7.59 (5.03-11.45)	8.17 (5.21-12.80)	2.03 (1.75-2.35)	3.03 (2.52-3.65)	1.88 (1.58-2.23)	1.69 (1.39-2.05)
Education								
No/Primary	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference
Secondary/Tertiary	0.49 (0.43-0.56)	0.90 (0.77-1.07)	0.80 (0.63-1.02)	1.07 (0.80-1.43)	1.37 (1.23-1.52)	1.39 (1.21-1.60)	0.48 (0.42-0.54)	0.69 (0.60-0.81)
Employment/income								
No	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference
Yes	1.36 (1.20-1.54)	1.06 (0.91-1.24)	1.16 (0.92-1.48)	0.87 (0.66-1.13)	1.34 (1.21-1.49)	0.76 (0.66-0.87)	0.43 (0.38-0.49)	0.83 (0.72-0.95)
Settlement								
Rural	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference
Urban	1.59 (1.40-1.80)	1.63 (1.40-1.90)	1.95 (1.51-2.50)	1.48 (1.12-1.96)	1.51 (1.36-1.68)	1.19 (1.04-1.36)	0.82 (0.33-0.40)	1.05 (0.92-1.21)
HIV Infection (reported)								
No/unknown	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference
Yes	1.22 (1.03-1.43)	0.91 (0.75-1.09)	1.31 (0.96-1.81)	1.08 (0.79-1.48)	1.21 (1.05-1.40)	0.76 (0.64-0.89)	1.21 (1.03-1.42)	1.33 (1.11-1.59)
Household wealth								
Q1	1.02 (0.83-1.25)	1.00 (0.80-1.26)	0.92 (0-59-1.42)	0.90 (0.58-1.42)	0.85 (0.71-1.00)	0.84 (0.70-1.01)	1.00 (0.83-1.20)	0.96 (0.79-1.16)
Q2	0.89 (0.72-1.1)	0.91(0.72-1.47)	0.74 (0.47-1.80)	0.78 (0.49-1.25)	0.80 (0.67-0.95)	0.83 (0.69-1.00)	1.14 (0.95-1.36)	1.09 (0.90-1.32)
Q3	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference
Q4	1.51 (1.24-1.83)	1.37 (1.10-1.72)	1.80 (1.22-2.64)	1.55 (1.04-2.30)	1.33 (1.12-1.57)	1.20 (0.99-1.44)	0.71 (0.59-0.86)	0.73 (0.60-0.90)
Q5	1.62 (1.33-1.97)	1.53 (1.22-1.93)	2.39 (1.66-3.46)	2.02 (1.36-3.00)	2.09 (1.78-2.47)	1.90 (1.57-2.32)	0.57 (0.47-0.69)	0.59 (0.48-0.74)

$ model adjusted for age, education level, employment/income, settlement, reported HIV infection and household wealth

Table S1: Characteristics of participants ≥30 years and full lipids panel results available, n=1493

		Females N(%)	Males N(%)	Total N(%)
Total participants		869 (58.6)	614 (41.4)	1483 (100)
	Sociodemographic characteristics			
Age (years)	Age median (IQR)	54 (42-66)	51 (41-65)	53 (41-66)
	30-59 years	528 (60.8)	391 (63.7)	919 (62.0)
	≥ 60 years	341 (39.2)	223 (36.3)	564 (38.0)
District	Butha-Buthe	507 (58.3)	341 (55.5)	848 (57.2)
	Mokhotlong	362 (41.7)	273 (44.5)	636 (42.8)
Setting	Urban/peri-urban	648 (74.6)	462 (75.2)	1110 (74.8)
	Rural	221 (25.4)	152 (24.8)	373 (25.2)
Relationship status	Married/in a relationship	463 (53.3)	456 (74.2)	919 (72.0)
	Single/divorced/widowed	406 (46.7)	158 (25.8)	564 (38.0)
Educational level	No schooling	46 (5.3)	106 (17.2)	152 (10.3)
	Primary school	523 (60.2)	302 (49.2)	825 (55.6)
	Secondary	247 (28.4)	152 (24.8)	399 (26.9)
	Tertiary	52 (6.0)	54 (8.8)	106 (7.1)
	Missing	1 (0.1)	0 (0)	1 (0.1)
Employment status	(Self-) Employment/regular income	354 (40.7)	440 (71.6)	794 (53.6)
	No employment/no regular income	508 (58.5)	173 (28.2)	681 (45.9)
	Missing	7 (0.8)	1 (0.2)	8 (0.5)

Table S2. Lipid panel results, disaggregated by age groups, sex and settlement in participants ≥30 years and with full lipids panel results available, n=1483

		Total n=1483 (100%)	30-59 y n=919 (61.5%)	≥60 y n=564 (37.8%)	Women n=869 (58.6%)	Men n=614 (41.4%)	Rural n=373 (25.2%)	Urban/peri-urban n=1110 (74.8%)
Lipid panel	Median total cholesterol (IQR)	3.7 (3.1-4.3)	3.6 (3.1-4.2)	3.9 (3.2-4.6)	3.9 (3.2-4.5)	3.5 (3.0-4.1)	3.5 (3.0-4.2)	3.7 (3.1-4.3)
	Median HDL-Chol (IQR)	1.2 (0.9-1.4)	1.1 (0.9-1.4)	1.2 (0.9-1.5)	1.1 (0.9-1.4)	1.2 (0.9-1.5)	1.3 (1.1-1.6)	1.1 (0.9-1.4)
	Median LDL-Chol (IQR)	1.9 (1.4-2.5)	1.9 (1.3-2.4)	2.0 (1.4-2.6)	2.1 (1.5-2.6)	1.7 (1.0-2.2)	1.6 (1.2-2.2)	2.0 (1.5-2.3)
	Median Triglycerides (IQR)	1.2 (0.9-1.8)	1.2 (0.9-1.7)	1.3 (1.0-2.0)	1.3 (0.9-1.9)	1.2 (0.9-1.7)	1.2 (0.9-1.7)	1.2 (0.9-1.9)
Dyslipidemia	Total cholesterol ≥ 5.2 mmol/L	112 (7.5)	54 (5.9)	58 (10.3)	85 (9.8)	27 (4.4)	25 (6.7)	87 (7.8)
	HDL-Chol <1.3 mmol/L in females and <1 males	782 (52.7)	501 (54.5)	281 (49.8)	590 (67.9)	192 (31.3)	151 (410.5)	631 (56.9)
	LDL-Chol > 4.1 mmol/L	24 (1.6)	10 (1.1)	14 (2.5)	18 (2.0)	6 (1.0)	3 (0.8)	21 (1.9)
	Triglycerides >1.7 mmol/L	432 (29.1)	238 (25.9)	194 (34.4)	265 (30.5)	167 (27.2)	102 (27.3)	330 (29.7)
	Elevated cholesterol/HDL ratio	377 (25.4)	224 (24.4)	153 (27.1)	295 (33.9)	82 (13.4)	46 (12.3)	331 (29.8)

HDL-Chol: high-density lipoprotein cholesterol LDL-Chol: low-density lipoprotein cholesterol

3.2 Hypertension and diabetes awareness, treatment, and control among adults

This is the file submitted to the journal

Awareness, treatment, and control among adults living with arterial hypertension or diabetes mellitus in two rural districts in Lesotho in 2022

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Abstract

Introduction

Hypertension and diabetes care cascades are a set of indicators that monitor outcomes among people living with these conditions. In Lesotho, a recent description of these cascades is lacking. In this study, we measured awareness, treatment, and control of hypertension and diabetes and identified factors associated with each step of the cascade.

Methods

We conducted a population-based, cross-sectional survey among adults ≥18 years in 120 randomly sampled clusters in the districts of Butha-Buthe and Mokhotlong from 1st November 2021 to 31st August 2022. We included participants who were diagnosed with hypertension or diabetes and had data across all steps of the cascade. For each cascade step, we reported frequencies with 95% confidence intervals (95%CI). We used multivariable logistic regression to assess associations.

Results

Of the identified 1308 participants with arterial hypertension and 291 participants with diabetes mellitus, we included 1305 and 229 participants with full information across the cascades. Among participants with hypertension, 69.7% (95%CI, 67.2-72.2%, 909/1305) were aware of their condition, 67.3% (95%CI 64.8-69.9%, 878/1305) took treatment, and 49.0% (95%CI 46.3-51.7%, 640/1305) were controlled. Among participants with diabetes, 48.4% (95%CI 42.0-55.0%, 111/229) were aware of their condition, 55.8% (95%CI 49.5-62.3%, 128/229) took treatment, and 41.5% (95%CI 35.1-47.9%, 95/229) were controlled. For hypertension, women had higher odds of being on treatment (adjusted odds ratio (aOR) 2.54, 95% CI 1.78-3.61) and controlled (aOR 2.44, 95%CI 1.76-3.37) than men. Participants from urban areas had lower odds of being on treatment (aOR 0.63, 95% CI 0.44-0.90) or being controlled (aOR 0.63, 95% CI 0.46-0.85). For diabetes, participants older than 60 years had highest odds of being on treatment (aOR 3.44, 95% CI 1.03-11.49).

Conclusion

Considerable gaps along the hypertension and diabetes care cascades in Lesotho indicate that access and quality of care for these conditions are insufficient to ensure adequate health outcomes.

Keywords

Arterial hypertension, diabetes mellitus, hypertension treatment, diabetes treatment, care cascades, non-communicable chronic diseases, Lesotho

Key messages

WHAT IS ALREADY KNOWN ON THIS TOPIC

- In Lesotho, recent data on the arterial hypertension and diabetes mellitus care cascades do not exist.

WHAT THIS STUDY ADDS

- Using data from a large-scale household survey in two of ten districts of the country, we provide data on the hypertension and diabetes care cascades, as well as factors associated with each cascade step.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

- Both the hypertension and the diabetes cascade present important gaps. Male sex and urban settlement were associated with worse outcomes along the hypertension cascade. Routine monitoring of such indicators are critical to tailor strategies tackling hypertension and diabetes effectively in this setting.

Introduction

Arterial hypertension and diabetes mellitus are risk factors linked to cardiovascular diseases (CVD) and paramount causes of mortality globally[1–3]. The sub-Saharan African region, including Lesotho, records rising rates of hypertension and diabetes and increasing CVD-related morbidity and mortality[4–8]. Despite this, these conditions remain largely under-diagnosed, and access to high-quality treatment is inadequate[9–12].

Hypertension and diabetes care cascades describe a series of sequential steps in a patient's journey to reach treatment control. Various steps are evaluated: screening and diagnosis of the condition including disease awareness, treatment initiation, long-term retention in care, and treatment control. Quality of care of a health program can be assessed by monitoring each step (i.e., minimum drop-out, maximum rate of treatment control). Countries in sub-Saharan Africa have begun promoting care cascades as a regular monitoring tool to enhance hypertension and diabetes treatment outcomes [13–15].

Lesotho has a population just over 2 million and is classified as a lower-middle-income country[16]. Health services have traditionally been geared towards the control of infectious diseases and infant and maternal mortality[17–19]. Despite a significant prevalence of hypertension and diabetes in the country[20], up-to-date data about awareness, treatment and control of hypertension and diabetes is scarcely available and is not routinely used to guide programmatic interventions. In the context of a broad population-based survey that measured a wide range of non-communicable diseases in two of ten districts of the country, this study aimed to measure the hypertension and diabetes care cascade, and to identify factors associated with being on treatment and reaching treatment targets.

Methods

Study setting

This study is part of a population-based, cross-sectional survey conducted in the districts of Butha-Buthe and Mokhotlong, in Lesotho, from 1st November 2021 to 31st August 2022. In 2021 the Butha-Buthe district had a total population of approximately 150,000 inhabitants; 35,000 living in Butha-Buthe town, the remaining in often remote villages scattered over an area of 1767km^2. The district has one district hospital, one missionary hospital and 12 peripheral clinics (six public, three missionary, and three private-for-profit facilities). The Mokhotlong district has approximately 100,000 inhabitants, of which 30,000 live in Mokhotlong town, with the remaining living in villages over an area of 4075km^2. The district has one hospital, and nine rural public clinics[21].

Survey design and field procedures

We randomly selected 120 population clusters, 60 in (peri-)urban and 60 in rural areas. We considered these clusters as primary sampling units and household members as secondary sampling units. Households were eligible if the household head, or an adult representative, gave verbal consent. Household members were randomly selected using an algorithm based on age, sex and settlement (rural vs urban), programmed in the Open Data Kit (ODK) data collection software[22]. Selected household members were eligible if they provided written informed consent. Further information on survey procedures is published elsewhere.

Participants received oral and written study information in the local language (Sesotho) and gave written informed consent. In case of illiteracy, participants signed with a thumbprint and a witness co-signed the form. Interviews were conducted in Sesotho. We collected information about sociodemographic characteristics (sex, age, marital status, level of education completed, employment), past medical history (self-reported, or described in the patient health booklet) and household wealth. The household wealth was computed using the Demographic and Health Survey (DHS) Program wealth index questions for Lesotho. The DHS wealth index is calculated based on a questionnaire that assesses housing construction characteristics, household assets and utility services, including country-specific assets that are viewed as indicators of economic status[23,24].

Blood pressure (BP) was measured using the validated Watch BP Office ABI® device[25] with participants sitting after resting for 15 minutes, and automatically repeated two more times at 2-minute intervals each. The mean of the last two measurements was used to calculate the final systolic blood pressure (SBP) and diastolic blood pressure (DBP) results. Due to the conduct of several point-of-care tests in parallel, venous blood was collected in EDTA tubes. Random blood glucose (RBG) was measured using the Accu-chek Active® testing platform[26]. For participants with RBG ≥ 5.6 mmol/L, a glycosylated hemoglobin (HbA1c) measurement was performed using either the Jana Care Aina station® or the A1CNow+ Professional system®.

Study population

We included participants who were found to have arterial hypertension, defined as SBP ≥140 mmHg and/or DBP ≥90 mmHg and those who reported to be taking antihypertensive medication (self-reported or written in their health booklet). Inclusion of participants with diabetes was subject to a measurement of RBG ≥5.6mmol/L and HbA1c ≥ 6.5%, and those who reported to be taking antidiabetic medication (self-reported or written in their health booklet).

Hypertension and diabetes care cascades

For both the hypertension and diabetes cascades, we assessed the following three steps: being aware of the condition, being on treatment for the condition, and being medically controlled for the condition, i.e., reaching treatment targets. A participant was categorized as "being aware" of their condition if they stated that a health care worker had previously told them they had arterial hypertension and/or diabetes mellitus. "On treatment" was defined as participants stating they were taking medication along with a written proof of anti-hypertensive or anti-diabetic medication prescription, respectively, in their health booklet. Hypertension control was defined as SBP <140mmHg and DBP <90 mmHg on the day of the survey. Diabetes control was defined as a HbA1c $\leq$ 8.0% on the day of the survey.

Statistical analysis

We extracted information for each participant from the main study dataset, including sex, age, settlement, relationship status, level of education, employment, self-reported HIV status, body mass index (BMI), and household wealth.

Participants' characteristics were described using frequency and median with interquartile ranges (IQR). The number of participants diagnosed with hypertension or diabetes was set as the denominator for all other steps of the respective care cascade. For each step of the care cascades, we reported frequencies with Wald 95% confidence intervals (CI). We reported adjusted odds ratios (aOR) with 95% CI derived from logistic regression models to assess the association of patient characteristics with the different steps in the care cascades. Statistical analysis was done using Stata/IC (version 16.0, College Station, Tex: Stata Corp LP, 2019).

Results

Participants characteristics

Enrolment of participants is detailed in figure 1. In the 120 clusters, the study teams visited 3498 households with 7412 eligible household members and identified 1308 participants with arterial hypertension and 291 participants with diabetes as per survey definitions. We excluded participants with missing data in any of the steps along the care cascades. Therefore, we finally included 1305 and 229 participants with hypertension and diabetes, respectively. Table 1 summarizes their characteristics. Women represented a total of 65.6% (856/1305) and 73.8% (169/229) of participants in the hypertension and the diabetes cascades, respectively. Approximately two-thirds of the participants lived in urban or peri-urban settlements and almost half reported having regular income. Overall, approximately one in five participants reported to live with HIV.

Care cascades for hypertension and diabetes

Figure 2 shows the care cascades for arterial hypertension and diabetes. Among the participants with hypertension, 69.7% (95%CI 67.2-72.2%, 909/1305) were aware of their condition, 67.3% (95%CI 64.8-69.9%, 878/1305) took medical treatment, and 49.0% (95%CI 46.3-51.7%, 640/1305) had controlled BP on the day of the survey. Among the participants with diabetes, 48.4% (95%CI 42.0-55.0%, 111/229) were previously diagnosed, 55.8% (95%CI 49.5-62.3%, 128/229) took medical treatment, and 41.5% (95%CI 35.1-47.9%, 95/229) were controlled on the day of the survey. When analyzing the care cascades as a proportion of the prior step, a total of 69.7%, (95%CI 67.2-72.1%, 909/1305) participants with hypertension were aware of their condition, out of these, 96.6% (95%CI 95.4-97.8%, 878/909) were on treatment, and 72.9% (95%CI 71.0-76.8%, 640/878) had controlled BP. Among those with diabetes, 48.5% (95%CI 42.0-54.9%, 111/229) were aware of their condition. A total of 128 participants reported being on anti-diabetic treatment, and of those, 74.2%, (95%CI 66.6-81.8%, 95/128) were controlled.

Factors associated with hypertension and diabetes treatment and control

Table 2 provides the estimates from univariate and multivariable logistic regression analyses. For hypertension, women had higher odds of being on treatment (aOR 2.54, 95% CI 1.78-3.61) and achieving BP control (aOR 2.44, 95% CI 1.76-3.37) than men. Participants from urban areas had lower odds of being on treatment (OR 0.63, 95% CI 0.44-0.90) or having controlled BP (OR 0.63, 95% CI 0.43-0.85), than participants living in rural areas. We did not find significant associations with comorbidities, such as overweight or living with HIV, nor with household wealth, education, or employment. For diabetes, the oldest age group (60 years and older), had highest odds of being on treatment (OR 3.44, 95% CI 1.03-11.49). None of the covariates included in our model showed a significant association with diabetes control.

Discussion

To our knowledge, this is the first study to investigate the cascades of care for hypertension and diabetes using population-based data in Lesotho. Our results show insufficient rates of awareness, treatment, and control for both conditions. With regards to hypertension, one in three adults did not know they had hypertension, nor had initiated treatment, and only half of all the adults with hypertension had adequate BP control. The diabetes cascade shows even larger gaps across all the steps. Only half of the adults that screened positive for diabetes had a previous diagnosis or had initiated treatment and glycemic control was achieved by less than half of the participants. Young adults (18-30 years) with hypertension or diabetes had lower odds of treatment initiation and control.

Curbing the morbidity and mortality of hypertension and diabetes in sub-Saharan Africa will require identification of all those who remain undiagnosed, untreated, and uncontrolled[27]. Routine monitoring of care cascades is a fundamental tool to achieve these objectives in health programs. In the case of diabetes, in 2022 the World Health Organization (WHO) set programmatic targets of 80% for each cascade step[28]. With regards to hypertension, WHO standard recommendations to monitor cascade indicators were released in 2022 without specific targets[29,30]. Once established, CVDs programs must attain high rates of BP and glycemic control and integrate comprehensive CVDs risks management. Health systems strengthening approaches are needed to ensure no cascade gaps, including a functional supply chain for drugs and diagnostic commodities, capacity building for task shifted care, and availability of routine BP and HbA1c measurements (including point-of-care devices). Much can be learned from the HIV and tuberculosis programmes[31–35].

Our study shows that the performance of both cascades, although better than the regional average[27], remains suboptimal in Lesotho. There are significant gaps across all steps, and BP and glycemic control are insufficient to substantially decrease CVD risk in this population. Adults with hypertension appeared to have a higher level of awareness (69.6%, 95%CI 67.2-72.2%), than those with diabetes (48.4%, 95%CI 42.0-55.0%), indicating a more frequent routine measurement of BP than glycemia.

In 2014, the Lesotho Demographic and Health Survey[36] reported that 68.5% of the participants who were found to have hypertension were on treatment, and 70.0% of participants who were found to have diabetes had started treatment, representing similar findings to this study. A recent analysis of the continuum of care in Tanzania[37] revealed important gaps in both cascades. In this setting only 21% and 11% of participants with hypertension were on treatment and had achieved BP controlled, respectively, whereas 66% and 48% of participants with diabetes had started treatment and had achieved glycemic control, respectively. The authors suggested that these gaps were heavily influenced by out-of-pocket expenses, i.e., patient fees for services. In Lesotho, services for hypertension and diabetes are predominantly free in health centers, and patients are only required to pay a minimal fee when attending hospital services. Our study found no significant association between household wealth and awareness, treatment initiation, or control. The 2012 South Africa National Health and Nutrition Examination Survey[38] reported that half of the adults who screened positive for hypertension were undiagnosed, 78% of those with hypertension were not on treatment and, overall, only 9% of participants with hypertension had achieved the threshold of treatment control.

In our study, we did not find a significant association between participants living with HIV and outcomes across the hypertension or diabetes care cascades. A recent study reviewing hypertension and diabetes outcomes along the HIV care cascade in rural South Africa[39] found that participants living with HIV had lower systolic BP and blood glucose than participants not

living with the virus. Today, a growing body of evidence fosters the idea that HIV treatment programs can successfully integrate, and thus strengthen, care for CVDs in settings with a HIV prevalence such as Lesotho[31,39–41]. Nonetheless, maintaining the quality of CVD care in the long-term remains programmatically challenging, especially in fragile health systems. This is the case in Mozambique, where a recent report revealed worsening performance of the diabetes cascade, with a decrease of 3% in diagnosis and 50% of treatment initiation between 2005 and 2015[42].

Improvement in coverage and quality of services for CVDs will require active identification and successful engagement in care of all the adults who live with these conditions[43]. With regards to this, our study found that participants with hypertension who were male, below 30 years, and lived in urban areas had lower odds of taking treatment or being controlled than women, elder age groups or those in rural areas. These findings are consistent with regards to women and elder groups engaging in care better[37,44–46], however it is contrary to previous studies which have suggested that awareness and control tend to be higher in urban areas[47,48].

Our study has several limitations. The information for HIV status, and the first step (awareness) in the cascades are collected from self-reported information.[49,50] This is the reason why in the diabetes care cascade (Figure 2B) the proportion of participants being aware or recalling a previous diagnosis is lower than those who reported being on diabetes treatment. Thus, this step needs to be interpreted with caution and we decided not to include this step in the multivariable analyses. Second, as this was a cross-sectional household-based survey, hypertension diagnosis and control relied on single-day measurements. However, this is the standard approach recommended by WHO for household-based surveys, such as STEPwise approach to NCD risk factor surveillance (STEPS) surveys, in these settings[8]. Third, from approximately one third of the participants we did not have information on their HIV status. This was due to procedural changes during the survey conduct, and there is no reason to believe the survey population was different after the procedural change than before and thus we consider this data being missing completely at random.

Conclusion

The cascades of care for hypertension and diabetes in Lesotho have considerable gaps, indicating that access and quality of services remain insufficient to ensure adequate health outcomes. Routine monitoring of such indicators across age and sex groups can support the progress to achieving programmatic targets in this setting.

Declarations

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Patient and public involvement
This survey is part of the Community-based chronic care project Lesotho (ComBaCaL; www.combacal.org). It was designed together with the ComBaCaL steering committee that includes a community representative, as well as representatives from the Ministry of Health of Lesotho. The survey was discussed with local authorities (village chiefs, local Ministry of Health), who were engaged throughout the survey.

Ethics
All procedures were carried out in line with the ethical standards laid out in the Declaration of Helsinki. Participants received information on all research procedures in Sesotho and gave written informed consent. Illiterate participants gave consent by thumbprint and a witness co-signed the form. Once the informed consent process was completed, a signed copy of the form was retained by study staff and a copy was given to the participant. This study was reviewed by the Ethics Committee Northwest and Central Switzerland (ID AO_2021-00056) and approved by the National Health Research Ethics Committee in Lesotho (ID139-2021).

Availability of data and materials
We will deposit a pseudo-anonymized dataset and a codebook with the data presented in the manuscript on zenodo.org.

Competing interests
The authors declare no conflicts of interest.

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Author Contributions
LGF, EF, TIL, RG, AA and NDL conceptualized the study. MPS, MK, MM, and MB collected data in the field under supervision of RG. TL oversaw routine data quality checks. LGF performed analysis with the support of TL and FC. MT, ES, FG, TIL, SMC, and IA provided important clinical, technical, and intellectual input. LGF drafted the first version of the manuscript. All authors reviewed the manuscript and approved the final version.

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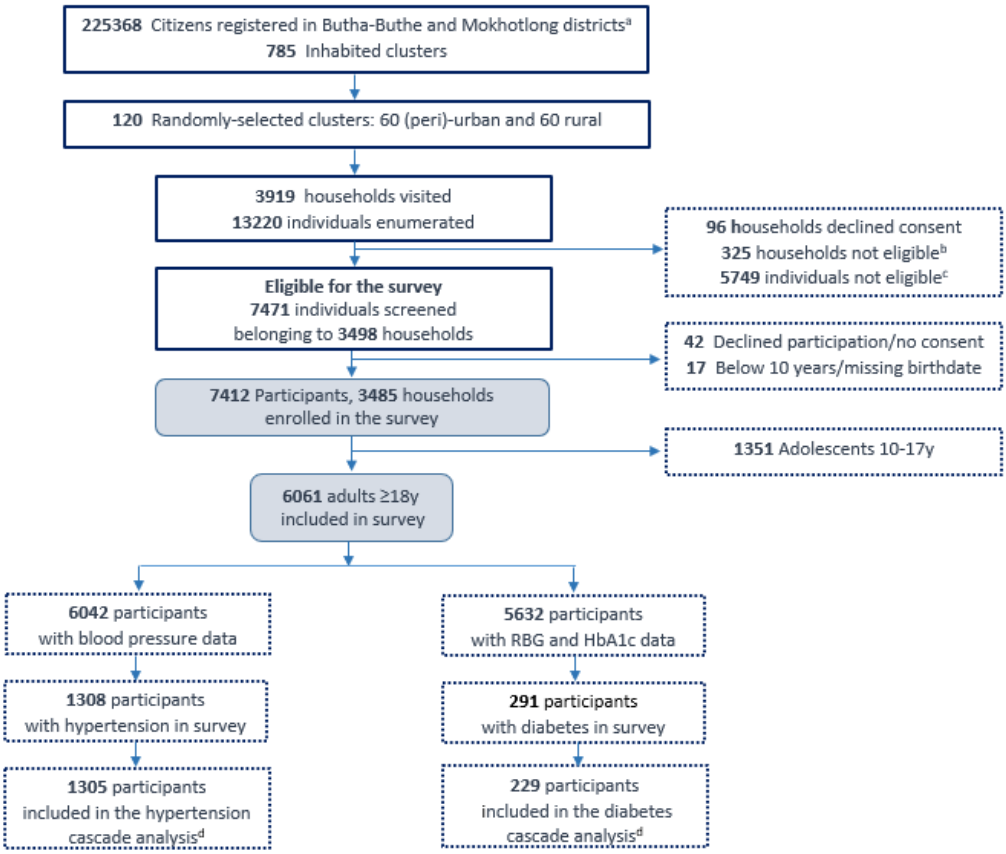
Figure 1. Study flow



[a] Lesotho - Subnational Population Statistics-UNFPA: https://data.humdata.org/dataset/cod-ps-lso
[b] Had no participants who were eligible for survey (i.e., participants received a basic package of services: BP and RBG measurements, members who were present were <10 years)
[c] Individuals were enumerated but not present at the time of the survey or were not eligible (i.e., <10 years, or those who received a basic to package of services: BP and RBG measurements)
[d] Individuals included had information in all four steps of the care cascades
Acronyms: RBG: random blood glucose; HbA1c: glycosylated hemoglobin

Table 1 –Baseline characteristics of study participants in hypertension and diabetes care cascades

		Hypertension cascade n (%)	Diabetes cascade n (%)
Total participants		1305 (100)	229 (100)
Sex	Female	856 (65.6)	169 (73.8)
	Male	449 (34.4)	60 (26.2)
Age	<30 years	69 (5.3)	19 (8.3)
	30-59 years	537 (41.1)	93 (4.6)
	≥ 60 years	699 (53.6)	117 (51.1)
Settlement	Urban/peri-urban	797 (61.1)	159 (69.4)
	Rural	508 (38.9)	70 (30.6)
Relationship status	Married/in a relationship	704 (53.9)	128 (55.9)
	Single/divorced/widowed	601 (46.1)	101 (44.1)
Education level	No schooling	148 (11.3)	10 (4.3)
	Primary school	761 (58.3)	135 (58.9)
	Secondary	320 (24.5)	62 (27.1)
	Tertiary	75 (5.8)	21 (9.3)
	Missing	1 (0.1)	1 (0.4)
Employment status	(Self-) Employment/regular income	583 (44.7)	106 (46.3)
	No employment/no regular income	722 (55.3)	123 (53.7)
HIV status*	Positive	227 (17.4)	45 (19.6)
	Negative ≤12 m ago	458 (35.1)	85 (37.1)
	Negative >12 m ago	291 (22.3)	51 (22.3)
	Missing/unknown	329 (25.2)	48 (21.0)

*Self-reported or recorded in participants' health card

Figure 2. Care cascades for arterial hypertension (A) and diabetes (B), showing the percentage, with 95% confidence intervals, and number of participants in each step of the cascade: screened positive, reported a previous diagnosis, taking treatment and condition controlled.

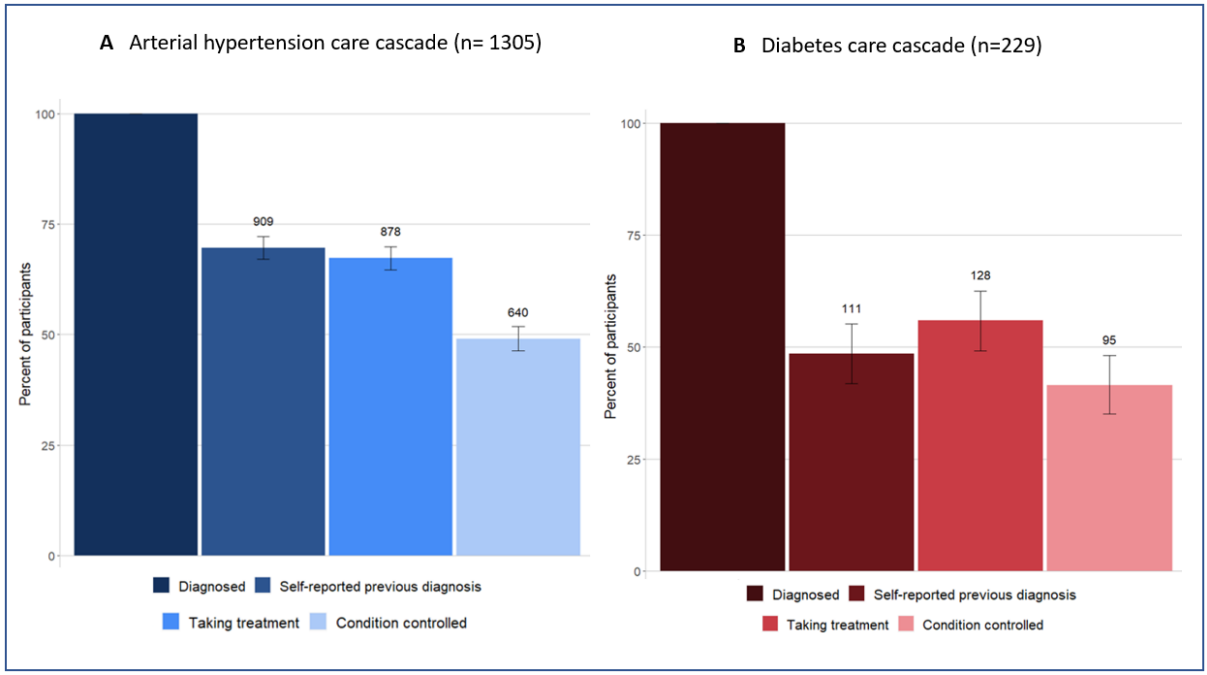


Table 2. Univariate and multivariable regression analysis for previous treatment and condition control in participants of the hypertension and diabetes care cascades

	Arterial Hypertension (n=1305)				Diabetes (n=229)			
	On treatment		Blood pressure controlled		On treatment		Diabetes controlled	
	OR (95%CI)	aOR (95%CI)[§]	OR (95%CI)	aOR (95%CI)[§]	OR (95%CI)	aOR (95%CI)[¥]	OR (95%CI)	aOR (95%CI)[¥]
Sex								
Male	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference
Female	2.97 (2.33-3.78)	2.54 (1.78-3.61)	2.27 (1.80-2.87)	2.44 (1.76-3.37)	1.51 (0.83-2.73)	1.90 (0.93-3.89)	1.19 (0.65-2.18)	1.25 (0.61-2.54)
Age group								
<30y	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference
30-59y	2.42 (1.44-4.07)	2.45 (1.28-4.71)	1.98 (1.14-3.42)	2.44 (1.26-4.75)	3.87 (1.29-11.65)	2.49 (0.71-8.65)	1.50 (0.52-4.29)	1.44 (0.43-4.82)
≥ 60y	6.07 (3.60-10.24)	7.09 (3.61-13.92)	2.92 (1.70-5.01)	3.09 (1.58-6.06)	4.02 (1.36-11.91)	3.44 (1.03-11.49)	1.67 (0.59-4.71)	1.77 (0.56-5.61)
Education								
No/Primary	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference
Secondary/Tertiary	0.71 (0.56-0.92)[R]	1.33 (0.93-1.90)	0.70 (0.55-0.89)[R]	1.01 (0.80-1.52)	0.95 (0.55-0.64)[µ]	1.04 (0.54-2.01)	0.95 (0.55-1.66)[µ]	1.23 (0.64-3.37)
Stable relation								
No	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference
Yes	0.94 (0.74-1.18)	1.39 (0.99-1.93)	0.89 (0.72-1.11)	1.21 (0.90-1.62)	1.84 (1.08-3.12)	1.98 (1.06-3.71)	1.06 (0.63-1.81)	1.07 (0.58-1.99)
Employment/Regular income								
No	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference
Yes	1.84 (1.45-2.32)	1.02 (0.73-1.42)	1.49 (1.19-1.85)	0.99 (0.74-1.33)	1.10 (0.65-1.85)	0.83 (0.44-1.54)	0.93 (0.55-1.57)	0-79 (0.36-1.41)
Settlement								
Rural	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference
Urban	0.60 (0.46-0.76)	0.63 (0.44-0.90)	0.59 (0.47-0.74)	0.63 (0.46-0.85)	0.78 (0.55-1.39)	0.76 (0.40-1.43)	0.60 (0.34-1.07)	0.63 (0.33-1.19)
BMI ≥ 25 Kg/m²								
No	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference
Yes	2.24 (1.76-2.84)[ß]	1.49 (1.07-2.07)	1.31 (1.04-1.64)[ß]	0.87 (0.65-1.18)	1.50 (0.84-2.68)[#]	0.97 (0.49-1.92)	0.83 (0.46-1.49)[#]	0.72 (0.36-1.41)
Known HIV-positive[α]								
No	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference
Yes	0.98 (0.71-1.36)[€]	1.17 (0.81-1.69)	0.93 (0.69-1.25)[€]	0.92 (0.67-1.28)	0.70 (0.37-1.35)	0.58 (0.29-1.16)	0.92 (0.47-1.80)	0.86 (0.42-1.75)
Household wealth								
Q1	0.95 (0.64-1.40)[¥]	1.19 (0.69-2.05)	1.16 (0.80-1.68)[¥]	1.50 (1.76-3.37)	0.74 (0.29-1.99)	0.71 (0.24-2.06)	0.63 (0.23-1.72)	0.55 (0.19-1.60)
Q2	0.94 (0.63-1.41)	0.91 (0.53-1.56)	1.12 (0.76-1.63)	1.15 (0.94-2.38)	0.65 (0.23-1.90)	1.02 (0.33-3.10)	0.32 (0.11-0.92)	0.30 (0.10-0.92)
Q3	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference
Q4	0.96 (0.66-1.38)	0.81 (0.50-1.34)	0.97 (0.69-1.37)	1.07 (0.69-1.28)	0.93 (0.46-2.43)	1.78 (0.68-4.64)	0.74 (0.31-1.78)	0.65 (0.26-1.63)
Q5	1.04 (0.72-1.50)	1.07 (0.65-1.76)	0.99 (0.70-1.39)	1.28 (0.83-1.98)	0.89 (0.36-2.20)	1.48-0.61-3.58)	0.48 (0.21-1.10)	0.47 (0.19-1.15)

[R] Total number of observations 1304. [ß] Total number of observations 1262. [α] Self-reported. [€] Total number of observations 976. [¥] Total number of observations 1299. [§] Multivariate model fitted on a reduced dataset of 941 observations (participants with missing covariate information were dropped). [µ] Total number of observations 228. [#]Total number of observations 223. [¥] Multivariate model fitted on a reduced dataset of 222 observations (participants with missing covariate information were dropped).

3.3 Mental health and substance use problems among adults

This is the file that is being reviewed by the co-authors

Prevalence of mental health and substance use problems and access to services in Lesotho: results from a population-based survey

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Abstract

We conducted a household survey of adults in two rural districts in Lesotho to (1) assess the prevalence mental health (MH) symptoms, including depression, anxiety, posttraumatic stress, suicidal ideation, and substance use (SU) problems, using validated questionnaires, (2) describe the gaps in awareness and uptake of MH and SU services and (3) describe the profile of individuals that reported moderate/severe problems and had considered accessing health services. Of 6061 participants 1.7%, 0.7%, 0.8%, and 4.4% reported moderate/severe symptoms of depression, anxiety, suicidal thoughts, trauma, and post-traumatic syndrome, respectively. Among the participants who reported alcohol and cannabis use in the previous three months, 36.2% and 93.5% scored moderate/high risk for use, respectively. Only 38% and 11% of participants who reported moderate/severe problems had considered accessing services Few predictors related to the need to access health services were linked to outcomes. Research should investigate reasons for low awareness for mental health problems in this setting.

Keywords

Depression, suicidal ideation, anxiety, trauma, substance use, mental health services

Introduction

Mental health (MH) and substance use (SU) problems have increased globally and are recognized as major barriers to achieving the health-for-all goals laid out in the United Nations' Sustainable Development Goals (Frankish et al., 2018; *Goal 3 | Department of Economic and Social Affairs*, n.d.). In 2019, an estimated 970 million people with MH and SU disorders were reported globally, representing an increase in these disorders of 48% between 1990 and 2019. The proportion of global disability-adjusted life years (DALYs) attributed to MH and SU disorders increased from 3.1% to 4.9% in the same period ("Global, Regional, and National Burden of 12 Mental Disorders in 204 Countries and Territories, 1990–2019," 2022). In addition to the growing global burden of MH and SU problems, a large gap exists between those who need MH and SU health services and those who have access to and make use of them. It is estimated that only 1% of the global health workforce provides mental health care, and between 75% to 95% of people who need care for these conditions are unable to receive services (Freeman, 2022; "Global, Regional, and National Burden of 12 Mental Disorders in 204 Countries and Territories, 1990–2019," 2022; Jack et al., 2014). This high prevalence, combined with the unmet need for mental health services, are the main contributors to the increasing proportion of global DALYs attributed to these conditions ("Global, Regional, and National Burden of 12 Mental Disorders in 204 Countries and Territories, 1990–2019," 2022).

On the African continent and in the sub-Saharan region, MH problems, including depression, anxiety, trauma, suicidal ideation, and SU, including alcohol and other substances such as cannabis, have also been identified as major sources of DALYs ("Global, Regional, and National Burden of 12 Mental Disorders in 204 Countries and Territories, 1990–2019," 2022; Patel et al., 2018), and the treatment gap is higher than the global average (Jack et al., 2014; Wilson et al., 2014).

Lesotho is a landlocked country within Southern Africa with a population of two million, with a historically heavy burden of infectious diseases, such as HIV and tuberculosis, and a growing burden of non-communicable diseases, including mental health and substance use problems (*Atlas of African Health Statistics 2022 Health Situation Analysis of the WHO African Region*, n.d.; *Lesotho*, n.d.-a; *LESOTHO TB Dashboard*, n.d.; Gouda et al., 2019). The prevalence and health service gap for MH and SU symptoms are not well understood, as accurate and representative data are scarce(Thabane, 2021). Historical data from a small number of studies indicate that such problems are prevalent and may have a significant impact on the overall disease burden in Lesotho. The most recent estimates in Lesotho, which are over 30 years old, suggest that major depression and generalized anxiety were common both in the community (12.4%, 6.2%) and in general outpatient setting (21.7%, 27.9%), respectively (Hollifield et al., 1990a, 1994). More recent estimates highlight that trauma, sexual and interpersonal violence, alcohol use and abuse represent important health problems in the country (Cerutti et al., 2016; *Lesotho-VACS-2019_Final-Report-1.Pdf*, n.d.; Marlow et al., 2021; Meursing & Morojele, 1989;

Siegfried et al., 2001). With regards to the use of other substances (i.e., not alcohol, nor nicotine), studies from 1999 estimated that 10% of the population regularly consumed cannabis (*Cannabis in Lesotho: A Preliminary Survey - UNESCO Digital Library*, n.d.-a), and there is no available data about the use of other drugs in the country. Most of these studies did not use validated questionnaires for data collection. Still, as the characteristics that increase risk for MH and SU symptoms are well described in sub-Saharan Africa, we were interested in exploring factors associated with health services seeking behavior in our setting. In general, services for mental health in Lesotho are scarce(Hollifield et al., 1990b). Care is available at the National Referral Psychiatric Hospital, and in Mental Health Observation Units (MOUs) at district hospitals. Limited services are also available in the private sector, and routine data is scant(Mental Health Atlas Lesotho Country Profile 2014, n.d.; World Health Organization, 2018).

This study was set out to examine, in adults living in two mostly rural districts in Lesotho, (1) the prevalence of depression, anxiety, lifetime trauma and posttraumatic stress, suicidal ideation, and substance use; (2) the cascades of care and the healthcare gaps; and (3) the profile of individuals who reported moderate/severe MH or SU problems and had considered accessing health services for these conditions.

Methods

Setting

This study is part of the community-based chronic care Lesotho project (ComBaCaL; www.combacal.org). The first part of this project included a large population-based, cross-sectional survey assessing different non-communicable diseases among individuals living in the Butha-Buthe and Mokhotlong districts, in Northern Lesotho. Data was collected between November 2021 to August 2022. The estimated combined population of the two districts is 250,000 people and includes predominantly subsistence farmers, mine workers, as well as construction or domestic laborers who work in neighboring South Africa. Each district has one central mid-size town, Butha-Buthe with ca. 25,000 inhabitants and Mokhotlong with ca. 10,000 inhabitants. The remaining population lives in rural villages scattered over a mountainous area of 5,842 km^2. The available health services are provided through 22 health facilities. Butha-Buthe has ten nurse-led rural health centers, one missionary hospital, and one governmental hospital. In Mokhotlong, there are nine nurse-led rural health centers and one governmental hospital (*LESOTHO DISTRICT PROFILE | United Nations Development Programme*, n.d.).

Participants

We randomly sampled 120 population clusters (60 urban/peri-urban clusters and 60 rural clusters) in the two districts. We considered the clusters as primary sampling units and household members as

secondary sampling units. A household was defined as one or more individuals who resided in a physical structure (e.g., compound, homestead) and shared housekeeping arrangements. A household member was defined as any individual who was acknowledged by the head of household as such. All household members, both absent and present, of all ages were enumerated. Households were eligible if the household head, or an adult representative, gave verbal consent. Household members were randomly selected by an algorithm considering age, sex and settlement (urban vs rural), programmed in the Open Data Kit (ODK) data collection software (*ODK - Collect Data Anywhere*, n.d.). Selected household members were eligible if they provided written informed consent.

Field procedures

A study team was usually composed of eight members and included nurses, nursing assistants, and lay health workers. After arriving at a cluster, the team sought oral approval from the village chief, and thereafter started visiting the households. Upon consent from the household head, the team collected sex and age information of all present and absent household members. If a present household member was randomly selected by the algorithm and provided written informed consent, the study team proceeded to collect data.

Survey participants received study information in Sesotho, the local language, and were asked written informed consent. Trained study staff collected data using the ODK platform(*ODK - Collect Data Anywhere*, n.d.), administered the questionnaires, and collected responses from participants in English or Sesotho with in-person interviews. All MH and SU questionnaires underwent a standardized translation and back-translation process.

Measurements

Demographics. Information was collected at household and individual level. Household information included geographic coordinates. Socioeconomic status was computed for each household using the Demographic and Health Survey (DHS) Program wealth index questions for Lesotho. The DHS wealth index is calculated based on a questionnaire that assesses housing construction characteristics, household assets and utility services, including country-specific assets that are viewed as indicators of economic status (*Making the Demographic and Health Surveys Wealth Index Comparable*, n.d.; *The DHS Program - Wealth-Index-Construction*, n.d.). Participant information included gender, age, highest level of education completed, employment in the past 12 months, and relationship status.

Depression and suicidal ideation. The Patient Health Questionnaire-9 (PHQ-9) assesses symptoms of major depression over the last two weeks. There are a total of 9 items, with each item scored on a 4-point Likert scale ranging from “0” (not at all) to “3” (nearly every day). Suicidal thinking was measured using a positive response to the final item of the PHQ-9 that asks about thoughts being better off dead

or of hurting oneself in some way (Chibanda et al., 2016; Cholera et al., 2014; Gelaye et al., 2013, 2016). Symptoms were categorized following the standardized cut-offs of the instrument: “none/minimal risk” (score 0–4), “low risk” (5–9), and “moderate to high risk” (10–27). This questionnaire has been validated for use in similar settings(Cholera et al., 2014; Gelaye et al., 2013, 2016; Sweetland et al., 2014a).

Anxiety. The Generalized Anxiety Disorder-7 (GAD-7) questionnaire is a 7-item scale assessing the symptoms of anxiety. Each item is scored on a 4-point Likert scale ranging from “0” (not at all) to “3” (nearly every day)(Adjorlolo, 2019; Chibanda et al., 2016; Manzar et al., 2021; Mughal et al., 2020; Nyongesa et al., 2020). This tool uses the same standardized symptom severity categorizations as are used for the PHQ-9. This questionnaire is validated for use in similar settings(Manzar et al., 2021; Nyongesa et al., 2020; Sweetland et al., 2014a).

Trauma and posttraumatic stress. The Primary Care Post-Traumatic Stress Disorder screener (PC-PTSD-5) is a validated questionnaire that was used to assess the presence of lifetime trauma and subsequent symptoms of posttraumatic stress (Mughal et al., 2020; Prins et al., 2016; *The Prevalence of Posttraumatic Stress Disorder in Primary Care: A Systematic Review - PubMed*, n.d.). Participants who reported a traumatic event were screened for the five symptoms of posttraumatic stress disorder (PTSD). A score of ≥3 indicated a possible PTSD (Prins et al., 2016). Traumatic events were categorized based on previously reported trauma episode type (Kessler et al., 2017).

Alcohol and other substance use. The Alcohol, Smoking and Substance Involvement Screening Test (ASSIST) questionnaire is a World Health Organization (WHO) -developed assessment tool for unhealthy alcohol or other drug use in adults. ASSIST explores the use of ten substances: tobacco, alcohol, cannabis, cocaine, amphetamine-type stimulants, inhalants, sedatives, hallucinogens, opioids, and other drugs. A risk score is provided for each substance, and scores are grouped into 'low risk' (score <11 for alcohol and <4 for other substances), 'moderate risk,' (score between 11-26 for alcohol, and 4-26 for all other drugs), or 'high risk' (score ≥ 27 for all substances)(Chibanda et al., 2016; Humeniuk et al., 2010; van der Westhuizen et al., 2016). This questionnaire has been widely used in clinical practice and research settings across Africa (Humeniuk et al., 2010; van der Westhuizen et al., 2016).

Mental health care needs and access to services. The need and use of care services was determined using a questionnaire adapted from the World Mental Health Surveys(Alonso et al., 2018). Participants who reported moderate/severe MH symptoms (i.e., on the PHQ-9, GAD-7, or PC-PTSD) or moderate/severe SU symptoms (at least 11-26 for alcohol, and 4-26 for all other drugs on the ASSIST) were asked whether they felt they needed professional treatment for their reported symptoms/behaviors (“awareness gap”), whether they actually had access to care (“treatment gap”), and who provided the care. “Care” was conceptualized broadly, and response options included: specialized/general medical (psychiatric nurse, social worker, doctor, or nurse), complementary alternative medical (traditional healer), non-medical professional (religious or spiritual advisor), trained lay health worker (village

health worker, lay counsellor, or similar), support provided by a close friend or family member (non-trained), and support provided by other community member (non-trained). Response options to capture access to specific treatment were as follows: medication, talk therapy, or other. To construct the MH and SU care cascades, we included all participants who reported moderate/severe MH or moderate/severe SU problems. This included participants who scored ≥10 in the PHQ-9 and GAD-7, or ≥ 3 in the PTSD-PC questionnaires, and participants who reported thoughts of suicide. For the SU cascade participants who scored ≥ 10 for alcohol and ≥ 4 for all other substances using the ASSIST questionnaire were included. We excluded participants who did not have information across all the steps in the cascade.

Statistical analysis

Participants characteristics are summarized as frequency (CI) or median with interquartile range (IQR). We provide 95% Wald confidence interval the prevalence of moderate/severe depression and anxiety symptoms, PTSD, suicidal ideation, and alcohol and cannabis use. We report odds ratios (OR) with 95% CI derived from univariable and multivariable logistic regression models to assess sociodemographic correlates in participants who had considered accessing services for the reported conditions. Statistical analyses were performed with Stata (version 16.1, College Station, Tex: StataCorp LP, 2007).

Results

In the 120 clusters, the teams visited 3485 households with 6061 consenting adult participants who were 18 years or older. Fully documented results are available in 5699, 6048, 5809, and 6054 participants for PHQ-9, GAD-7, and PTSD-PC, respectively. A total of 6057 and 6052 results are available in ASSIST-alcohol and ASSIST-cannabis, respectively (figure 1).

Table 1 provides the characteristics of 6061 study participants. A total of 52.2% (3164/6061) were females. Half of all participants lived in urban or peri-urban settings. The median age of participants was 39 years (IQR 27-58 years). Most were married or in a stable relationship and had obtained at least primary school education. About half of the participants reported having a regular income-generating activity. A total of 48.9% (2962/6061) participants did not have a source of regular income, and of them 72.0% (2132/2962) were women. Regarding comorbidities, a total of 15.2% (924/6061) participants reported to be living with HIV, 21.6% (1308/6061) had arterial hypertension, and 4.8% (291/6061) had diabetes mellitus.

Prevalence of MH and SU symptoms

The prevalence estimates, disaggregated by sex, settlement (urban vs rural), and self-reported HIV status are presented in table 2. Using a cutoff score of ≥10, indicating moderate/severe symptoms (usually

taken to indicate clinical levels of depression or anxiety), 1.7% (95% CI 1.4-2.1%; 98/5699) participants and 0.7% (95% CI 0.5-0.9%; 43/6048) participants reported these depression and anxiety symptoms, respectively. Suicidal thoughts were reported by 0.8% (95% CI 0.6-1.1%; 47/5699) participants. Amongst them, the median age was 41 years (IQR 27-51 years), 63.8% (30/47) were women, 65.9% (31/47) lived in urban areas and 23.4% (11/47) had reported to live with HIV. A total of 18.5% (1121/6054) participants reported at least one traumatic experience in their lifetime and 4.2% (95% CI 3.6-4.7%; 252/6054) participants screened positive for PTSD. Overall, 1362 traumatic experiences were reported (Supplementary Table 1), representing an average of 1.21 events per participant who reported these events. The most frequent event reported was related to "unexpected death of a loved one" (40.2%), followed by "life threatening accident" (21.7%), "witnessing trauma in others" (12.6%), or being victims of physical violence (10.9%). A total of 4.3% participants reported conflict-related trauma, linked to "blanket wars", a specific source of very violent episodes between tribal groups, involving especially men, in Lesotho. Life threatening accidents, physical violence, and conflict-related events were more frequently reported by men, whereas traumatic events related to the unexpected death of a loved one was more frequently reported by women.

In relation to SU problems (table 2), alcohol was the most commonly used substance, with 26.0% (1579/6057) participants reporting consumption in the previous three months and 11.7% (707/6057) participants reporting weekly/daily use of alcohol. Among the participants who reported alcohol use in the previous three months, 36.4% (95% CI 33.9-38.6%; 572/1579) scored moderate-high risk of use, of which 81.6% (95%CI 78.5-84.8%; 467/572) were men. With regards to other substances, cannabis was the second most commonly reported substance used. Overall, 4.4% (267/6052) participants reported consumption of cannabis during their lifetime and 4.1% (248/6052) had consumed during the previous three months. Among the participants who reported use of cannabis in the previous three months, 93.5% (95% CI 90.5-96.6%; 232/248) scored moderate/high risk of use, and 98.7% (95%CI 97.3-100.0%, 229/232) were men. We found similar levels of use of alcohol, cannabis, or other drugs were similar in people living in urban/peri-urban or rural settings or people living with and without HIV. Use of other drugs, such as cocaine, amphetamines, inhalants, sedatives, hallucinogens, or opioids was very scarcely reported in this population (supplementary table 2).

Overall, 7.2% (95%CI 6.6-7.9, 438/6061) participants reported problems related to two or more conditions. Participants living in urban areas reported MH or SU problems more frequently than participants living in rural areas. Similarly, men reported MH or SU problems more frequently than in women, mainly driven by alcohol use and PTSD.

Mental health care cascade

Figure 2 displays the MH and SU cascades and unmet gap for health services affecting this population. A total of 367 and 768 participants with full information in the MH and SU cascade were included. In the MH cascade, 38% (139/367) participants had felt the need for treatment, 18,5% (68/367) had accessed (any kind of) care in the previous 12 months, and 9,2% (34/367) obtained health care services from a professional health worker. In the SU cascade, 11% (84/768) participants had considered that they needed professional treatment, 5% (38/768) accessed services, and 3% (20/768) had received services from a professional health care worker.

Risk factors associated with MH and SU health service seeking behavior

Table 3 shows the sociodemographic factors associated with participants reporting moderate/severe MH or SU problems, who had considered accessing services. Elder participants had lower odds of having considered access to care for moderate/severe MH problems (aOR=0.61, 95% CI 0.38-0.98). Participants living in urban settings had higher odds of having considered seeking services for their problem (aOR= 2.40, 95% CI 1.37-4.21).

Discussion

This study reports for the first time the community-based prevalence of a wide number of MH and SU problems in adults living in two primarily rural districts in Lesotho. A total of 6% and 13% participants reported MH and SU moderate/severe risk symptoms, respectively. Moderate/severe symptoms of depression and anxiety were reported by approximately 1% of the participants. The most frequently reported MH problems were symptoms consistent with PTSD. Lifetime rates of trauma were reported in about one in five participants, more frequently in men. We found equally frequent, but not significantly different rates of MH symptoms among adults who reported to be living with HIV and the rest of the participants. Moderate/severe risk SU problems were mostly related to the use of alcohol and cannabis, with one in six participants reporting moderate- or high-risk SU consumption, more frequently in men than in women.

Data on depression prevalence in the sub-Saharan region is scarce due to underdiagnosis and underreporting, however, estimates for depression are around 4% in the general population, with great variations across cultures, and contexts(Gbadamosi et al., 2022; Peltzer & Phaswana-Mafuya, 2013; Sweetland et al., 2014b). A recent systematic review on prevalence of PTSD in sub-Saharan Africa reported an overall pooled prevalence of probable PTSD of 22% (95% CI 13%–32%). Conflict-unexposed regions had a pooled prevalence of probable PTSD of 8% (95% CI 3%–15%), while conflict-exposed regions had a pooled prevalence of probable PTSD of 30% (95% CI 21%–40%); and there was no significant difference in the pooled prevalence of PTSD for men and women(Ng et al., 2020). Our

study provides the first measure of trauma and PTSD in Lesotho. We found lower rates of reported trauma event (18.5%) and probable PTSD (4.2%) than the review reported for conflict-unexposed regions, with men reporting trauma more frequently than women.

Suicide ideation was more frequently reported by women, however, our prevalence of approximately 1% contrasts with international recent estimates of 7%, that have triggered action to mitigate the "Lesotho suicide crisis"(*Lesotho Tops Global Suicide Charts*, n.d.; *Suicide Mortality Rate (per 100,000 Population) - Lesotho | Data*, n.d.; Smith, 2022). Our study found no difference in the substances most commonly used, compared with previous estimates in Lesotho. By 2016, alcohol (together with nicotine) was the most commonly used substance in the country(Degenhardt et al., 2018). In 2012, heavy episodic drinking (men who had 5 or more / women who had 4 or more drinks on any day in the past 30 days) was reported in 34.5% of men and 9.4% in women(*Alcohol Consumption: Levels and Paterns Lesotho*, n.d.; *Lesotho_2012_STEPS_fact_sheet.Pdf*, n.d.; Mahlomaholo et al., 2021) and estimates by 2018 revealed that people older than 15 years consumed an average of 4.6 litres of pure alcohol per year, in contrast to the 2019 world average of 5.8 litres(*Alcohol, Total per Capita (15+) Consumption (in Litres of Pure Alcohol) (SDG Indicator 3.5.2)*, n.d.)·(*Total Alcohol Consumption per Capita (Liters of Pure Alcohol, Projected Estimates, 15+ Years of Age) - Lesotho | Data*, n.d.). Our study found that consumption of cannabis has increased in Lesotho compared to data in 2009(*Cannabis in Africa*, n.d.; *Cannabis in Lesotho: A Preliminary Survey - UNESCO Digital Library*, n.d.-b; "Drug Abuse Rife in Lesotho," 2009), and consumption of other substances is sporadic.

A second major finding of this study is the very important unmet need of mental health care among those reporting MH and/or SU symptoms. The treatment gap in mental health has been typically framed as a result of shortages in either the supply side (i.e., services are available), rather than on the supply side (i.e., services are in demand)(Roberts et al., 2022). However, the World Mental Health Surveys(Andrade et al., 2014) found that the lack of perceived need for treatment has been, by far, the most frequent reason for not seeking services in mental health globally, and most importantly affects substance use problems(Nadkarni et al., 2022). Our results showed that only one in three participants who reported moderate-severe mental health problems, and one in ten participants who reported moderate-high risk for alcohol and cannabis had felt (considered) to approach the health system to receive services for their symptoms. This data supports the hypothesis that in Lesotho, in addition to the very low availability of mental health services, many adults who fall in the treatment gap, do not want health services for their problems. The factors at individual and system's level that contribute to this low demand for mental health services in this and similar settings warrant investigation.

Nonetheless, when participants obtained care for MH or SU problems in this setting, they accessed a mix of professionals in both formal and informal sectors. Approximately half of these participants accessed services from a non-professional provider, including traditional healers, religious or spiritual

advisors, village health workers, lay counsellors, close friends, family members or other community members.

This could be an indication that services for MH and SU conditions could be successfully shared across different cadre of health professionals, using task-shifting or task-sharing strategies(Adepoju, 2020; Charlson et al., 2014; Galvin & Byansi, 2020).

This survey collected data during November 2021 to August 2022, in a period when the communities in Lesotho were exposed to the negative impacts of the COVID-19 pandemic(Katende et al., 2022). Severe disruptions of health care, uncertainty for the future, fear and stigma, and social restrictions impacted the lives of people globally(Amu et al., 2022; Assefa et al., n.d.; *COVID-19 Has Caused Major Disruptions and Backlogs in Health Care, New WHO Study Finds*, n.d.; Getzzg, 2022). In Lesotho additional effects of the pandemic included closure of business and borders, which reduced the income and remittances for thousands of households, decreased access to basic goods, and increased gender-based violence("Africa," 2022; *COVID-19 Lock down Exacerbates Gender Based Violence Cases in Lesotho*, 2020; *Lesotho-Covid-Relief-Progress-Report446.Docx.Pdf*, n.d.; *Strong Post-COVID-19 Economic and Social Systems in Lesotho*, n.d.). Our study was not set to specifically investigate pandemic-related effects in the mental health of this population, but surprisingly, we did not encounter frequent references to COVID-19 impacting the narrative of the respondents during data collection(Assefa et al., 2023; Chen et al., 2021; Molebatsi et al., 2021; Oyat et al., 2022; Semo & Frissa, 2020; Wang et al., 2023).

There are some limitations to consider when interpreting these findings. The frequency of reporting symptoms could be affected by recall bias, and especially by the social and personal stigma associated with anxiety, depression, suicidal ideas, trauma, or use of substances. Despite that we used validated questionnaires to collect information, these may not be culturally adapted and may have contributed to the underreporting of symptoms. Additionally, the findings related to HIV cannot be fully extrapolated as we considered a participant living with HIV after they self-reported this condition or found the information in their health card. In our sample, we recorded a lower prevalence of HIV (15%) than the statistics reported by UNAIDS in 2022, (*Lesotho*, n.d.-b). Finally, data were collected from adults who were available in the household and consented to participate in the survey on the day that the survey team collected the data. Respondents who were not present in the household (migrants, workers) or were institutionalized (prison, hospital) were not included, which could influence the estimates of MH or SU symptoms.

Conclusion

This is the first study to quantify and describe the distribution of MH and SU symptoms at community level in Lesotho. We found a lower prevalence of moderate/severe problems than similar settings, nonetheless we found a significant gap in awareness of the need for services in individuals, as well as a large treatment gap in the availability of services. To mitigate this burden, investments must focus on the design provision of interventions for the most prevalent conditions, such as trauma or alcohol use and the training of providers (specialist and non-specialist) to provide them. Public health efforts can also work to increase awareness of such problems in the population with significant risk. Finally, there is a need to develop culturally adapted tools and informed interventions for MH and SU services in Lesotho.

Author Contributions

LGF, EF, NDL and JMB conceptualized the study and design. LGF, TL, and FC performed data analysis and summarization. LGF and JMB drafted the manuscript. All authors commented and provided edits to the manuscript. All authors reviewed the results and approved the final version of the manuscript.

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Patient and public involvement

This survey is part of the Community-based chronic care project Lesotho (ComBaCaL). It was designed together with the ComBaCaL steering committee that includes a community representative, as well as representatives from the Ministry of Health of Lesotho. The survey was discussed with local authorities (village chiefs, local Ministry of Health), who were engaged throughout the survey.

Ethics

All procedures were carried out in line with the ethical standards laid out in the Declaration of Helsinki. Participants received information on the clinical procedures in Sesotho and gave written informed consent. Those participants who were illiterate gave consent by thumbprint and a witness signature. Once the informed consent process was completed, a signed copy of the form was retained by study staff and a copy was given to participants. This study was reviewed by the Ethics Committee Northwest and Central Switzerland (ID AO_2021-00056) and approved by the National Health Research Ethics Committee in Lesotho (ID139-2021).

Availability of data and materials

If the manuscript is accepted, we will deposit an anonymized dataset with key data presented in the manuscript on zenodo.org

Competing interests

The authors declare no conflicts of interest

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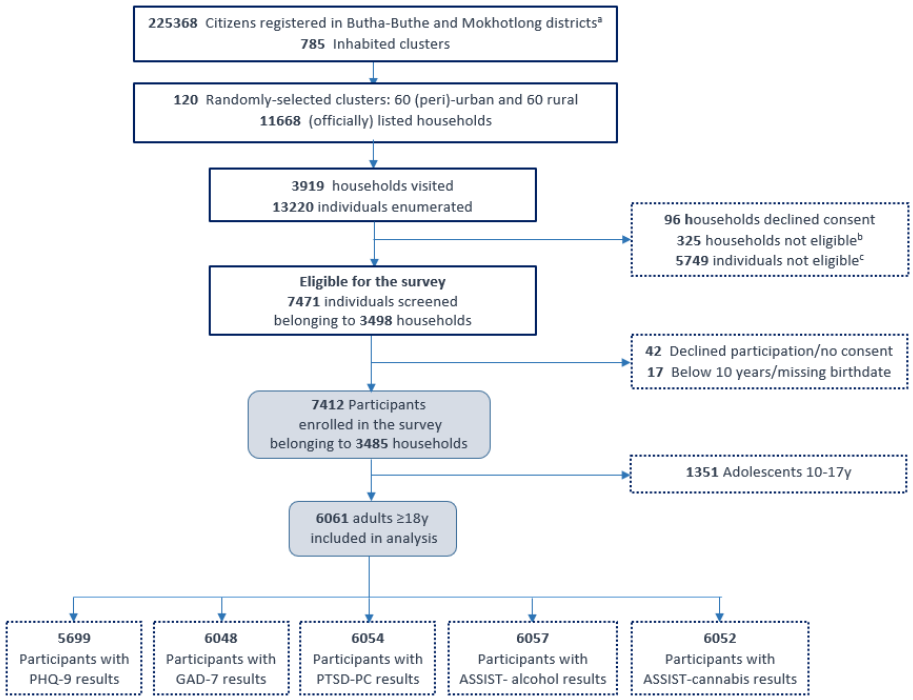
Figure 1. Study flow



[a] Lesotho - Subnational Population Statistics-UNFPA: https://data.humdata.org/dataset/cod-ps-lso
[b] Had no participants who were eligible for survey
[c] Individuals were enumerated but not present at the time of the survey or were not eligible
[d] Individuals included had information in all four steps of the care cascades
Acronyms: PHQ-9: Patient Health Questionnaire-9, GAD-7: The Generalized Anxiety Disorder-7 questionnaire, PC-PTSD-5The Primary Care Post-Traumatic Stress Disorder screener, ASSIST: The Alcohol, Smoking and Substance Involvement Screening Test

Table 1. Demographic and clinical characteristics of study participants

	Females N(%)	Males N(%)	Total N(%)
Total participants	3164 (52.2)	2897(47.8)	6061 (100)
Setting			
(Peri-)urban	1662 (52.5)	1501 (51.8)	3163 (52.2)
Rural	1502 (47.5)	1396 (48.2)	2898 (47.8)
Age (years)			
Median IQR	39 (26-59)	40 (27-57)	39 (27-58)
<30 years	1075 (34.0)	864 (29.8)	1939 (32.0)
≥30 years	2089 (66.0)	2033 (70.2)	4122 (68.0)
Marital status			
Married/ in a relationship	1813 (57.3)	1730 (59.7)	3543 (58.4)
Single/widowed/divorced	1348 (42.6)	1165 (40.2)	2513 (41.5)
Missing	3 (0.1)	2 (0.1)	5 (0.1)
Educational level			
No schooling	153 (4.8)	460 (15.9)	613 (10.1)
Primary school	1476 (46.7)	1349 (46.6)	2825 (46.7)
Secondary	1315 (41.6)	864 (29.8)	2179 (35.9)
Tertiary	219 (6.9)	224 (7.7)	443 (7.3)
Missing	1 (<.1%)	0	1 (<.1%)
Employment status			
Working	1016 (32.1)	2059 (71.1)	3075 (50.7)
Not working	2132 (67.4)	830 (28.6)	2962 (48.9)
Missing	16 (0.5)	8 (0.3)	24 (0.4)
Comorbidities			
Current use of tobacco	344 (10.9)	1167 (40.3)	1511 (25.0)
Hypertension	858 (27.2)	450 (15.5)	1308 (21.6)
Diabetes	211 (6.7)	80 (2.8)	291 (4.8)
HIV positive (self-reported)	582 (18.4)	342 (11.8)	924 (15.2)
Pregnancy (self-reported)	99 (3.1)	NA	NA

IRQ: Interquartile range

Table 2. Mental health and substance use symptoms, disaggregated by sex, settlement, and reported HIV status

	Sex		Settlement		Reported HIV status		
	Females N(%)	Males N(%)	Rural N(%)	Urban N(%)	HIV negative N(%)	HIV positive N(%)	Total
Depression- PHQ-9 (total)	**2962**	**2737**	**2734**	**2965**	**4844**	**855**	**5699**
Median score (IQR)	1 (0-3)	0 (0-2)	0 (0-2)	1 (0-3)	0 (0-2)	1 (0-3)	0 (0-2)
Minimum risk	2571 (86.8)	2436 (89.0)	2437 (89.1)	2570 (86.7)	4294 (88.7)	713 (83.4)	5007 (87.9)
Low risk	329 (11.1)	265 (9.7)	266 (9.7)	328 (11.1)	476 (9.8)	118 (13.8)	594 (10.4)
Moderate or high-risk	62 (2.1)	36 (1.3)	31 (1.2)	67 (2.2)	74 (1.5)	24 (2.8)	98 (1.7)
Suicidal thoughts	30 (1.0)	17 (0.6)	16 (0.5)	31 (1.0)	36 (0.7)	11 (1.2)	47 (0.8)
Anxiety- GAD-7 (total)	**3157**	**2891**	**2894**	**3154**	**5125**	**923**	**6048**
Median score (IQR)	0 (0-2)	0 (0-1)	0 (0-1)	0 (0-2)	0 (0-2)	1 (0-2)	0 (0-2)
Minimum risk	2953 (93.5)	2706 (93.6)	2735 (94.5)	2924 (92.7)	4808 (93.8)	851 (92.2)	5659 (93.6)
Low risk	177 (5.6)	169 (5.8)	147 (5.1)	99 (6.3)	280 (5.5)	66 (7.1)	346 (5.7)
Moderate or high-risk	27 (0.9)	16 (0.6)	12 (0.4)	31 (1.0)	37 (0.7)	6 (0.7)	43 (0.7)
Post-traumatic stress- PTSD-PC (total)	**3162**	**2892**	**2897**	**3157**	**5131**	**923**	**6054**
Median score (IQR)	1 (0-2)	1 (0-2)	1 (0-2)	1 (0-2)	1 (0-2)	1 (0-3)	1 (0-2)
Reported lifetime trauma	543 (17.2)	578 (20.0)	482 (16.6)	639 (20.2)	918 (17.9)	203 (22.0)	1121 (18.5)
Moderate or high-risk	117 (3.7)	135 (4.7)	102 (3.5)	150 (4.7)	199 (3.9)	53 (5.7)	252 (4.2)
Alcohol use- ASSIST (total)	**3159**	**2888**	**2894**	**3153**	**5125**	**922**	**6057**
Lifetime use	461 (14.6)	1267 (43.8)	727 (25.0)	1001 (31.6)	1452 (28.2)	276 (29.9)	1728 (28.5)
Any use[b]	385 (12.2)	1194 (41.3)	667 (23.0)	912 (28.9)	1328 (25.9)	251 (27.2)	1579 (26.1)
Daily/weekly use[b]	117 (3.7)	590 (20.4)	292 (10.1)	415 (13.1)	603 (11.8)	104 (11.3)	707 (11.7)
Low risk[b]	279 (72.7)	721 (60.7)	436 (65.5)	564 (62.2)	829 (62.7)	171 (68.4)	1000 (63.6)
Moderate/high risk[b]	105 (27.3)	467 (39.3)	230 (34.5)	342 (37.8)	493 (37.3)	79 (31.6)	572 (36.4)
Cannabis use- ASSIST (total)	**3162**	**2890**	**2895**	**3157**	**5130**	**922**	**6052**
Lifetime use	8 (0.2)	259 (9.0)	104 (3.6)	163 (5.1)	238 (4.6)	29 (3.1)	267 (4.4)
Any use[b]	3 (0.1)	245 (8.5)	98 (3.4)	150 (4.7)	222 (4.3)	26 (2.8)	248 (4.1)
Daily/weekly use[b]	2 (0.1)	185 (6.4)	72 (2.5)	115 (3.6)	168 (3.3)	19 (2.1)	187 (3.1)
Low risk[b]	0 (0.0)	16 (6.5)	8 (8.2)	8 (5.3)	14 (6.3)	2 (7.7)	16 (6.4)
Moderate/high risk[b]	3 (100)	229 (93.5)	90 (91.8)	142 (94.7)	208 (93.7)	24 (92.3)	232 (93.5)

PHQ-9: Patient Health Questionnaire-9; GAD-7: General Anxiety Disorder-7; IRQ: Interquartile range; PTSD-PC: Primary Care post-traumatic stress disorder screen; ASSIST: the alcohol, smoking and substance involvement screening test.

[b] During the previous three months.

Supplementary table 1. Reported trauma events in 1121 study participants, disaggregated by sex, in two districts in Lesotho

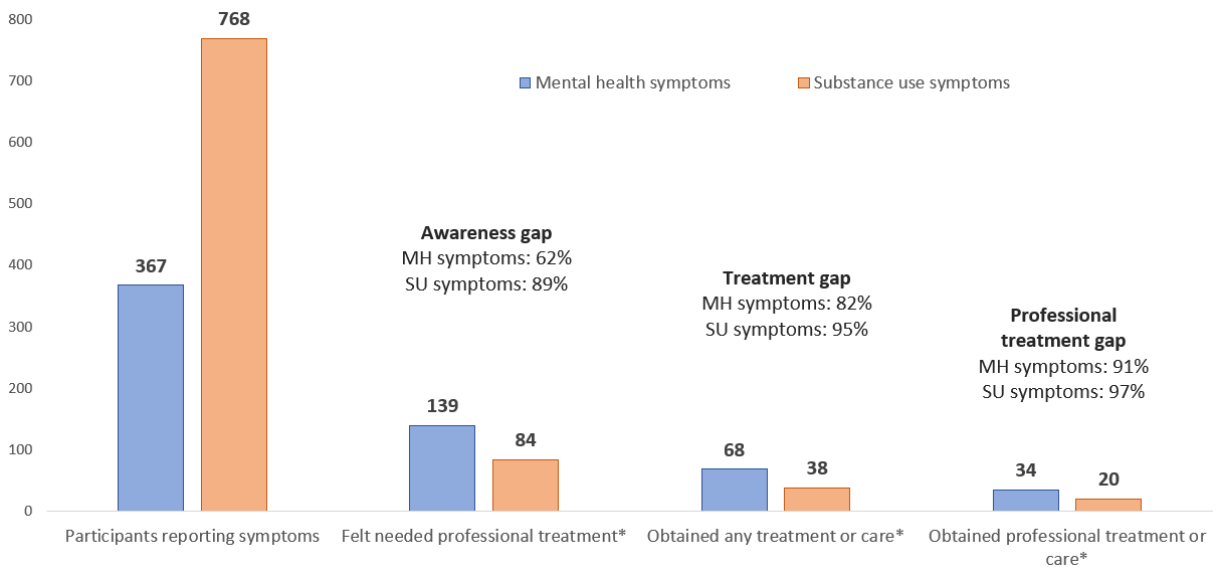
Traumatic event	Female N (%)	Male N (%)	Total N (%)
Unexpected death of a loved one	320 (51.3)	227 (30.7)	547 (40.2)
Own life-threatening accident	111 (17.8)	185 (25.1)	296 (21.7)
Witnessing trauma in others	69 (11.0)	102 (13.8)	171 (12.6)
Physical violence	46 (7.4)	103 (13.9)	149 (10.9)
Conflict related trauma	10 (1.6)	48 (6.5)	58 (4.3)
Intimate partner violence	27 (4.3)	13 (1.8)	40 (2.9)
Other *	35 (5.7)	56 (7.6)	91 (6.7)
Prefer not to answer	6 (0.9)	4 (0.6)	10 (0.7)
Total number of events[a]	**624**	**738**	**1362**

[a] Some participants reported more than one event. *Other: includes other events not included in the main categories

Supplementary table 2. Consumption of other illicit drugs in a sample of 6061 survey participants in Lesotho, disaggregated by sex

N=6061	Females N(%)	Males N(%)	Total N(%)
Cocaine			
Lifetime use	2 (0.1)	5 (0.2)	7 (0.1)
Last 3 months use	0 (0.0)	2 (0.1)	2 (0.0)
Amphetamines			
Lifetime use	0(0.0)	2 (0.1)	2 (0.0)
Last 3 months use	0 (0.0)	2 (0.0)	2 (0.0)
Inhalants			
Lifetime use	2 (0.1)	4 (0.1)	6 (0.1)
Last 3 months use	0 (0)	2 (0.0)	2 (0.00)
Sedatives			
Lifetime use	15 (0.5)	2 (0.0)	17 (0.3)
Last 3 months use	10 (0.3)	1 (0.0)	11 (0.1)
Hallucinogens			
Lifetime use	1 (0.0)	2 (0.1)	3 (0.0)
Last 3 months use	0 (0.0)	1 (0.0)	1 (0.0)
Opioids			
Lifetime use	0 (0.0)	1 (0.0)	1 (0.0)
Last 3 months use	0 (0.0)	0 (0.0)	0 (0.0)

Figure 2. Cascades of care for mental health and substance use problems in adults living in two districts in Lesotho. A total of 367 and 768 participants reporting moderate- or high-risk symptoms and with full information in all elements of the cascades are included.



*Among participants reporting moderate or severe symptoms

Table 3. Factors associated with participants reporting moderate mental health or substance use problems who considered accessing services and socio-demographic factors

	Moderate/severe mental health symptoms risk Observations=367		Moderate/severe substance use symptoms risk Observations=768	
	OR (95%CI)	aOR[$] (95%CI)	OR (95%CI)	aOR[$] (95%CI)
Sex (female)	0.93 (0.61-1.42)	0.82 (0.51-1.30)	0.38 (0.78-2.45)	1.22 (0.66-2.24)
Age group				
<30y	Reference	Reference	Reference	Reference
≥ 30y	**0.54 (0.34-0.84)**	**0.61 (0.38-0.98)**	1.34 (1.13-1.59)	0.69 (0.41-1.18)
Stable relationship				
No	Reference	Reference	Reference	Reference
Yes	**0.63 (0.41-0.97)**	0.67 (0.43-1.05)	**0.62 (0.38-0.99)**	0.88 (0.54-0.42)
Employment/income				
No	Reference	Reference	Reference	Reference
Yes	1.48 (0.97-1.26)	1.39 (0.87-2.23)	1.35 (0.84-1.16)	1.21 (0.73-2.01)
Settlement				
Rural	Reference	Reference	Reference	Reference
Urban	1.35 (0.87-2.09)	1.58 (0.95-2.62)	**2.20 (1.20-1.64)**	**2.40 (1.37-4.21)**
HIV Infection (reported)				
No/unknown	Reference	Reference	Reference	Reference
Yes	1.04 (0.63-1.74)	1.27 (0.73-2.20)	1.01 (0.51-1.97)	1.04 (0.52-2.09)
Household wealth				
Q1	0.73 (0.38-1.41)	0.67 (0.34-1.34)	0.70 (0.36-1.38)	0.59 (0.30-1.19)
Q2	1.26 (0.66-2.40)	1.24 (0.64-2.41)	0.54 (0.26-1.12)	0.51 (0.27-1.19)
Q3	Reference	Reference	Reference	Reference
Q4	0.55 (0.28-1.08)	**0.44 (0.21-0.92)**	0.69 (0.34-1.38)	0.48 (0.23-1.01)
Q5	0.84 (0.43-1.66)	0.72 (0.34-1.53)	0.80 (0.40-1.60)	0.52 (0.25-1.08)

[$] model adjusted for sex, age, marital status, employment/income, settlement, reported HIV infection and household wealth

Significant associations are shown in bold

OR: odds ratios; CI: confidence interval

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RESEARCH Open Access

Community-based care models for arterial hypertension management in non-pregnant adults in sub-Saharan Africa: a literature scoping review and framework for designing chronic services

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Abstract

Background: Arterial hypertension (aHT) is the leading cardiovascular disease (CVD) risk factor in sub-Saharan Africa; it remains, however, underdiagnosed, and undertreated. Community-based care services could potentially expand access to aHT diagnosis and treatment in underserved communities. In this scoping review, we catalogued, described,and appraised community-based care models for aHT in sub-Saharan Africa, considering their acceptability, engagement in care and clinical outcomes. Additionally, we developed a framework to design and describe service delivery models for long-term aHT care.

Methods: We searched relevant references in Embase Elsevier, MEDLINE Ovid, CINAHL EBSCOhost and Scopus. Included studies described models where substantial care occurred outside a formal health facility and reported on acceptability, blood pressure (BP) control, engagement in care, or end-organ damage. We summarized the interventions' characteristics, effectiveness, and evaluated the quality of included studies. Considering the common integrating elements of aHT care services, we conceptualized a general framework to guide the design of service models foraHT.

Results: We identified 18,695 records, screened 4,954 and included twelve studies. Four types of aHT care models were identified: services provided at community pharmacies, out-of-facility, household services, and aHT treatment groups. Two studies reported on acceptability, eleven on BP control, ten on engagement in care and one on end- organ damage. Most studies reported significant reductions in BP values and improved access to comprehensive CVDs services through task-sharing. Major reported shortcomings included high attrition rates and their nature as parallel, non-integrated models of care. The overall quality of the studies was low, with high risk of bias, and most of the studies did not include comparisons with routine facility-based care.

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Conclusions: The overall quality of available evidence on community-based aHT care is low. Published models of care are very heterogeneous and available evidence is insufficient to recommend or refute further scale up in sub- Sahara Africa. We propose that future projects and studies implementing and assessing community-based models for aHT care are designed and described according to six building blocks: providers, target groups, components, location,time of service delivery, and their use of information systems.

Keywords: Arterial hypertension, Hypertension treatment, Cardiovascular disease, Implementation research, Community-based care, Out-of-facility care, Non-communicable diseases, Chronic diseases, Chronic care services,Models of care, Health systems, Sub-Saharan Africa

Background and aim

The World Health Organization (WHO) defines aHT as a persistent systolic blood pressure (SBP) ≥ 140 mmHg or diastolic BP (DBP) ≥ 90 mmHg. An estimated 1.28 billion adults aged 30–79 years worldwide have aHT, two-thirds of them living in low- and middle-income countries. Modifiable risk factors include unhealthy diets (excessive salt consumption, saturated fat and trans fats, low intake of fruits and vegetables), physical inactivity, consumption of tobacco and alcohol, and overweight or obesity. Non-modifiable risk factors include a family history of aHT, age over 65 years, and co-existing diseases such as diabetes or kidney disease. aHT is the largest modifiable cardiovascular risk factor (CVRF) globally and the leading cause of the 22.9 million deaths attributed to cardio-vascular diseases (CVDs) each year in sub-Saharan Africa [1–3].

Prevalence of aHT is highest in the African region, where an estimated 27% of the population aged 30–79 years have aHT [4]. However, despite an increasing burden of CVDs, aHT awareness, diagnosis, treatment and control remain low [5–8]. Barriers to aHT control exist at patient and health system levels [9, 10]. Major challenges for people living with aHT relate to the asymptomatic nature of the condition, leading to a delayed diagnosis and treatment initiation. Once diagnosed, aHT requires lifelong lifestyle modifications, frequent medical check-ups, ongoing counselling and regular adaptation of treatment dosage or drug regimen [9, 11]. Regional health systems remain poorly adapted to provide comprehensive CVD care, with insufficiently trained, equipped and supported workforce, limited availability of treatment options, and infrequent or non-existing monitoring of treatment outcomes, such as BP control and end-organ function [8, 12].

As aHT is a prevalent, chronic and, often, asympto-matic health condition, successful care models must be easy to access and provide long-term medical follow-up [13–16]. Community-based health services have been proposed as solutions to bridge existing barriers in access and to scale up services for aHT [17–19]. These care models frequently promote task-shifting/sharing, simplification of clinical care algorithms and integration of other services [20–25]. Although the terms task shift- ing and task sharing are sometimes used interchangeably, task shifting is defined as a systematic and planned trans- fer of care duties from physicians to non-physicians, such as nurses, or community health workers [26], whereastask sharing describes professionals working together to deliver health services. In practice, this implies that when physicians are not available, care tasks must be shifted to non-physician workers for the health system to function. When a few physicians are available, tasks may be shared with other health-care professionals with some supervision or referral to physicians [27, 28].

To date, community-based and out-of-facility care models have been applied to scale up treatment for HIV and tuberculosis (TB), with different success [29–35]. However, currently, there is no consensus nor guidance on how such models should be structured to have substantial impact in aHT care. Similarly, evidence to understand how, and to what extent tasks could be shifted to lower cadre health care providers, and how services could be decentralized is lacking. A preliminarysearch of MEDLINE, the Cochrane Database of Systematic Reviews and the Joanna Briggs Institute (JBI) Evidence Synthesis revealed no systematic reviews or similarscoping reviews on this topic. To inform future research, public health programs, and policies, this literature scoping review aims to catalogue the existing community-based aHT care models for non-pregnant adults in sub-Sahara Africa.

Methods

We chose a scoping review methodology to provide an overview and a categorization of existing knowledge, rather than a narrow synthesis of a predefined research question. Typically, scoping reviews are used to map the key concepts that underpin a field of research, as well as to clarify working definitions, and/or the conceptual boundaries of a topic. In this scoping review, the authors explore the breadth of the literature, map and summarize the evidence, and inform future research in the topic [36]. We followed the framework proposed by Arksey

Table 1 Study inclusion and exclusion criteria

FIELD	INCLUSION CRITERIA	EXCLUSION CRITERIA
POPULATION	Non-pregnant adults ≥18 years diagnosed for aHT Any gender	
GEOGRAPHIC REGION	sub-Saharan Africa, which includes the following countries: Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Central African Republic, Chad, Congo, Cote d'Ivoire, Equatorial New Guinea, Eritrea, Ethiopia, eSwatini, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritania, Mauritius, Mozambique, Namibia, Niger, Nigeria, Rwanda, Senegal, Sierra Leone, Seychelles, Somalia, South Africa, Sudan (North, South), United Republic of Tanzania, Togo, Uganda, Zaire, Zambia, Zimbabwe	Studies conducted outside the sub-Saharan region
INTERVENTION/MODEL OF CARE AND OUTCOMES	Medical management and treatment for aHT, including health promotion strategies, self-care, and screening of complications, that differs from standard, facility-based or conventional care in terms of provider cadre, location, or frequency Studies that report at least one of the following outcomes: •Acceptability •Blood pressure control •Engagement in care •End-organ damage	Report solely about standard or conventional, facility-based model for delivering treatment Description does not describe the main characteristics needed to define the model Unable to provide sufficient description of at least oneoutcome of interest
SECTOR	Services provided in the public sector through government-managed public health infrastructure or through private or non-governmental programs or facilities that serve the uninsured sector	Services or programs for privately (commercially) insured patients
TYPE OF STUDIES	Peer-reviewed studies that provide the necessary data to assess at least one of the outcomes of interest, including prospective cohort studies, case control studies, randomized controlled trials, letters to editors, and qualitative studies on the topic	Treatment guidelines, mathematical models, conference abstracts that have not resulted in a peer-reviewed publication, editorials, viewpoints, commentaries. case reports, and systematic reviews
LANGUAGE	No limits	None
STUDY DATE	No limits	None

and O'Malley [37], further developed by Levac et al. [38] and the Joanna Briggs Institute [39]. The protocol has been published [40]. Our primary objective is to construct a framework to categorize these aHT care models. Secondary objectives include: 1) to appraise the models of care, in terms of acceptability, BP control, engagement in care, and occurrence of end-organ damage, 2) to describe within-study comparisons between community-based and facility-based models of care, if providedby authors and 3) to identify gaps in the literature with respect to community-based service models for aHT.

We included studies in which participants were non-pregnant adults ≥ 18 years, diagnosed with aHT and living in sub-Saharan Africa. A summary of eligibility criteria is available in Table 1. Included studies had to report medical management and treatmentfor aHT that differed from conventional facility-based care in terms of provider cadre, location, or frequency of follow-up visits. Interventions had to address general management and medical treatment for aHT, including lifestyle modification, self-care, treatment administration and screening or management of organ complications. Included studies had also to report on at least one of the following outcomes: acceptabilityof the care model, BP control, engagement in care, or end-organ damage. We did not include studies where only aHT screening or diagnosis was reported. Studies where the intervention was a mere add-on and did not replace, at least partly, facility-based care, or did not reduce the frequency of visits to a professional healthcare worker, were not eligible. We also excluded studies that reported the pilot experience of a published intervention, if the model of care was the same.

A first literature search was conducted on 23 May 2021. The search was repeated on 15 October 2021, yielding no further eligible studies. The literature search strategy was drafted and refined through discussions with the study team and an experienced scientific information specialist (JH), then reviewed by a second information specialist (CA). The search strategy was first developed in Embase Elsevier [41], and subsequently translated for the databases Medline Ovid [42], Cumulative Index to Nursing and Allied Health Literature (CINAHL) [43], and Scopus [44]. Detailed information on the search strategy and is available in Annex 1.

No language limits or date restrictions were applied. Conference abstracts where no peer-reviewed publication was available were excluded. The search results from each database were imported to EndNote X9 and deduplicated according to the method of Bramer [45]. Two independent reviewers (LG, ER) individually assessed study titles, abstracts, and full texts against the predefined eligibility criteria of the review. Authors were contacted when the description of the model of care was unclear or incomplete to decide on inclusion or exclusion. Backward and forward citation from included studies was used to identify additional articles that met the inclusion criteria. Disagreements were resolved throughdiscussions between the two first authors (LGF, EF) andthe last author (NDL).

Data extraction was independently conducted by two authors (LG, ER) using a tool created in Word™v.16.0 and piloted on three studies. Information included author, year of publication, study design, target population, location of study, duration of follow-up, type of community- care model, health provider cadre, outcomes measured and comparison arm if available. All reported variables were described as the authors defined them, with no other assumptions. Discrepancies between reviewers were discussed and solved by consensus. The information was chartered in Excel™ v16.0.

We summarized each study's outcomes and, where possible, we pooled outcomes and reported average,range and/or median values. If models of care were simi-lar, we grouped results by intervention type and reportedcommon features, such as health cadre providing the ser- vice, location of delivery and frequency, use of e-Health, or integration with other chronic conditions. Assessment of quality of the included evidence was not initiallyplanned, and thus not specified in the published proto- col. However, we undertook the analysis at a later stageto comment on recommendations for evidence generation in the field. We assessed the quality of the includedcohort and case–control studies using the Newcastle– Ottawa Scale [46]. The domains of the tool rate the selection of participants, comparability, and outcomes, to a maximum of 9 points. Whereas this scale is widely usedto assess the quality of observational studies, there are no established thresholds to define "poor" or "good" qualityof a study. Based on a recent literature review, we applied a threshold ≥ 6 as "no high risk of bias" [47]. Randomized controlled trials (RCTs) were judged using the Cochrane Collaboration's tool to assess RCTs [48] and cluster RCTs [49]. We evaluated the sequence generation, participant recruitment with respect to randomization timing, deviation from intended intervention, completeness of outcome data for the main outcome, bias in the measurement of outcome, and bias in the selection of the reported result. Additionally, we addressed both quantitative and qualitative gaps in the literature and proposedsuggestions for further studies and applications for pro-grammatic scale up. The results of the review are documented in accordance with the PRISMA-P reporting checklist [50].

Using the reported experiences, we conceptualized a framework containing six building blocks to design and describe community care models for aHT.

Results

Search results

Literature search and deduplication yielded a total of 4,618 citations (Prisma Fig. 1). Titles and abstracts screening resulted in a first classification, after which 76 papers were included for full-text review. Reasons for exclusion at full-text screening included: studies described models with most of the aHT care happening

at facility level (n = 6); the description of the model of care lacked details on the content of the intervention (n = 4); studies piloted a model of care that was further described in an included study (n = 4); and the described model of care or outcomes did not match the inclusion criteria (n = 53). Backward and forward citation searching of included studies yielded 333 additional references;
all of them were screened, and three new studies were identified. As a result, 12 references were finally included [51–62].

Characteristics of the studies

Characteristics of included studies are available in Table 2. Identified studies were published between 1994and 2021, and seven (58%) were published after 2017
[52–57, 59, 61] (Fig. 2). Eleven (92%) were single country studies [51–56, 58–62] whereas one [57] implemented the same service model in two countries. West African populations were represented in four (33%) [52, 55, 59, 60] , East African populations in five (42%) [53, 54, 56, 58, 61] , Southern African populations in two (17%) [51, 62] studies and one (8%) study presented results from both East and West Africa [57] (Fig. 3). Seven (58%) studies were conducted in urban areas [51, 54, 55, 58–61], three (25%) in rural areas [53, 56, 62], one (8%) study [52] took place in semi-urban areas and one (8%) [57] study reported findings in urban and rural settings. No studies reported interventions in special settings, such as remote, hard-to-reach populations or conflict areas.

The majority were before-after studies, describing post-intervention outcomes [52–54, 57, 58, 60, 62] (7, 58%). Other designs included: case-control [51] (1, 8%), mixed-methods [61] (1, 8%), prospective non-randomized controlled trial [55] (1, 8%), RCT [59] (1, 8%), and cluster RCT [56] (1, 8%). The primary aim of most of the studies was to test a specific intervention adapted to a particular context [51, 55–57, 59–62] (8, 67%), while, four (33%) studies were part of broader health or non-communicable chronic disease (NCD) implementation projects [52–54, 58]. Sample size varied from 42 to 7188 participants, with five (42%) studies including more than 1000participants [52, 56–58, 62]. The majority of the studies (10, 83%), narrowed the inclusion criteria to participants with uncomplicated aHT [52–56, 58–62]. A total of seven(58%) studies had no comparator arm [52–54, 57, 58, 60,61], whereas five (42%) provided intra-study comparisons of interventions [51, 55, 56, 59, 62], with either standard
of care [51, 55, 59] or a second intervention [56, 62].

Models of care

Four different service delivery models were described: services provided by community pharmacists [52, 55, 60, 61], temporary or permanent stations placed at strategic and accessible locations in the community [54, 62], routine facility-based care complemented with home vis- its or services in other community locations to reduce patient visits to the facility [51, 57, 59], and care provided at the time of collecting medication in aHT treatmentgroups [53, 56, 58]. All models applied different elements of task shifting or task sharing. Medical specialists, including cardiologists or general doctors, had a substantial role in supporting the services in seven (58%) studies, either managing referred patients or supportingthe practice of lower cadres [51, 52, 54, 56, 57, 61, 62]. Among non-physician delivered services, aHT care was delivered by nurses [51, 52, 54, 56–59, 62] (8, 67%), com-
munity health workers [51–54, 56, 57] (CHW) (6, 50%) or pharmacists [51, 52, 55, 56, 60, 61] (5, 42%). For each model of care, authors described the preparation and training given to the health workers involved. Most commonly, an initial training session included training on BP measurement technique, healthy lifestyle, clinical guidelines, counselling and support techniques, and familiarization with the information capturing tools. Sessions were longer for lay cadres and shorter for health professionals and only three (25%) provided ongoing mentoring or supervision [57, 59, 60]. Five (42%) studies specifically reported on aHT medical treatment regimens [52, 56, 57, 60, 62] (Table 3). Treatment choices reflected historical and context recommendations, as well as, availability of drugs. Most frequently, treatment algorithms used diuretics, calcium channel blockers (CCB), ß-blockers, angiotensin-converting enzyme (ACE) inhibitors, and angiotensin receptor blockers (ARBs). Treatments included the use of mono-therapy and combinations, however, none used fixed dose combinations. Seven (58%) studies integrated aHT care with other prevalent chronic health conditions, mostly diabetes [51, 53, 55, 56, 58], and HIV [58]. Only two (16%) models integrated care with other NCDs, such as mental health, epilepsy, asthma, or heart disease [53, 59]. Five (42%) studies used electronic information systems as a substantial component of the model of care, including clinical and computerized decision support systems or e-health platforms [52, 55, 57, 60, 61].

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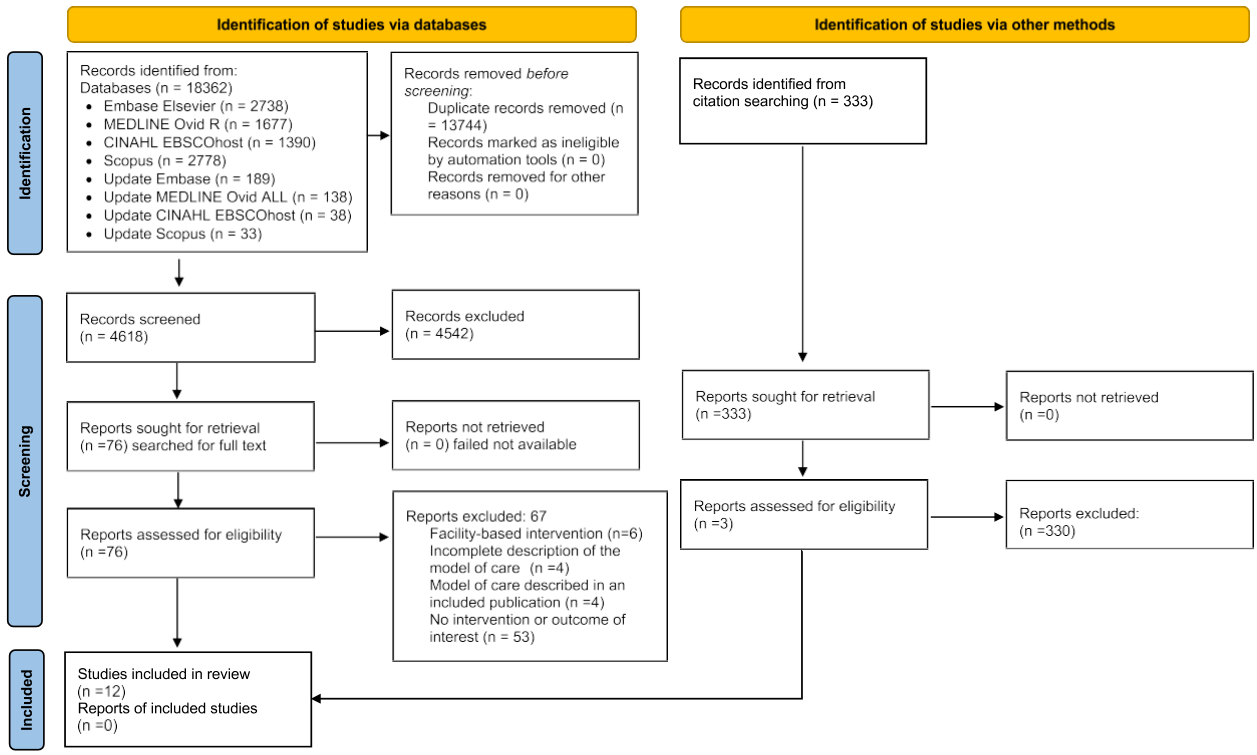

Fig. 1 Studies selection PRISMA diagram. *From:* Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 2021;372:n71. https://doi.org/10.1136/bmj.n71. https://doi.org/10.1136/bmj.n71, For more information, visit: http://www.prisma-statement.org/

Table 2 Baseline characteristics of studies

	Author and publication year	Study design	Country and setting	Name project/ model of care	Participants (eligibility criteria)	Sample size (n)	Study period	Comparisons Intervention	Intervention	Integration with other services	Use of eHealth technology
1	Steyn et al. 1993 [62]	Prospective quasi-experimental study with cohort and cross-sectional elements	South Arica semi-urban (defined by authors as rural) towns	CORIS	Hypertensive patients, 15-64y at baseline, 15-68y at endline	7188	1979–1983	•1 low intensity intervention town: use of small mass media (billboards, posters, pamphlets) to deliver messages in the community •1 high intensity intervention town: hypertensives, active follow up through community BP stations and exposure to media messages	•Control town	General counselling on lifestyle related to CVDRFs	None
2	Oparah et al. 2006 [60]	Prospective cohort study	Nigeria urban	-	Hypertensive patients ≥ 18y on aHT treatment	42	2003–2004	•1 community pharmacy: pharmacists provided BP monitoring, BMI measurement, medication education, lifestyle modifications, and assistance with treatment compliance	•N/A	No	Follow up through phone calls
3	Ndou et al. 2013 [51]	Retrospective case control study	South Africa urban	Kgatelopele programme	Stable patients with hypertension or diabetes Three-fold matched controls	224	NR	•Monthly home visits by one CHWs. Pharmacist pre-packed a month's supply of medication for delivery. Patients visit the clinic every 6 months for a physical examination by a doctor who provides a renewed prescription	•Clinic-based standard of care	Diabetes	None

Table 2 (continued)

	Author and publication year	Study design	Country and setting	Name project/ model of care	Participants (eligibility criteria)	Sample size (n)	Study period	Comparisons Intervention	Intervention	Integration with other services	Use of eHealth technology
4	Khabala et al. 2015 [58]	Retrospective cohort study	Kenya urban	Medication Adherence Clubs for multiple chronic diseases	Stable patients with diabetes, hypertension and/or HIV	1432	2013–2014	•MACs are nurse-facilitated, mixed groups of 25–35 stable hypertension, diabetes and/or HIV patients •Nurses lead quarterly meetings in medication adherence clubs (MACs)in health facilities to confirm clinical stability, have brief health discussions and receive medication •Clinical officer reviewed MACs yearly when patients devel- oped complica- tions or no longermet stability criteria	•N/A	Diabetes and HIV	None
5	Marfo et al. 2017 [55]	Prospective non-randomized controlled trial	Ghana urban	-	Patients diagnosed with hypertension $\geq$6 months, with a review period of at least two months	180	NR	•Monthly follow up at 3 community pharmacies: BP monitoring, medicines use review, health education and adherence counselling •Follow up reminders via text messages and phone calls	•2 control community pharmacies	Diabetes	Follow up through SMS and phone calls

Table 2 (continued)

	Author and publication year	Study design	Country and setting	Name project/ model of care	Participants (eligibility criteria)	Sample size (n)	Study period	Comparisons Intervention	Intervention	Integration with other services	Use of eHealth technology
6	Nelissen et al. 2018 [61]	Prospective mixed-methods study	Nigeria urban	-	Hypertensive patients > 18y. SBP ≥ 180 mmHg and DBP 110 mmHg. No history of cardiac failure, stroke, or renal disease. No additional CVRF. Non-pregnant	336	2016–2017	•5 community pharmacies where staff and cardiologists provide joint care directly connected through a mobile application (mHealth) for remote patient monitoring •Task-shifting from medical doctors to pharmacy staff: pharmacy staff performed regular follow up, including BP measurements, medication and lifestyle counselling, visits reminders and communication with the cardiologist	•N/A	None	Patients, pharma- cists, and cardi- ologists connected through a mobile application: mHealth

Table 2 (continued)

	Author and publication year	Study design	Country and setting	Name project/ model of care	Participants (eligibility criteria)	Sample size (n)	Study period	Comparisons Intervention	Intervention	Integration with other services	Use of eHealth technology
7	Kuria et al. 2018 [54]	Retrospective cohort study	Kenya urban	-	Hypertensive patients retained in clinics for at least 6 months	785	2015–2016	•Model of care adapted to give services to a transient community •Weekend clinics in churches offered comprehensive services between 0900 and 1600 h, on worship days • "Walkways", drop-in-clinics offered comprehensive care, located on commonly used roadways outside or near the clinic operating between 1630 and 1830 h •CHVs take BP readings. A clinician supervises the CHVs, diagnoses, treats patients, and dispenses medication. Clinicians are drawn from project sites and work on a rotational basis •A patient booklet containing clinical information is issued to address patients mobility	•Regular services at health facilities	None	None

Table 2 (continued)

	Author and publication year	Study design	Country and setting	Name project/ model of care	Participants (eligibility criteria)	Sample size (n)	Study period	Comparisons Intervention	Comparisons Intervention	Integration with other services	Use of eHealth technology
8	Adler et al. 2019 [52]	Prospective cohort study	Ghana semiurban/ peri-urban	ComHIP study	Diagnosed hypertension in 18y, non-pregnant, with accessto a mobile phone	1339	2015–2016	•Monthly BP monitoring appointments, review visits every 1,2 or 3 months depending on risk and personal factors •6-monthly follow up assessments at local drug shops or CHWs •Daily adherence reminders and weekly healthy living tips by SMS	•N/A	None	-Electronic database CommCare -Cloud-based health records system that links patients' records with SMS system -SMS platform automatically sends daily adherence reminders, weekly healthy living tips, and consultation and prescription refill reminders to enrolled patients
9	Bolarinwa et al. 2019 [59]	Unblinded individual open RCT	Nigeria urban	-	Hypertensive adults on treatment	299	NR	•Monthly follow up visits at home conducted by nurses including counselling, education, family approaches and integration of other chronic conditions	•Usual care	Quality of Life, including physical and mental health components	None

Table 2 (continued)

	Author and publication year	Study design	Country and setting	Name project/ model of care	Participants (eligibility criteria)	Sample size (n)	Study period	Comparisons Intervention	Comparisons Intervention	Integration with other services	Use of eHealth technology
10	Stephens et al. 2021 [53]	Retrospective cohort study	Uganda rural	CDCom program	SBP < 170 mmHg for 6 months. Good adherence. No renal or cardiovascular complications	761 (413 on hypertension treatment)	2016- 2019	•Monthly meetings of patients with VHW and their clinician supervisors at places used for gatherings in the community, delivering integrated care •Content of meetings: treatment monitoring, lifestyle and medication adherence counselling, diagnosis of chronic complications. Referral to health facilities if necessary •BP treatment prioritization according to individual risk and adapted to minimize effects of drug stock outs	•N/A	Diabetes, heart disease, asthma, epilepsy and other NCDs	None
11	Otieno et al. 2021 [57]	Prospective cohort study	Kenya and Ghana Urban/rural	-	Hypertensive patients ≥ 18y	1266	2018–2019	•Weekly, bi-weekly, or monthly blood pressure assessments as determined by app or providers at community location, central employment location or home •In-clinic review visits every 30, 60 or 90 days •Digital application-generated personalized educational, supportive, and instructive messages	•N/A	None	-eHealth platform: Empower Health, stores patients' records -Algorithm driven follow-up provides patients with personalized/risk-based care plans - Platform delivers educational/ adherence/locally appropriate healthy lifestyle messages, based on the patient's enrolment risk classification, and follow up

Table 2 (continued)

	Author and publication year	Study design	Country and setting	Name project/ model of care	Participants (eligibility criteria)	Sample size (n)	Study period	Comparisons Intervention	Intervention	Integration with other services	Use of eHealth technology
12	Vedanthan et al. 2021 [56]	Cluster RCT	Kenya rural	BIGPIC	Hypertensive ≥35y patients not on treatment or on treatment < 6 m. No acute illness, non-pregnant or HIV-infected patients	2890	NR	•Monthly meetings in respective groups: -Usual care (UC) plus microfinance (MF) support -Group medicalvisits (GMV) -Group medical visits plus micro-finance support (GMV-MF) •Group medical visits comprised monitoring and counselling	•Usual standardof care	Diabetes	None

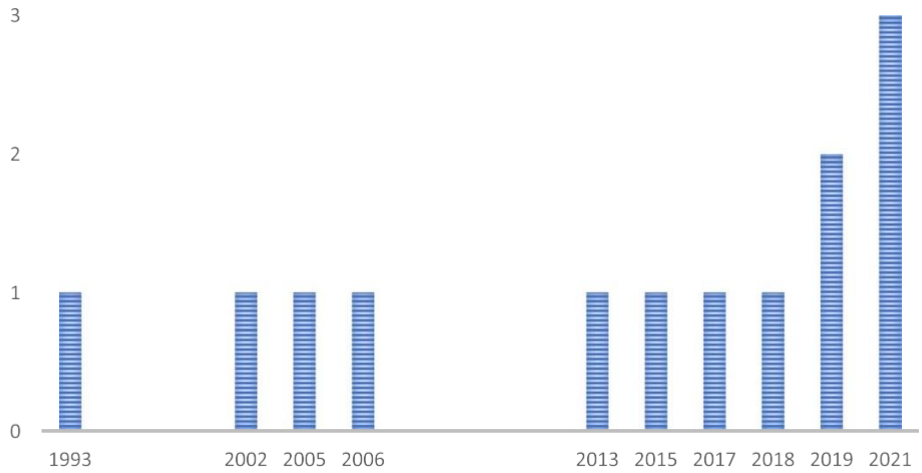

Fig. 2 Included studies by year of publication

Measured outcomes

Table 4 summarizes the studies' outcomes of interest, perceived benefits, and challenges of the models of care, as described by the authors. Two (17%) studies reported on acceptability of the care model [60, 61]; eleven (92%) on BP control [51–53, 55–62]; and 10 (83%) on engagement in care [52–56, 58–62]. Only one (8%) study reported on end-organ damage. Nine (75%) studies report outcomes between an average follow up of 6–12 months [51, 52, 55–61], while 3 (25%) studies reported a follow up longer than one year [53, 54, 57].

Acceptability was reported either collecting the experience of the health workers [61], or measuring patients'satisfaction through qualitative research and the Larson satisfaction questionnaire [63]. Of the two studies reporting satisfaction, one model delivered home-based treatment and one provided care in community pharmacies [60, 61]. Participants reported benefits in adhering to the treatment and general knowledge on self-care practices.

With regards to reporting BP control, targets for (SBP, (DBP and aHT definitions varied, reflecting historical definitions [62] or pragmatic targets linked to inclusion criteria in the care model [53, 58]. Seven (58%)studies [52, 55–57, 59–61] used SBP $\leq$ 140 mmHg and DBP $\leq$ 90 mmHg to define BP control, while two (16%)[55, 61] modified control thresholds for diabetic patients.

Eight (67%) studies showed a significant improvement in BP control [51, 52, 55, 57, 58, 60–62] and one (8%) showed that BP was controlled in higher proportion for diabetic patients receiving community-based services [51].

Eight (67%) studies reported engagement in care [51, 52, 54–56, 58, 59, 61] using different measures: lost to follow-up or death [54, 58], self-reported adherence to the treatment [54, 55, 59–61], regular use of the e-health support platform [61] or attendance to follow up visits [51, 52, 56, 58]. Two (16%) community pharmacy models in West Africa were the only ones that reported significant improvements in engagement in care and adherence to aHT treatment [55, 59], whereas two studies suggest that community care posts and home-based care could increase long-term engagement in aHT care [52, 54].

The only study reporting end-organ damage measured serum creatinine as surrogate marker for renal function. In this care model, laboratory tests were offered at the time of patients group meetings and collection of aHT medication in a subset of participants [58].

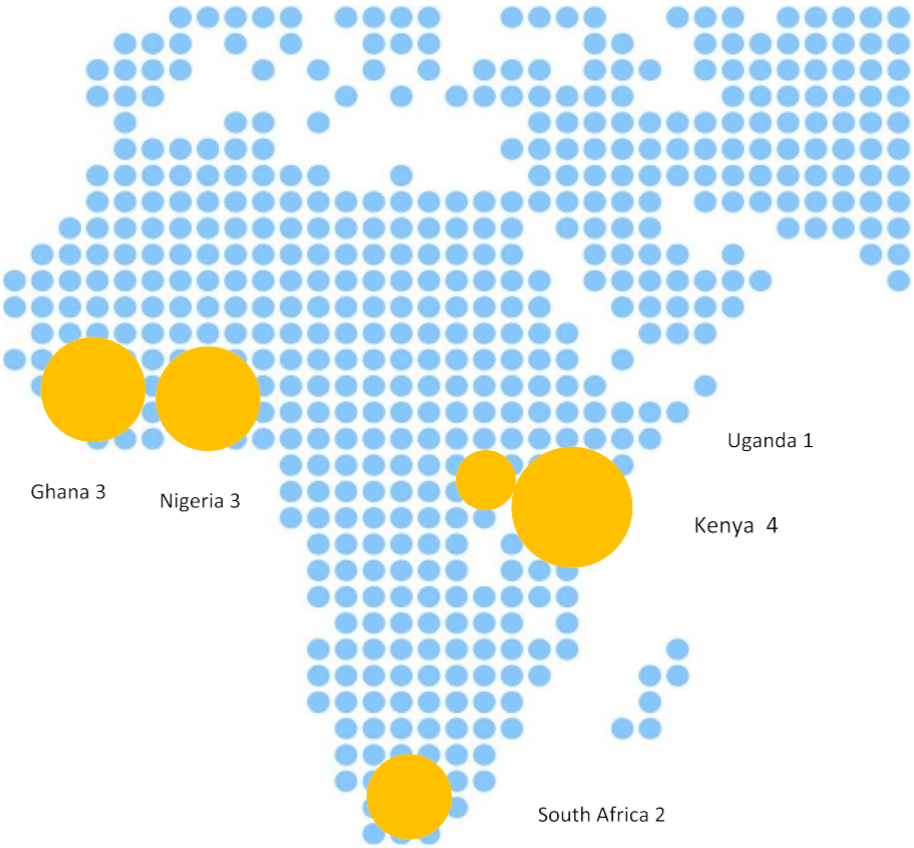

Fig. 3 Included studies by country

Authors reported the perceived benefits of the aHT models of care in relation to the health system and the users. Benefits for the health system included: task- sharing across different professionals, decrease in daily patients load at facilities, and possibility to offer wider access for services and prevention of other CVDs [51, 53–62]. Perceived advantages from the patients' perspective referred to increased flexibility to access services, and reduction of costs and waiting times [51, 53–55, 57, 58, 61]. One study noted positive impacts in patients' quality of life, as the model of care addressed broader social determinants of health closely linked to CVDs, such as poverty, rather than just providing aHT treatment [56].

Authors also reported the weaknesses of these aHT care models. Doubts on generalizability of the modelsarose in relation to strict inclusion criteria, as care was provided either to selected groups or clinically stable participants. Seven (7, 58%) used clinically narrow eligibility criteria, excluding patients with complicated aHT, severe conditions, or comorbidities [53, 54, 56–58, 61]. One study in South Africa provided care only to the privileged white population during Apartheid [62]. High attrition rates through lost to follow-up and mortality, deficiencies in data quality, small sample sizes, short follow-up periods, or lack of control arms compromised the report of accurate outcomes and the capacity to provide a more complete picture of the real benefit of these models[52–55, 57, 59, 60, 62]. Poor sustainability of care models was brought up in relation to the use of vertical, non-integrated interventions, including parallel remuneration of health workers, lack of staff, medication stock outsor difficulties in managing and sustaining eHealth solutions [51–53, 55, 60, 61]. The overall quality of provided services was a common concern to authors, including difficulties in providing ongoing supervision and mentoring of lower cadres [51–55]. Specifically, the models testing services at community pharmacies in West Africa expressed concerns about the capacity to contribute to asubstantial change in service delivery, as the strategy was too far away from existing policies and standards, and sustainability was heavily associated with motivation and remuneration of professionals [55, 60].

Quality of evidence

Nine cohort studies and one case control study were evaluated using the Newcastle–Ottawa scale [64–66]

Table 3 aHT drug regimens used in the included care models

Author and publication year	Reported pharmacological treatment for aHT
Steyn et al. 1993 [62]	•Men: 25.3% ß-blockers, 22.3% diuretics, 6.4% reserpine-containing preparations •Women: 43.2% diuretics, 15% reserpine-containing preparations, 14.6% ß-blockers
Oparah et al. 2006 [60]	•Prior to intervention: 33% methyldopa, 11% diuretics, 33% combinations •Intervention: JNC (Joint National Committee) VII guidelines*, 2004
Ndou et al. 2013 [51]	NR
Khabala et al. 2015 [58]	NR
Marfo et al. 2017 [55]	NR
Nelissen et al. 2018 [61]	NR
Kuria et al. 2018 [54]	NR
Adler et al. 2019 [52]	•At enrolment: 36% used a calcium channel blocker (CCB) •After 6-months enrolment: 75.9% patients used diuretics and 69.5% were on a CCB. A total of 24.1% were taking onlyone medication, 32% were taking two medications and over 30% were taking more than two medications •At 12 m-enrolment: 79.8% were on diuretics, and 71.5% taking a CCB.A total of 23% were taking one medication,32.6% were taking two medications and over 32% were taking more than two medications
Bolarinwa et al. 2019 [59]	NR
Stephens et al. 2021 [53]	NR
Otieno et al. 2021 [57]	•A total of 74% of patients were on calcium channel blocker, 64% on ACE or ARB and 14% on diuretics. A minority ofpatients used other treatments
Vedanthan et al. 2021 [56]	•Use of diuretics if SBP ≥ 140 and < 180 OR DBP ≥ 90 and < 110, without edema of legs or dyspnoea on exertion orreduced urine output •Treatment of hypertension in Diabetes: initial ACE inhibitors. Escalate to ARBs with/without diuretics

* https://www.nhlbi.nih.gov/files/docs/guidelines/jnc7full.pdf

(Table 5). All studies scored below 6, mainly driven by very narrowly selected study populations and the absence of comparators in many of the studies. One RCT and one cluster-RCT were assessed using the Cochrane Collaboration's tool for assessing risk of bias in RCTs [48, 49] (Table 6). Overall bias assessment was "low risk for bias" for one study and "some concerns" for the other.

Discussion

To our knowledge, this scoping review is the first comprehensive analysis of community-based aHT treatment models in sub-Saharan Africa. We systematically compiled and synthesized the current evidence related to service delivery models for aHT treatment that differ from traditional, facility-based care between 1993 and 2021. The increasing number of publications in recent years indicates that this is an active field where rapid devel opments can be expected in future [67–71]. We identified 12 studies that described one or more outcomes of interest from four distinct types of community-based aHT service delivery in five countries. However, only a minority of studies (4, 33%) compared alternative models to conventional care or to other interventions, making it difficult to draw solid conclusions about the overall effectiveness of these models on clinical outcomes. Due to the wide heterogeneity of the models of care, inclusion criteria, outcome definitions, participants follow up and study types we only described each of the studies individually, rather than providing aggregated statistics. In the process of summarizing the literature for thisscoping review, we abstracted the main elements that integrate the models of care, as described by the authors (manuscript tables). These elements constitute the "building blocks" of each care model and are represented in Fig. 4: cadre of health care provider (who delivers the service, including self-care), target population (for whom the care model is created), location of service delivery (where is the service provided), components of the ser- vice package, information systems (methods used for collecting information about the users and the service), and the timing of service delivery (when is the service avail- able to the user). Each of these elements is intrinsically composed by other components. i.e.: in the "information systems" category, different models use either paper- based/digitalized patients' files/cards and/or digital technology. We propose the use of these building blocks to either design or analyze care models for aHT and in general CVDs. To tailor a model of care to a given setting, each of the six blocks should be taken into account and adapted, considering different aspects, such as: setting, resources, cultural preferences, or specific needs of the target population (Fig. 4). Similar models have been used to scale up tuberculosis or HIV services [29, 72–76].

The West African experiences mostly integrated pharmacists and microfinance solutions in urban areas, while East and Southern African models tested interventions that increased access to care in rural communities. In all service models, care is most often provided by lower

Table 4 Studies reported outcomes and key findings

	Author and publication year	Country	Described outcomes	Timeline of outcomes	Reported outcomes (Study comparations if available)	Key findings reported by authors	
						Reported benefits	Reported challenges
1	Steyn 1993 [62]	South Africa	•BP control (< 160/95 mmHg) •Engagement in care	4 years	•**BP control:** -In men: SBP decreased by 4,5 mmHg in both intervention towns compared with 1,8 mmHg in the control town -DBP decreased by 1,5 and 2,3 mmHg in control towns, while it increased by 2,2 mmHg in the control town -In women: SBP, mean SBP decreased by 6,3 and 8,0 mmHg in the intervention towns, compared with a decrease of 4,9 mmHg in the control town -DBP decreased by 3,4 and 3,8 mmHg against 0,7 in the control town	•Positive impact on prevention of CVDRFs and BP treatment management	•Limited generalisability due to only inclusion of white population during the Apartheid years •Unclear impact on stand-alone BP intervention, as the program was part of an extensive multifactorial risk factor intervention •Historical BP control targets

Table 4 (continued)

	Author and publication year	Country	Described outcomes	Timeline of outcomes	Reported outcomes (Study comparations if available)	Key findings reported by authors	
						Reported benefits	Reported challenges
2	Oparah 2006 [60]	Nigeria	•Acceptability •BP control (< 140/90 mmHg) •Engagement in care	6 months	•Patient satisfaction: significantly higher rating than baseline P < 0.0001 •BP control: -Significant difference (P < 0.0001) in mean SBP from baseline (187.67 ± 29.46 mmHg) (137.22 ± 21.65 mmHg) to the end of the study -Significant difference (P < 0.0001) in mean DBP from baseline (117.56 ± 21.65) to the end of study (89 ± 17.23) DBP goals •Adherence to treatment: -Improvement on compliance-rated scores at the end of the study compared to baseline (< 0.006)	•Increased access and acceptability of the BP intervention with the involvement of community pharmacists •Community pharmacists involved in early diagnosis of BP and potential role in CVRFs screening	•Practices in Nigeria do not conform to international standards for community pharmacies •Limited long-term impact due to short follow-up and small sample size •Need to provide remuneration for the community pharmacists
3	Ndou 2013 [51]	South Africa	•BP control (< 130/85 mmHg)	8 (2–18) months	•BP control: -21.4% of patients in the community were controlled at > 40% of health checks in comparison to 13.1% of clinic patients -In diabetic patients: hypertension was controlled in higher proportion of community-based patients (27.3%) at > 40% of health checks in com-	•Increased accessibility of services, especially among elder groups •Reduced patient load at the clinics	•Service delivery frequently compromised by lack of doctors, poor drug supply, centralized services, and poor stakeholders coordination •Quality of care compromised by poor management of side effects, lack of CHWs supervision, poor referrals of patients to higher levels, inability to

Table 4 (continued)

	Author and publication year	Country	Described outcomes	Timeline of outcomes	Reported outcomes (Study comparations if available)	Key findings reported by authors	
						Reported benefits	Reported challenges
4	Khabala 2015 [58]	Kenya	•BP control (BP threshold in MACs < 150/100 mmHg) •Engagement in care	12 months	•**BP control:** -A total of 12/2208 consultations were referred back to regular care due to failure to control diabetes/hypertension •**Engagement in care:** -Overall loss to follow-up: 3.5% -LTFU occurred only between the 1st and 2nd MAC attendees -There were no known deaths of MAC patients during the study period •**End-organ damage:** -followed up 211 group participants with creatinine (outcomes not reported)	•Reduced patient burden at clinics •Reduced waiting times and increased appointment flexibility •Free services, leading to increased retention in care	•Unclear impact in long-term outcomes •Very selected population: "Stable": HIV ≥ 25y on treatment > 6 months (in HIV + > 1y). Criteria of stability: BP < 150/200, HbA1C < 8%, CD4 > 200, undetectable viral load, not WHO stage 3 or 4, or other active disease
5	Marfo 2017 [55]	Ghana	•BP control (< 140/90 mmHg/ < 130/80 mmHg in diabetic hypertensive patients) •Engagement in care	6 months	•**BP control:** -Mean SBP difference between the intervention and the control group was statistically significant ($p = 0.001$) -Mean adherence difference between the two groups was statistically significant(p 0.001) •**Adherence:** -The intervention group increased in mean adherence scores and the control group showed a decrease in adherence scores at the end of the study. The difference in the mean adherence scores between the two groups was statistically significant	• Increased users satisfaction due to reductions in waiting time and increased access to health education	•Lack of national policies concerning services at community pharmacies •Time consuming intervention for pharmacists (preparing appointments and

	atientsreminders)
	•Remuneration of com- munity pharmacists couldincrease cost for the patients
	•Quality of services compromised by lack of assessment of adherence to medicines and poor tel- ecommunication coverage,leading to increased LFU

Table 4 (continued)

	Author and publication year	Country	Described outcomes	Timeline of outcomes	Reported outcomes (Study comparations if available)	Key findings reported by authors	
						Reported benefits	Reported challenges
6	Nelissen 2018 [61]	Nigeria	•Acceptability •BP control (SBP < 140/ 90 mmHg in patients < 60y< 150/ 90 mmHg in diabetic and > 60 years) •Engagement in care	6–8 months	•**Acceptability:** -Cardiologists, pharmacists, and patients where content with model of care, however, expressed difficulties with management of mHealth digital platform •**BP control:** -Mean SBP decreased 9.9 mmHg (SD: 18) -BP on target increased from 24 to 56% and an additional 10% had an improved blood pressure. However, this was not associated with duration of mHealth activity •**Engagement in care:** -mHealth activity was present ranging from 38 to 83% across pharmacies - Median mHealth activity duration was 3.3 months. However, patients self-reported more visits than recorded in the mHealth data -52% self-reported low adherence, 24% moderate adherence and 24% high adherence to antihypertensive medication. This distribution did not significantly differ across the pharmacies	•Increased access and quality of care for users •Increased self-care practice and reduction in waiting times •mHealth app bridged the gap between clinicians and pharmacies •Financial savings: costs reductions and ability to negotiate different payment methods with the pharmacists	•Limited representability of population as very selected participants •Patients perspectives: user fees. Sense of being monitored too closely. Unclear links with the cardiologists through the app •Health care workers perspectives: Understaffing. Users fees. Difficulties with connectivity to the mHealth application and usability. Fear of clinicians/ cardiologists to have their role been taken over by the pharmacists. Increased workload for clinicians and pharmacies •Overall long-term financial sustainability of the model of care

Table 4 (continued)

	Author and publication year	Country	Described outcomes	Timeline of outcomes	Reported outcomes (Study comparations if available)	Key findings reported by authors	
						Reported benefits	Reported challenges
7	Kuria 2018 [54]	Kenya	•Engagement in care	20 months	**•Engagement in care:** -Of the 4960 scheduled follow-up visits, the health facility group were more compliant (64%) than either walkway (60%) or week- end clinic attenders (55%)(P 0.006) -Self-reported adherenceof those who complied with scheduled clinic visits was 94%, with walkway at96%, facility at 94% and weekend at 88%, (P 0.001) -Patients who received hypertension services through the weekend clinic were 76% less likely to adhere to the treatment than those treated at the facility (AOR 0.24,95% CI 0.10–0.57) -The association between the model of hyperten- sion service delivery and self-reported adherence to medication remained significant even after adjusting for sex and ageat enrolment	•Placing full-service clinicsin strategic locations to account for travel to work may be effective •Offering services for men outside working hours may increase their participation •Using a simple pill regimen likely increasesadherence •Health passports with medical information facilitate long-term care in transient populations	•Services did not provide comprehensive services ata convenient location for patients •Adherence to medica- tion was self-reported and hence could have introduced bias in care •Lack of quality dataincreased LFU •Compliance with the health facility model was better than in walkway and weekend clinics

Table 4 (continued)

	Author and publication year	Country	Described outcomes	Timeline of outcomes	Reported outcomes (Study comparations if available)	Key findings reported by authors	
						Reported benefits	Reported challenges
8	Adler 2019 [52]	Ghana	•BP control (< 140/90 mm Hg) •Engagement in care	6–12 months	•**Blood pressure control:** - 72% (95% CI: 67% to 77%) of participants had their BP under control. SBP was reduced by 12.2 mm Hg (95% CI: 14.4 to 10.1) and diastolic BP by 7.5 mm Hg (95% CI: 9.9 to 6.1) •**Engagement in care:** 552/1339 (41%) patients were in care at 6 m and 338/1339 (25%) were retained in care at 12 months	•Use of Ghana health system existing protocols and medications	•Incomplete picture of medical interventions as ComHIP was connected only with certain HCWs •No control cohort •High LFU rates and staff turnover
9	Bolarinwa 2019 [59]	Nigeria	•BP control (< 140/90 mm Hg) •Engagement in care	6–12 months	•**Blood pressure control:** -Mean SBP ± SD (mmHg) was 139.39 ± 23.79 in the intervention group and 140.57 ± 21.90 in the control group (P = 0.658) - Mean DBP ± SD (mmHg) was 86.58 ± 12.11 in the intervention group and 87.27 ~~11~~.63 in the control group (P 0.616~~)~~= •**Engagement in care:** Adherence to treatment was increased inthe intervention group (P = < 0.001)	•Improvement of the physical component of quality of life after controlling for the baseline quality of life and age •Possible improvement in adherence linked to improved counselling	•High attrition rates (lower than similar RCTs)

Table 4 (continued)

	Author and publication year	Country	Described outcomes	Timeline of outcomes	Reported outcomes (Study comparations if available)	Key findings reported by authors	
						Reported benefits	Reported challenges
10	Stephens 21 [53]	Uganda	•BP control (SBP < 169 mm Hg) •Engagement in care	24 months	•**Blood pressure control:** -Treatment targets: once treatment is initiated for uncomplicated aHT, the target SBP is < 159. If the SBP is 140–169, the patient is given lifestyle advice and followed up regularly by the VHW for a year. If the threshold of SBP > 169 is reached, the patient is enrolled in CDCom -68% hypertensive patients enrolled in CDCom had their most recent blood pressure below the treatment target	•Ability to integrate medical treatment within VHWs screening activities, improving the continuum of care •Services are closer to patients home •VHWs have better rapport with the communities •Increased communication among the different levels of care (primary, secondary and tertiary)	•Inconsistency in measuring BP, leading to over/under measurement •Increased cost if there is not a comprehensive package of care •Rotation of clinical staff and lack of clear job descriptions •Drug stock-outs •Cost of drugs (user fees) likely rends the model unsuccessful
11	Otieno 21 [57]	Kenya and Ghana	•BP control (< 140/90 mm Hg)	7–16 months	•**Blood pressure control:** -SBP decreased significantly through 12 months in both the overall cohort (− 9.4 mmHg, p < .001) and in the uncontrolled subgroup (−17.6 mmHg,p< .001) -Proportion of patients with controlled pressure increased from 46% at baseline to 77% at12 months (p < .001)	•Co-created, locally appropriate model of care implemented to address formidable socioeconomic barriers •The drops BP plateaued at about 4 months and were sustained over the 12-month follow-up period •In-clinic patient visits were reduced 60% as compared to standard monthly visits	•Limited representability, as cohort may not represent correspond to the broader sub-population of undiagnosed or untreated patients outside an organized health care system •The analysis did not include a control arm for comparison. However, the magnitude of the BP reduction and the sustainment of the large reduction through a year of follow-up provided evidence against the effect of a Hawthorne effect

Table 4 (continued)

	Author and publication year	Country	Described outcomes	Timeline of outcomes	Reported outcomes (Study comparations if available)	Key findings reported by authors	
						Reported benefits	Reported challenges
12	Vedanthan 2021 [56]	Kenya	•BP control (< 140/90 mm Hg) •Engagement in care	12 months	•**Blood pressure control:** -Model-based estimates showed that, compared with the UC arm, the mean reduction in SBP was 3.9 mm Hg greater in the GMV-MF arm (98.3% CI: -8.5 to 0.7 mm Hg; p = 0.05), 3.3 mm Hg greater in the GMV arm (98.3% CI: -7.8 to 1.2 mm Hg; p 0.09), and 2.3 mm Hg greater in the MF arm(98.3% CI: -7.0 to 2.4 mm Hg; p 0.25) **Engagement in care:** - 12-moths retention: 661/708 (93%) UC, 673/709 (95%) MF, 704/740 (95%) GMVs, 672/763 GMV-MF (88%)	•Observed improvements in BP control were clinically meaningful and would yield substantial long-term cardiovascular and mortality benefit •Model of care addressing social determinants of health	•Contingent upon enrolment led to differential exposure to the intervention across participants •Follow-up duration was insufficient to demonstrate a significant benefit •Unlikely, but possible cross-contamination across the trial arms •Study population not fully representative of the general population. However, the economic challenges experienced by study participants werenot dissimilar from a large proportion of the global population

Table 5 Risk of bias assessment for cohort and case–control studies (Newcastle–Ottawa Scale)

Author and publication year	Selection				Comparability	Outcome			Score	Quality
	1	2	3	4		1	2	3		
Steyn et al. 1993 [62]	-	-	*	*	*	*	*	-	5	high risk of bias
Oparah et al. 2006 [60]	-	-	*	*	-	*	*	85% *	5	high risk of bias
Ndou et al. 2013 [51]	-	*	*	*	*	*	-	-	5	high risk of bias
Khabala et al. 2015 [58]	-	-	*	-	-	*	-	-	2	high risk of bias
Marfo et al. 2017 [55]	-	*	*	*	-	*	*	-	5	high risk of bias
Nelissen et al. 2018 [61]	-	-	*	*	-	*	*	-	4	high risk of bias
Kuria et al. 2018 [54]	-	-	*	*	-	-	*	-	3	high risk of bias
Adler et al. 2019 [52]	-	-	*	*	-	*	*	-	4	high risk of bias
Stephens et al. 2021 [53]	*	-	*	*	-	*	*	-	5	high risk of bias
Otieno et al. 2021 [57]	-	-	*	-	-	*	*	*	4	high risk of bias

Table 6 Risk of bias assessment for single arm and cluster randomized trials (Cochrane Collaboration's tool)

Author and publication year	Bias arising from the randomization process	Bias arising from the timing of identification and recruitment of individual participants in relation to timing of randomization	Bias due to deviations from intended interventions	Bias due to missing outcome data	Bias in measurement of the outcome	Bias in selection of the reported result	Overall bias
Bolarinwa et al. 2019 [59]	Low risk	-	Low risk	Low risk	Low risk	Low	Low risk
Vedanthan et al. 2021 [56]	Low risk	Some concerns	High risk	Low risk	Low risk	Low risk	Some concerns

* The assessment was conducted using the Revised Cochrane risk-of-bias tool for randomized trials and cluster randomized trials (RoB 2) (https://sites.google.com/site/riskofbiastool/welcome/rob-2-0-tool?authuser=0). Scoring was assigned following the algorithms in guidance documents

cadres of health workers, decreasing frequency of interactions with routine services, and combining a high level of self-care. However, most of the models only included participants with already an acceptable BP control, had a short follow-up period, and failed to provide comparable performance with facility-based care in the same setting. Although it is hard to evaluate their real impact, the reported care models do not seem to be associated with lower user's satisfaction or worse treatment outcomes.

Beyond clinical indicators that report individual aHT treatment outcomes for participants receiving care in these models, a few studies collected patients' and service providers' perspectives. Future studies should seek a combination of quantitative and qualitative data and possibly socio-economic data to understand the real reach and impact of such models. The use of electronic information systems becomes an important part of the care in the most recent studies. Patients receive reminders for adherence to medication, general lifestyle counseling or provision of personalized risk-based care plans through, phone calls, SMS, or use of other e-Health platforms. Similarly, these systems support communication between medical specialists, nurses and lay workers [52, 53, 55, 56, 60, 61].

One interesting finding of this review reinforces the idea that expanding the provision of chronic aHT care, and probably other chronic health conditions, to health workers and structures that are outside of traditional care in facilities, reduces, but does not eliminate the need of care provided by medical doctors or specialized nurses. Rather, these services can be used to provide referral paths to manage patients that need to be evaluated for more complex comorbidities or new cardiovascular events by specialized health workers. Our findings describe diverse and heterogenous models of care and suggest that each setting requires its own specifically adapted model of care, taking into account the six building blocks after careful analysis of local gaps and needs. As such, there is not just "one size fits all" care model to efficiently expand out-of-clinic aHT management.

In an effort to close the global aHT treatment gap and improve BP control at societal level, in 2021 the WHO issued updated guidelines for the pharmacological treatment of aHT in non-pregnant adults [3]. These new global recommendations guide decisions such as the threshold for the initiation of pharmacological aHT treatment, choice of treatment regimens and drug combinations, frequency of patients follow up, BP control targets, and the cadre of providers who may initiate or manage long-term treatment. However, regarding frequency of patients' follow up and treatment by nonphysician professionals these recommendations remain conditional due to low-certainty evidence. Through scoping the published literature on this topic, we have identified additional research questions where future research could help establishing evidence-based recommendations to scale up similar aHT models of care. First, the development of standard descriptions of the models of care, taking into account the six building blocks, definitions of inclusion criteria of participants and clinical outcomes will be needed. Second, as aHT is a chronic condition, it will be important to understand the use of these models to achieve and maintain BP control beyond the first 12 or 24 months of enrolment, and even longer follow up. Third, to understand the potential of these models to improve BP control at population level, it will be important to describe the patterns of transition between conventional aHT care and one or subsequent alternative models across years of care. Fourth, investigators could provide a description of the capacity that each model of care has to reach BP targets after a period of uncontrolled BP and to integrate care for important co-morbidities,like diabetes, HIV, or tuberculosis. Fifth, reports should aim to demonstrate a decrease of overall risk in CVD events and aHT-related end-organ damage. Sixth, studies should also include a description of the wider hypertensive population, not included in these models, including their treatment outcomes for reference comparison. Lastly, the reporting of costs and cost-effectiveness willbe crucial to mobilize investments that can catalyze a significant scale up of these services.

Strengths and limitations

Our review provides a comprehensive description and evaluation of the published community-based aHT care models, following a structured methodological framework. Equally, this review has several limitations. The concept of non-traditional, outside-of-facility health service is heterogenous, poorly defined and lacks standard terminology. Our search terms included most common related synonyms, however, despite the efforts to develop a broad literature search strategy following PRISMA guidance, the selection of standard search terms and databases may have excluded some relevant publications. Our search also excluded regional databases and grey literature; therefore, it is possible that we have missed evidence provided by interventions used in practice and not published. Lastly, we could have missed relevant data when the authors failed to provide sufficient details or disaggregated results [69, 77–80].

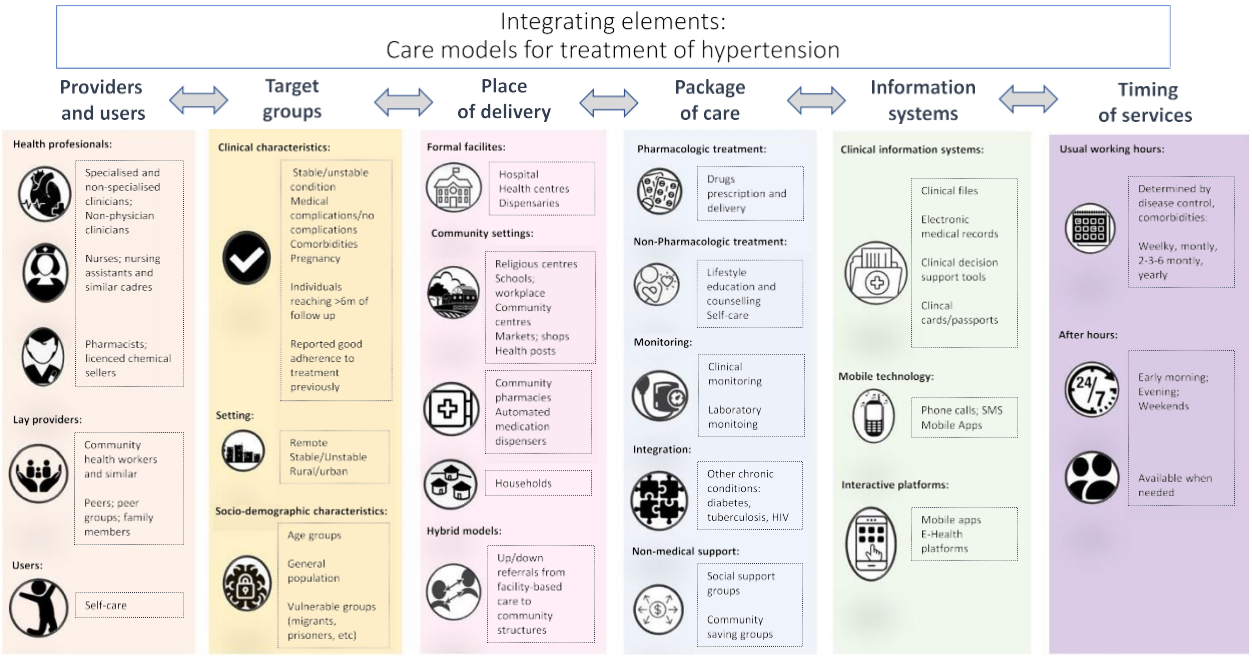

Fig. 4 A framework for design of aHT service models, considering their building blocks or main integrating elements

Conclusions

The search for efficient and sustainable service delivery models for the management of aHT in sub-Saharan settings, outside of conventional care, is a rapid evolving field. This scoping review has identified different community-based models that can potentially be seeds of scalable programs that integrate comprehensive chronic care. However, the wide heterogeneity of the studies, lack of standardization of definitions and measurement of outcomes, small number of participants, short follow up, and lack of reliable comparisons with standard of care, does not allow to describe their real impact in achieving long-term BP control and overall CVD risk decrease. The available literature does not provide a sound basis for policymakers and implementers on whether, and in what form, community-based care delivery models for aHT could be applied to counteract the growing CVD burden in sub-Saharan Africa. We propose that future projects and studies implementing and assessing community-based models of aHT care are designed and described according to six building blocks defining the providers, target groups, components, location, time of services and their use of information systems.

Abbreviations

ACE: Angiotensin-Converting Enzyme; aHT: Arterial Hypertension; ARBs: Angi-otensin Receptor Blockers; BP: Blood Pressure; CCB: Calcium channel blockers;CINAHL: Cumulative Index to Nursing and Allied Health Literature; CVDs: Car- diovascular Diseases; CHW: Community Health Worker; DBP: Diastolic Blood Pressure; NCDs: Non-Communicable Diseases; RCTs: Randomized Controlled Trials; SBP: Systolic Blood Pressure.

Supplementary Information

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Additional file 1: Annex 1. ScR databases search strategy.

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Authors' contributions

LGF, EF and NDL conceptualized the study and design. LGF, EF, ER and FU performed references screening, data collection and summarization. JH led the literature search and deduplication of sources. LG, ER, EF and NDL draftedthe manuscript. RG, TL, AA, FG, JM, and IA reviewed the manuscript draft. HU provided comments to the almost-final manuscript. All authors reviewed the results and approved the final version of the manuscript.

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Availability of data and materials

All data generated or analysed during this study are included in this published article [and its supplementary information files]. All articles used for the revieware in the references section.

Declarations

Ethics approval and consent to participate

Not applicable.

Consent for publication

Not applicable.

Competing interests

None declared.

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4. DISCUSSION AND OUTLOOK

This section aims to summarize and contextualize significant findings from the studies included in this thesis. Further extensions for this work are also discussed.

4. 1 The ComBaCaL baseline survey

4.1.1 Measuring cardiovascular risks and mental health problems in Lesotho

In order to investigate current prevalence estimates of a wide range of NCDs, we planned and conducted a household-based survey, in two of the ten districts situated in northern Lesotho. The design of the ComBaCaL survey followed the STEPS methodology and data collection occurred from 1 November 2021 to 31 August 2022. Used for first time in 2002, STEPS allows to collect, and report standardized information on NCDs in adults between 25 and 64 years, using questionnaires, physical measurements, and biological tests. This information has been typically used to monitor national trends, enable comparisons across countries, and inform health policies and programmes[70.]

To fulfill the objectives of different studies, we added other components to the standard STEPS methods: i) measurement of Hb1aC**,** that allows to discriminate between elevated glycemia on a random measurement and diabetes, ii) inclusion of questionnaires to measure depression, anxiety, trauma, and substance use, iii) stratification of the sample to investigate differences across sex and rural and (peri-)urban settings, and iv) inclusion of participants from 18-25 years and above 59 years.

We obtained a list of all 1011 administrative entities in the two districts, based on the Lesotho Census list 2016. After excluding clusters of population with less than 30 households and some areas that will be flooded in a dam construction in the coming years, the final list consisted of 785 inhabited clusters with at least 30 households each. We randomly selected 120 clusters, 60 rural and 60 (peri-)urban where the study team collected data from households and household members. The sample size was calculated using the STEPS sample size calculator that considers estimated proportion of the population who would meet the criteria for the primary conditions of interest (elevated BP, diabetes), and finally included 2000 adults between 18-29 years, and 4000 adults who were 30 years or older. Typically, a study team was composed of eight members and included nurses, nursing assistants, and lay health

workers, who after obtaining oral approval from the village chief, visited a total of 3498 households.

4.1.2 Assessing the quality of health services

In recent years clinical and public health professionals have adapted the so-called cascades of care (treatment) as means to evaluate the quality of different NCD programmes, following the example of HIV, TB, or malaria[71]. A care cascade is a set of pre-defined indicators, each representing discrete categories. Put together, these indicators describe critical and sequential steps in a patient's journey from the diagnosis of the health condition to reaching a health outcome. Typically, a care cascade contains four indicators or steps: i) screening or diagnosis, ii) awareness (does the person know he/she has the condition), iii) treatment initiation, and iv) retention in care, or treatment control. Each of these steps measures the number or percentage of people that meet the agreed definition. Usually, data is collected through (sub-)national and facility-based surveys, or using routine programs monitoring data[72,73]. This set of indicators is based on the framework for quality of healthcare originally developed by Avedis Donabedian in 1996 and typically includes process or outcome measurements[74,75]. Assumptions on quality of the health services are derived from the number and percentage of individuals included in each step. Satisfactory performance is achieved by having minimum dropouts -losses- across the steps, or by achieving pre-set targets.

The diabetes and hypertension care cascades were designed mirroring those routinely used in HIV or TB programmes. They have four pre-defined steps, including three process indicators and a fourth outcome indicator based on a biological measure that measures the control of the condition by achieving a BP or glycemia measurement below a standard value. In 2022 the World Health Assembly set the first-ever targets for diabetes care at 80% in each step by 2030, aiming to galvanize its routine use and allow comparability of data[76,77]. However, the WHO guidelines for the pharmacological treatment of hypertension in adults released in 2022, standardized the steps of the hypertension cascade, without specific targets[78]. In contrast, the cascades that evaluate mental health services are far less standardized, and their use as an evaluation tool is not widely spread[79,80]. In 2018 Alonso et al. conceptualized a care cascade and investigated the quality of available services for anxiety, using data from 23 community

surveys across 21 countries. The four steps had very wide definitions and included mostly process indicators[81].

Using these methods, I investigated the reach and quality of services for hypertension, diabetes, and an array of mental health problems in Lesotho, using the data collected in the ComBaCaL survey. I used the standard diabetes and hypertension care cascades indicators, whereas I adapted the proposed indicators by Alonso et al. to evaluate health services for moderate and severe symptoms of depression, anxiety, trauma, and substance use.

4. 2 High occurrence of cardiovascular risks and insufficient health services

The data analyzed from 6061 participants in the 2022 ComBaCaL survey demonstrated that tobacco use, elevated BP, overweight and diabetes are widespread health risks in Lesotho. These CVRFs affect adults of all age groups, are prevalent in both rural and urban areas, and as much as one in five adults present two or more overlapping CVDRFs. Overall, tobacco use was reported by 24.9% (95% confidence interval (CI) 23.9-26.1%), with higher use in men compared to women (40.2% vs. 10.9%). A total of 21.6% (95%CI 20.5-22.6%) participants had elevated BP measurements, more frequently in women (27.1% vs. 15.3%). Rates of elevated BP were particularly high in participants over 60 years old (49.9%) and were higher in (peri-)urban, than rural areas (25.3% vs. 17.6%). Overall, 39.9% (95%CI 38.7-41.2%) participants had overweight, more frequently in women (57.0% vs. 19.6%), in participants 30 years and older (28.1% vs. 44.3%), and in those living in (peri)-urban settings (44.0% vs. 33.8%). Interestingly, among younger participants (18-29 years), a total of 16.1% (95%CI 14.4-17.7%) participants reported tobacco use; 28.6% (95%CI 26.6-30.6%) had overweight; 1.5% (95%CI 1.0-2.1%) participants had diabetes; and 3.5% (95%CI 2.7-4.3%) participants had elevated BP. We found that different socioeconomic factors were associated with these health risks: elevated BP, overweigh, diabetes, and overlapping CVDRFs presented more frequently in women and adults living in wealthier households, while tobacco use occurred most frequently in men, adults with lower educational level, and poorer households.

These results offer a springboard to compare multiple morbidity measures and provide guidance as to which conditions are most common and deserve priority health interventions, across different population groups in Lesotho, and similar settings. Further, they are crucial inputs for studies on burden of disease, simulation models for future population health needs, or the design and implementation of clinical research studies. They call for interventions to

improve routine cardiovascular surveillance and reduce the associated effects in health. Specifically, developing and scaling country and regional structured surveillance tools for CVDRFs, for example through the District Health Information Software 2 (DHIS2), should be investigated[82,83]. Research can also elucidate effective and scalable socio-cultural, behavioral, and medical interventions, as well as their optimal combination to target different population groups in Lesotho and similar settings. Some of these groups include: i) young adults, despite that they do not often relate with the health system and may not prioritize long-term health[84,85], ii) people living with HIV, who have a combined higher risk of CVDs[86,87], iii) people at risk of TB disease or latent infection activation[88–90], and iv) adults who frequently travel or temporarily work in neighboring countries[91].

In a comparison with the HIV or TB cascades, in the ComBaCaL survey we found that the hypertension cascade reached 70-67-49 and the diabetes cascade reached 48-56-41. This represents a very sub-optimal performance with regards to rates of previous diagnosis, treatment initiation, and condition control for these risk factors. With regards to hypertension, one in three adults did not know they had hypertension, nor had initiated treatment, and only half of all the adults with hypertension had adequate BP control. The diabetes cascade shows even larger gaps across all the steps, as only half of the adults that screened positive for diabetes had a previous diagnosis or had initiated treatment. Glycemic control was achieved by less than half of diabetic adults. Hypertensive and diabetic young adults (18-30 years) and men had lower odds of being on treatment or being controlled than elder age groups and women. Surprisingly, we found that hypertensive and diabetic adults living in urban areas had lower odds to be on treatment than those in rural areas. This finding was contrary to other studies which have reported that hypertension and diabetes awareness and control in sub-Saharan Africa tend to be higher in urban areas[92,93], and merits further research.

While monitoring care cascades has become prominent in cardiovascular programmes in sub-Saharan Africa, the information obtained in cross-sectional surveys or programmatic settings must be considered in the light of several limitations. First, they tend to simplify the reality and give the impression that healthcare is homogenous across all sites where data is collected. Second, the information contained in each step definition may not be sufficiently defined or comparable. For example, in the case of hypertension, the indicator “treatment initiation” includes the number of individuals who, having the condition, take any pharmaceutical

treatment option to decrease BP, regardless of whether these options are prioritized in the global recommendations (i.e., optimal treatment choices, use of fixed dose combinations)[78]. Lastly, as hypertension and diabetes care cascades are designed to measure single risk factors, they fail to capture the essence of the comprehensive management of CVDRFs. Today, a significant intervention to reduce the negative effects of CVDRFs at individual and population level requires consideration to their multifactorial nature and should integrate a comprehensive approach to lifestyle and therapeutic interventions (i.e., addressing a single risk factor in an individual will leave a substantial CVD residual risk). Therefore, even if monitoring the care cascades for hypertension or diabetes may achieve progress to close service gaps for these specific risks, they can only offer limited information to inform sound national or global cardiovascular risk reduction strategies from the perspective of medical services.

4. 3 Unaddressed mental health problems

The ComBaCaL survey provided the first ever community-based prevalence estimates on a wide range of mental health problems in Lesotho, obtained through structured interviews and using validated questionnaires collected in 6061 participants. We found that the most prevalent problems were psychological trauma and excessive use of alcohol. A total of 18.5% participants reported at least one traumatic experience in their lifetime and 4.2% (95% CI 3.6-4.7%) participants screened positive for post-traumatic stress disorder. Overall, 1362 traumatic experiences were reported, representing an average of 1.21 events per participant who reported these events. Using a cutoff indicating moderate-severe symptoms (usually taken to indicate clinical levels of depression or anxiety), 1.7% (95% CI 1.4-2.1%) participants and 0.7% (95% CI 0.5-0.9%) participants reported these depression and anxiety symptoms, respectively. Suicidal thoughts were reported by 0.8% (95% CI 0.6-1.1%) participants. Amongst them, the median age was 41 years (IQR 27-51 years), 63.8% were women, 65.9% lived in urban areas and 23.4% had reported to live with HIV.

Among the participants who reported alcohol use in the previous three months, 36.4% (95% CI 33.9-38.6%) scored moderate-high risk of use, of which 81.6% (95%CI 78.5-84.8%) were men. Overall, 4.1% participants had consumed cannabis during the previous three months.

Among them, 93.5% (95% CI 90.5-96.6%) scored moderate-high risk of use, and 98.7% (95%CI 97.3-100.0%) were men.

In an effort to define the gap in mental health services, this study described also for first time the care cascades for mental health and substance use in this population. The treatment gap in mental health has been framed by experts as a result of shortages in either the supply side (i.e., services are available), rather than on the demand side (i.e., services are utilized)[94]. However, in 2018, the World Mental Health Surveys[95] found that the lack of perceived need for treatment has been, by far, the most frequent reason for not seeking services in mental health globally, and most importantly affects substance use[96]. Our results showed that in Lesotho only one in three participants who reported moderate-severe mental health problems, and one in ten participants who reported moderate-high risk for alcohol and cannabis had felt (considered) to approach the health system to receive services for their problems. This data supports the hypothesis that in Lesotho, in addition to the very low availability of mental health services, many adults who fall in the treatment gap, do not proactively seek health services for their problems. The factors at individual and system's level that contribute to such low demand for mental health services in this and similar settings warrant further investigation.

Perhaps, the most interesting finding was that the individuals who accessed mental health and substance use care obtained it from both health professionals and non-professionals, equally. As we adapted the definitions used by Alonso *et al*., the cascades steps measured very broad concepts. "Care" was defined broadly and included mostly medication and "talk therapy". Providers included specialized/general medical (psychiatric nurse, social worker, doctor, or nurse), complementary alternative medical (traditional healer), non-medical professional (religious or spiritual advisor), trained lay health worker (village health worker, lay counsellor, or similar), support provided by a close friend or family member (non-trained), and support provided by other community member (non-trained). Our findings confirm that, even if scarce, mental health services in Lesotho can be accessed in both in the formal and informal sectors and are provided by professional and non-professional workers. Such environment is most adequate to design, test, and scale task-shifted and task-shared interventions to close the supply side of the treatment gap[97,98]. Future research can help to identify culturally adapted interventions for the most prevalent conditions, validate tools, and

inform the needs to build up a responsive workforce, using the skills of available specialist and non-specialist professionals.

4. 4 Expanding cardiovascular care through community services

Health services that are anchored at community level have been proposed as solutions to expand services for hypertension and ensure long-term retention in sub-Saharan Africa, following successful experiences in HIV and TB programmes[99–103]. Such care models promote task-shifting, simplification of clinical algorithms, and integration of services for different conditions[104–106]. Nonetheless, by 2020, guidance on how such models should be structured, and to what extent tasks could be shifted to lower cadre health care providers in the sub-Saharan region had not been systematically compiled. I conducted a preliminary search of MEDLINE, the Cochrane Database of Systematic Reviews, and the Joanna Briggs Institute Evidence Synthesis that revealed no systematic reviews or similar scoping reviews on this topic. As a formative step to inform the design of a community-based and e-health supported hypertension care model to be tested in rural areas of Lesotho, I conducted a scoping review on this topic. Based on a standard study protocol[107] and a literature search strategy, two literature searches were conducted on 23 May 2021 and 15 October 2021. Of the 18,695 identified records, a total of 4,954 were screened and 12 studies were included in the study. Four types of hypertension care models were categorized: services provided at community pharmacies, out-of-facility, household services, and peers treatment groups. Most studies reported significant reductions in BP values and improved access to services through task-sharing. The overall quality of the studies was low, with high risk of bias[108].

Four distinct types of community-based hypertension services were described: provided by community pharmacists, delivered through temporary or permanent stations placed at strategic and accessible locations in the community, a mix of routine facility-based care complemented with home visits or services in other community locations to reduce patient visits to the facility, and services provided at the time of collecting medication in treatment groups. Due to the wide heterogeneity of the models of care, inclusion criteria, outcome definitions, participants follow up and study types we only described each of the studies individually, rather than providing aggregated statistics. The West African experiences mostly integrated pharmacists and microfinance solutions in urban areas, while East and Southern

African models tested interventions that increased access to care in rural communities. In all service models, care is most often provided by lower cadres of health workers, decreasing frequency of interactions with routine services, and combining a high level of self-care. Most of the models only included participants with already an acceptable BP control, had a short follow-up period, and did not seem to be associated with lower user satisfaction or worse treatment outcomes. A few studies collected patients' and service providers' perspectives. Lastly, only a minority of studies (four of the twelve) compared alternative models to conventional care or to other interventions, making it difficult to draw solid conclusions about the overall effectiveness of these models on clinical outcomes. The results of this study should be considered in the light of some limitations: perhaps the most relevant is that the search strategy was influenced by the fact that the concept of non-traditional, outside-of-facility health service is heterogenous, poorly defined, and lacks standard terminology. Our search terms included most common related synonyms; however, we used a selection of standard search terms and databases (i.e., excluded regional databases and grey literature), and this could exclude relevant publications.

In the process of summarizing the literature for this scoping review, we abstracted the main elements that integrate the models of care. They constitute the "building blocks": cadre of health care provider (who delivers the service, including self-care), target population (for whom the care model is created), location of service delivery (where is the service provided), components of the service package, information systems (methods used for collecting information about the users and the service), and the timing of service delivery (when is the service available to the user). An interesting concept abstracted from such framework was that expanding the provision of chronic hypertension care to health workers and structures that are outside of traditional care in facilities in these setting, reduces, but does not completely eliminate, the need of care provided by the scarce number of specialized staff. Nonetheless, in the light of critical shortages in the health workforce and the health needs shifting to a mix of maternal and child, infectious, and non-infectious conditions, community health workers can become an essential element to expand access to CVDs or mental health services in sub-Saharan Africa. Evidence suggesting feasibility and effectiveness of involving community workers in health programs for tobacco cessation, CVDRFs management, or mental health conditions is emerging[109–113]; however, important aspects that affect the engagement of community health workers, such as motivation, workload, integration of other

economic activities, wellbeing and health care, merit further investigation[114–117]. Further research could also shed light on to how leveraging other community mechanisms can improve diverse health outcomes in chronic care, such as the use of central chronic medicines dispensing and distribution programs or the promotion of self-care[118–120].

5. CONCLUDING REMARK

The studies presented in this PhD thesis draw attention to the widespread prevalence of cardiovascular risks, mental health, and substance use problems among adults in Lesotho, alongside with a significant treatment gap for these conditions. Following the demonstrated feasibility of community-based services for hypertension in sub-Saharan Africa, care and treatment for these issues could be similarly adapted and scaled up. The field of health services delivery for cardiovascular risks and mental health problems in low resource settings could be further enriched by elucidating a minimum and integrated package of care, tailored to the needs of most-at-risk groups and delivered by nurses, community workers, or peers. Ultimately, domestic and international health financial commitments should support routine surveillance and expansion of such services, with the aim to enhance the health system broadly.

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