

Prevalence and risk factors survey for hypertension and diabetes in rural western Kenya

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Abstract

Background

Hypertension and diabetes are rising causes of morbidity and mortality in sub-Saharan Africa, yet rural community-level data remain limited. National surveys often obscure local variation, hindering targeted prevention.

Methods

A population-based cross-sectional study was conducted in Kakum-Kombewa, Siaya County, Kenya (Dec 2024-Jun 2025). Multistage sampling identified 816 households, yielding 1,046 adults aged ≥ 18 years. Participants underwent household screening for blood pressure, random blood glucose, and anthropometry, with positive cases being referred to the hospital for confirmatory testing. Prevalence was estimated using descriptive statistics, while associations were examined with chi-square tests and generalized linear models.

Results

Known hypertension, diabetes, and comorbidity prevalence were 13.9%, 8.7%, and 4.9%, respectively. Confirmatory testing identified an additional 16.7% with hypertension, 9.1% with diabetes, and 9.9% with both. Risk factors included age ≥ 50 years, overweight/obesity, high waist-to-height ratio, elevated waist circumference, family history, and physical inactivity. Female sex, central adiposity, low activity, and family history remained significant predictors in multivariable models.

Conclusion

This study confirms a substantial burden of both diagnosed (known) and undiagnosed (previously unknown) hypertension and diabetes in rural Western Kenya. The high prevalence of undetected cases underscores the need for expanded community-based screening, improved follow-up, and integration of NCD care into primary health services. Many individuals with prior diagnoses exhibited poor disease control, highlighting the importance of adherence support, household-level monitoring, lifestyle modification, and regular risk assessment. Community-based screening served a dual role: identifying new cases and flagging poorly controlled patients, reinforcing its value as part of a continuum of care that bridges community health initiatives with formal health systems. Strengthening routine screening, lifestyle interventions, and consistent follow-up within rural health systems is essential to improve early detection, enhance disease control, and reduce long-term complications. Community-level screening emerges as a critical tool for surveillance, linkage, and continuity, ensuring that hypertension and diabetes care is continuous, coordinated, and population-centered.

Introduction

Hypertension and diabetes are the most significant non-communicable diseases (NCDs), not only due to their high prevalence but also because of their growing incidence and contribution to mortality [1]. Hypertension and diabetes cases have quadrupled since 1990. Together, they contribute substantially to global mortality and disability, underscoring the urgent need for strengthened prevention and control strategies [1–4]. While diabetes ranks fourth globally after cardiovascular diseases, cancers, and respiratory conditions, it is experiencing the fastest rate of increase [2,3,5]. Its coexistence more than doubles the risk of developing cardiovascular disease [6–9]. Hypertension affects an estimated 1.28 billion adults worldwide, while diabetes impacts over 537 million people [2]. Together, these conditions cause more than 40% of all non-communicable disease (NCD) deaths worldwide [10]. In Sub-Saharan Africa, the prevalence of hypertension is estimated at 30–40%, with nearly two-thirds of cases remaining undiagnosed [11,12], and 20–25% live with complications [13,14]. The prevalence of diabetes is increasing rapidly and is projected to reach 129% by 2045 in the African region [3,15], fueled by urbanization, dietary shifts, sedentary lifestyles, and aging populations. Kenya mirrors both the global and regional burden of hypertension and diabetes. Recent WHO estimates indicate that one in four adults lives with hypertension. At the same time, the IDF Diabetes Atlas (2025) reports a 3.1% adult prevalence of diabetes, equivalent to over 800,000 cases, with numbers projected to rise significantly by 2050 [1,3]. The 2015 STEP-wise survey reported that 24% of adults had high blood pressure, and 3% had raised fasting blood glucose [16].

Cascade of care studies indicate a substantial proportion of individuals with hypertension remain unaware of their condition. A global study estimated that 57.6% of adults with hypertension were not cognizant of their condition [12]. In Sub-Saharan Africa, awareness is particularly low, with approximately 73% of hypertensive individuals unaware of their diagnosis.[17] In Kenya, a national survey revealed that only 15.6% of individuals with hypertension were aware of their condition. Furthermore, the prevalence of undiagnosed hypertension appears to be significantly higher in rural areas. For instance, [18] reported a hypertension prevalence of 50% in rural Nakuru, with over 60% of cases undiagnosed. Additionally, a cross-sectional study conducted in Busia County reported a diabetes prevalence of 5.3%, with more than half of the cases previously unknown [19]. These statistics underscore a considerable hidden burden that is often obscured by national averages.

The Kenyan Ministry of Health has undertaken significant initiatives to address deficiencies in healthcare delivery in rural areas. Based on Kenya's National Strategic Plan for the prevention and control of Non-Communicable Diseases (2015–2025) and the Community Health Strategy (2020–2025), over 100,000 Community Health Workers (CHWs) have been formally integrated into the health system to bridge service delivery gaps at the community level. These CHWs have been equipped with blood pressure monitors and glucometers, thereby enhancing early risk identification through screening, health education, and health promotion. Their deployment responds to the strategic priority of expanding access to NCD services at the primary care level, where undiagnosed hypertension and diabetes remain widespread. This initiative is further embedded within the establishment of Primary Care Networks

(PCNs) and referral strategies under Kenya's universal health coverage (UHC) framework and Vision 2030, positioning CHWs as pivotal actors in the chronic care continuum.

To plan resource allocation effectively, it is essential to understand variations in the burden of disease within the country. Reliable estimates of local prevalence and undiagnosed rates remain limited [20]. The national survey data reveal substantial differences in hypertension prevalence, awareness, treatment, and control across regions and populations [17] in Kenya, ranging from 23–24% in the 2015 STEPwise survey to 29% in the 2022 KDHS [11,21,22] and 33.2% in 2025 [1]. Likewise, multi-country analyses demonstrate that estimates vary by methodology and locality, underscoring the importance of context-specific data [23]. Together, these findings highlight the need for locally generated evidence to guide health system planning and resource allocation.

While national surveys typically account for rural populations in their sampling frameworks, wide Socio-demographic, cultural, and geographic variations across regions may still pose challenges for comparability and interpretation of aggregate results. These complexities, alongside potential sampling errors and confounding factors, can obscure localized trends and limit the precision of general conclusions. Few community-based studies in Western Kenya provide combined, up-to-date estimates of both hypertension and diabetes, their previously undiagnosed proportion, and associated risk factors in the same population [24]. Without such granular data, county-level and national health planning and resource allocation risk being misaligned with actual needs. This study seeks to generate empirical, community-level evidence on the prevalence, undiagnosed burden, and risk factors for hypertension and diabetes in rural Western Kenya. The main objective of this study was to determine the prevalence and key risk factors of both known and previously unknown hypertension, diabetes, and their comorbidities in the rural Western Kenyan population. Specifically, the objectives are: to determine the prevalence of known hypertension and diabetes in the rural Siaya county, Western Kenyan population; to identify the proportion of unknown (previously undiagnosed) hypertension and diabetes in a rural Western Kenya Population and to explore the prevalence of key risk factors for hypertension and diabetes, and their association with having diabetes and/or hypertension in the rural Western Kenyan Population.

Methods

Study Design and Setting

This was a population-based cross-sectional study employing a quantitative, descriptive design. The study was conducted between December 2024 and June 2025 in Kakum-Kombewa, a rural sub-location within Alego-Usonga Sub-County, Siaya County, and western Kenya. The area has an estimated population of 5,600 residents across 1,335 households, with most individuals engaged in peasant farming, fishing, and informal trading. The population is predominantly of low socioeconomic status and faces limited access to healthcare services, health education, and preventive screening for non-communicable diseases (NCDs).

Kakum-Kombewa is a rural area comprising 11 villages. The region is served by 11 Community Health Workers (CHWs) and three primary health facilities. According to Kenya's health infrastructure norms and standards, each level of care has defined infrastructure and service delivery roles [25].

In Kenya, Community Health Workers (CHWs) act as the first point of contact for community healthcare services. Each village is served by one CHW, who provides basic health education and health promotion interventions. Their role is to provide preventive care, health promotion, early detection, screening, referral, and adherence support. Dispensaries and health centres (Level 2 facilities) which provide basic outpatient, preventive, and promotive services are staffed by nurses and Clinical officers, and [21,26].

However, these facilities are few, widely dispersed, and in some cases not compliant with national norms and standards for service delivery [27]. As a result, access to diagnostic services for hypertension and diabetes is significantly constrained. For example, at the study site, the nearest government health facility equipped to screen for these non-communicable diseases (NCDs) is the Boro Health Centre, located approximately 15 kilometers from Kakum-Kombewa. (see figure 1)

This distance poses a considerable barrier for community members who require routine screening and regular follow-up care. Consequently, dispensaries staffed by nurses and Clinical Officers are underutilized in providing ongoing care or screening for individuals with, or at high risk of, hypertension and diabetes. These facilities often operate with limited diagnostic capacity, laboratory services, and drug supply, and in some cases do not fully comply with national service delivery standards [28].

Target Population

The target population included all adults aged 18 years and above residing in the selected households of Kakum-Kombewa Sub-location. Eligibility criteria included being a usual resident (lived in the household for ≥ 6 months), which is a requirement for one to be registered in the CHPs Community Register, willingness to provide informed consent, and not being acutely unwell or cognitively impaired in a way that would prevent meaningful participation at the time of the visit.

Sample Size Estimation and Sampling Procedure

The sampling frame consisted of the 1,335 households in Kakum-Kombewa Sub-location, registered by Community Health Volunteers in the MOH 513 Household Register, which records household demographic data and is updated every six months. The sample size was calculated using the household survey formula:

Household sample size determination

Each household was considered a cluster within which eligible individuals would be recruited for the study. The minimum number of households required for the study was calculated using the approach

described by Bennett et al. [10], implemented by the function `epi.ssclus2estb` within the R package “`epiR`”. The following parameters were used:

- Number of households available for sampling = 1,335
- Average number of eligible individuals in each household = 2 (assuming an average household size of four, with two adults and two children) [29].
- Estimated prevalence of diabetes or hypertension = 200 per 1,000 population (i.e., 20%). This combined estimate reflects prior subnational studies in Kenya reporting hypertension prevalence ranging from 24% to 50% and diabetes from 3% to 5.3% [30].
- Desired margin of error (relative) = 0.1. For a 20% prevalence, a 10% relative margin implies $\pm 2\%$ absolute error.
- Estimated intra-cluster correlation coefficient (ICC) = 0.1. This value is commonly used in community-based NCD studies in rural settings where moderate clustering is expected [31,32]
- Confidence level = 0.95

The minimum number of clusters (households) determined to be included was 518, corresponding to a minimum of 1,036 individuals. In total, 816 households with 1,084 participants were identified from the households, of which 1050 were eligible, but 4 withdrew after initially consenting to participate in the study, leaving a total of 1046 participants.

Sampling Procedure

Siaya County, one of Kenya’s six counties located within the Lake Victoria Basin, was purposively selected for this study due to its notably high disease burden. Specifically, Siaya ranks fourth in HIV prevalence and second in HIV incidence nationally, while non-communicable diseases account for nearly 40% of deaths and half of inpatient admissions, underscoring a dual burden (MOH). To ensure a representative and systematic approach, a multistage sampling strategy was implemented, starting at the sub-county level and proceeding to individual households. At each administrative level, random selection methods were applied.

Of the six sub-counties, Alego-Usonga, Bondo, Rarieda, Gem, Ugunja, and Ugenya, Alego-Usonga was randomly selected. Within Alego-Usonga, Central Alego Ward, Kakum-Kombewa sublocation was randomly selected for the study. All 11 villages within Kakum-Kombewa in Central Alego Ward were included in the sampling frame. Households in each village were identified through systematic random sampling. The households are listed by village. Village and household numbers were used to randomly select the first household, then every even household number was selected until the selected sample size for the village was reached. The number of households selected per village was proportionate to its size (probability proportional to size-PPS) to ensure geographic representativeness across the sub-location. The total number of households screened was 816, with a population of 1046 household members. All eligible household members who provided informed consent were enrolled in the study. Additional details are in Table 1.

Table 1: Actual proportionate distribution per village

Village	Number of Households	Household Population	Actual recruited households	% of enrolled Households
Liganwa	155	580	98	63
Ndere C	150	560	95	63
Sirongo	149	550	94	63
Nyamboyo	137	540	85	62
Uyore	135	460	84	62
Ndere B	116	562	71	61
Magwar	115	445	71	62
Nyadhi A	110	670	64	58
Ndere A	108	469	66	61
Nyadhi B	90	500	54	60
Rarieda	56	300	34	61
Total	1321		816	

Data Collection and Procedures

Data were collected using structured interviews, anthropometric assessments, and biomedical measurements, all conducted at the household level by trained Community Health Workers. The data collection tools were adapted from the World Health Organization's Stepwise Approach to NCD Surveillance (WHO Steps), IDF Diabetes Atlas, 2021, and pretested in a similar rural setting. The consenting participants underwent a structured interview that comprised demographics and risk factor assessment, Physical measurements (blood pressure, weight, height, waist circumference, and Key ratio measurements- waist-hip ratio, waist-height ratio), and capillary blood glucose testing. All data collection was conducted at the household level.

Sociodemographic and Behavioral Variables included age, sex, marital status, education, occupation, and geographical location, behavioral risk factors (smoking, alcohol use, dietary habits, and physical activity), and family history of hypertension or diabetes. Anthropometric and clinical measures comprised the assessment of weight and height measured using calibrated scales and stadiometers to calculate BMI. Waist circumference was measured at the midpoint between the lower rib and the iliac crest. Blood pressure was measured three times at one-minute intervals using an automated digital blood pressure machine, and the average of the three taken if the 1st measurement was raised. Capillary blood glucose was measured using a calibrated On-Call Plus glucometer; fasting or random blood sugar measurements were recorded in mmol/l. For fasting assessment, participants were asked whether they

had consumed anything other than plain water in the past 10 hours (yes/no). If they answered "yes," a random blood sugar test was conducted; if "no," a fasting blood sugar test was performed. Tables 2 below and Table 6 in Appendix 3 have more details. Further, see Figure 3 in Appendix 2 for the risk score status for cardiovascular Diseases.

Table 2: Objectives, Variables, Data Collection, and References

Objective	Variables & Operational Definition / Measurement	How It Was Done (Data Collection)	Reference
1. To determine the prevalence of hypertension and diabetes, and their comorbidity	Blood pressure (3 readings at an interval of 5 minutes and an average documented): Hypertension defined as SBP ≥ 140 mmHg and/or DBP ≥ 90 mmHg (new/undiagnosed); Pre-existing hypertension confirmed by HCW or current antihypertensive use	BP measured using a validated digital Omron BP machine; three readings averaged	WHO STEPS Manual (2020); IDF Diabetes Atlas (2021);
	Diabetes: Fasting glucose ≥ 7.0 mmol/L or random glucose ≥ 11.1 mmol/L; confirmed by HCW or current diabetes medication	Blood glucose measured via On-Call Plus glucometer (fasting if ≥ 10 hours since last meal; random otherwise)	WHO STEPS Manual (2020); IDF Diabetes Atlas (2021);
	Diabetes/HTN status: Self-report of medication use for HTN/DM and observed	Interview and direct confirmation of the availability of medicines	WHO STEPS Manual (2020); IDF Diabetes Atlas (2021)
	Comorbidity: Concurrent diagnosis of both HTN and DM	Self-report of medication use and observed	WHO STEPS Manual (2020); IDF Diabetes Atlas (2021)
2. To identify the prevalence of undiagnosed hypertension and diabetes	Undiagnosed HTN: SBP ≥ 140 mmHg and/or DBP ≥ 90 mmHg with no prior diagnosis or medication; confirmed on follow-up after referral	BP measured at screening; confirmation by HCW after referral	WHO Global Monitoring Framework; IDF Diabetes Atlas (2021)
	Undiagnosed DM: Fasting glucose ≥ 7.0 mmol/L or random glucose ≥ 11.1 mmol/L with no prior diagnosis or medication; confirmed by HCW after referral	Blood glucose measured via glucometer; confirmation by HCW after referral	WHO Global Monitoring Framework; IDF Diabetes Atlas (2021)
	Cross-check with self-reported diagnosis and medication use	Interview and observation	WHO Global Monitoring Framework
3. To explore the prevalence of key risk factors and their association with HTN and/or DM	Age, Sex	Risk questionnaire (Part A)	WHO STEPS Survey Tool; WHO Global NCD Action Plan;
	Anthropometric measurements: Height, weight, waist, hip	Height and weight measured using tape and scale; waist/hip circumference	WHO STEPS Survey Tool; WHO Global NCD Action Plan

	measured with tape													
BMI categories: Normal (18.5–24.9), Overweight (25.0–29.9), Obesity I (30.0–34.9), Obesity II (35.0–39.9)	Calculated from measured height and weight	WHO STEPS Survey Tool												
Waist circumference risk: Men >102 cm = high risk; Women >88 cm = high risk Waist circumference	Measured with tape at standard anatomical sites	WHO STEPS Survey Tool												
<table border="1"> <thead> <tr> <th>Women</th><th>men</th><th>Risk Level</th></tr> </thead> <tbody> <tr> <td>Less than 80 cm</td><td>Less than 94cm</td><td>Normal</td></tr> <tr> <td>81- 88cm</td><td>94- 102 cm</td><td>Moderate risk</td></tr> <tr> <td>More than 88</td><td>More than 102</td><td>High risk</td></tr> </tbody> </table>			Women	men	Risk Level	Less than 80 cm	Less than 94cm	Normal	81- 88cm	94- 102 cm	Moderate risk	More than 88	More than 102	High risk
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Less than 80 cm	Less than 94cm	Normal												
81- 88cm	94- 102 cm	Moderate risk												
More than 88	More than 102	High risk												
Lifestyle and family history: Smoking, alcohol, physical activity, family history of HTN/DM/heart disease	Questionnaire administered by trained CHWs	WHO STEPS Survey Tool; WHO Global NCD Action Plan												
Smoking status: Never, past, sometimes, daily	Self-report via questionnaire	WHO STEPS Survey Tool												
Alcohol use: Assessment of Alcohol Use: Alcohol consumption was assessed using a self-reported questionnaire item: “Do you consume alcohol daily?” Responses were coded as: 0 = No daily consumption 1 = Yes, daily consumption. Daily alcohol use was classified as an elevated risk factor for cardiovascular disease, consistent with established public health guidelines.	Self-report via questionnaire	WHO STEPS Survey Tool												
Physical activity: Assessment of Physical Activity: Physical activity was assessed using a self-reported questionnaire item that asked participants: “Do you undertake any physical activities for a minimum of 150 minutes in a week?” Responses were categorized as: 0 = sufficient activity (≥150 minutes of moderate physical activity per week)	Self-report via questionnaire	WHO STEPS Survey Tool												

1 = insufficient activity/Physical inactivity (<150 minutes of moderate physical activity per week). This classification was based on the World Health Organization (WHO) recommendations for minimum weekly physical activity required for health benefits.

Family history: Parent/sibling with HTN/DM/heart disease = positive	Self-report via questionnaire	WHO STEPS Survey Tool									
Waist-Height ratio This is a measure of abdominal fat distribution. Waist in (cm) /Height(cm)	Ratio is auto-calculated through the REDCap	WHO									
<table><tr><td>Values</td><td>Risk Level</td></tr><tr><td>0.4- 0.49</td><td>Healthy</td></tr><tr><td>0.5- 0.59</td><td>Increased Risk</td></tr><tr><td>Above 0.6</td><td>High Risk</td></tr></table>	Values	Risk Level	0.4- 0.49	Healthy	0.5- 0.59	Increased Risk	Above 0.6	High Risk			
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<table><tr><td></td><td>women</td><td>Male</td></tr><tr><td>Normal</td><td>Less than=< 0.85cm</td><td>Less than=< 0.90cm</td></tr><tr><td>High risk</td><td>More than =>0.85cm</td><td>More than =>0.90cm</td></tr></table>		women	Male	Normal	Less than=< 0.85cm	Less than=< 0.90cm	High risk	More than =>0.85cm	More than =>0.90cm		
	women	Male									
Normal	Less than=< 0.85cm	Less than=< 0.90cm									
High risk	More than =>0.85cm	More than =>0.90cm									
Risk score for cardiovascular diseases: Composite score from risk factors (age, sex, smoking, alcohol, BMI, physical activity, family history)	Derived from questionnaire responses	WHO STEPS Survey Tool									

Data Management and Analysis

Data were collected electronically using REDCap (Research Electronic Data Capture), a secure, web-based application designed for building and managing online surveys and databases. This approach facilitated real-time data entry at the point of collection, minimizing data entry errors and enhancing data integrity. Following data collection, the dataset was exported from REDCap and imported into R statistical software (version 4.5.1) for initial data cleaning, validation, and analysis. Data cleaning procedures included checking for missing values, outliers, inconsistencies, and logical errors, with discrepancies cross-verified against original entries and field notes.

Descriptive statistics were used to summarize participant demographics and the prevalence of both diagnosed and undiagnosed hypertension and diabetes, along with associated risk factors in those with HTN and/or DM and in the undiagnosed group. A combined logistic regression model was developed by integrating data from participants who were previously diagnosed with diabetes or hypertension and those newly identified through household screening and later confirmed at health facilities. Prevalence estimates were calculated with 95% confidence intervals, adjusted for the survey's complex design. Associations between primary outcomes and potential risk factors were initially examined using chi-square tests. Independent variables considered for inclusion in the logistic regression model were age, sex, smoking status, BMI, alcohol consumption, physical activity, and family history of non-communicable diseases (NCDs). Variables were retained in the final model if they met the statistical significance threshold ($p < 0.05$) during model selection. Variable selection followed the purposeful selection approach described by [33], retaining predictors based on both statistical significance and clinical relevance, including potential confounding effects.

To enhance model flexibility and accommodate the binary nature of the outcome variables (presence or absence of HTN and/or DM), Generalized Linear Models (GLMs) with a binomial distribution and logit link function were employed. GLMs were preferred for their ability to handle outcomes considered to be not normally distributed and to model relationships between predictors and dichotomous outcomes.

The model-building process involved:

- Univariable screening of candidate predictors to identify variables associated with hypertension, diabetes, and their co-occurrence.
- Sequential multivariable modelling, where variables were added stepwise, and those losing statistical significance were re-evaluated for confounding influence before exclusion.
- Consideration of interaction terms between key covariates, guided by theoretical plausibility and prior literature.

Final models reported adjusted odds ratios (AORs) with 95% confidence intervals to identify independent predictors. Model performance was assessed using the Hosmer-Lemeshow goodness-of-fit test, classification tables, and the area under the receiver operating characteristic (ROC) curve to evaluate discrimination. Sensitivity analyses were conducted to ensure robustness of findings

For the chi-square tests of association, disease status was defined as the presence of hypertension and/or diabetes mellitus, including comorbidity. This outcome was used to evaluate associations across demographic and clinical variables. Separate chi-square analyses for each condition were not performed; instead, a generalized linear model was applied to identify predictors of hypertension, diabetes mellitus, and their coexistence.

We built a Generalized linear model (GLM) (1. HTN and/or DM; 2. HTN only, 3. DM only; 4. Comorbidity, and 5 previously unknown with selected covariates (age, sex, BMI, smoking, alcohol use, physical

activity, family history, waist/height measures, and blood pressure categories) were retained for adjustment (see tables 7, 8, 9, and 10 in the appendices for more details)

Results

Characteristics of the Study participants

Of the total 1,046 people who were included in the study, females accounted for 732 (70.0%). Approximately half of the participants were aged 50 years or older (497; 47.5%), followed by those aged 30-49 years (402; 38.4%), while only 147 (14.1%) were younger than 30 years (Table 2). Overall, 255 (24%) were categorized into the high-risk score for cardiometabolic risk, and 76% (791) in the low-risk category (Figure 2 in the Appendix section).

Prevalence of Known Hypertension, Diabetes, and Comorbidity

The study found a notable prevalence of known cases with chronic conditions in the community. The prevalence of known hypertension (pre-existing cases) was 145 (13.9%), while the prevalence of known cases of diabetes (pre-existing) was 91 (8.7%). Having both HTN and DM conditions was found in 51 (4.9%) of the population. (see Table 3).

Table 3. Prevalence of Known Cases of Hypertension, Diabetes, and Comorbidity

Condition	Total N	Known Cases(n)	Prevalence (95% CI)
Hypertension	1,046	145	13.9% (11.8-16.1)
Diabetes	1,046	91	8.7% (7.1-10.6)
Comorbidity (HTN + DM)	1,046	51	4.9% (3.7-6.4)

Prevalence of unknown (previously undiagnosed) cases of hypertension, diabetes, and hypertension-diabetes Comorbidities

Out of 1,046 individuals screened, 423 (40.4%) were identified and referred to a health facility for further evaluation due to either elevated blood pressure (EBP) or elevated blood sugar (EBS), of whom 385 (91.0%) completed the referrals. Follow-up efforts were conducted every 2 weeks for 6 months for all referrals (n = 423) to ascertain their status. Unfortunately, 38 (9.0%) did not complete the referrals despite attempts made to follow them up during the study period. Among those who completed referrals, 122 individuals were already diagnosed (known cases) with a condition at the time of referral, while 263 had no prior diagnosis. Among those who had no prior diagnosis, 24 individuals (9.1%) were

confirmed with Diabetes Mellitus (DM), 44 individuals (16.7%) with Hypertension (HTN), and 26 individuals (9.9%) confirmed with comorbidity (both DM and HTN). Figure 2 for more details.

Key Risk Factors for Hypertension and Diabetes

The following factors were associated with increased risk of hypertension and/or diabetes mellitus (HTN/DM) (Table 2). Age was a notable risk factor: 42.3% of participants aged 50 years and above had HTN/DM compared to 29.9% among those under 30 ($p = 0.0009$). Anthropometric measures showed strong associations with hypertension and/or diabetes (HTN/DM). Overall, 30.8% of participants were overweight or had mild to moderate obesity (BMI 25.0–39.9 kg/m²; $p = 0.0002$), and both BMI and abdominal adiposity measures were associated with diagnosis: 47.9% of individuals classified as high-risk by waist–height ratio ($p = 0.0016$) and 42.0% by waist circumference ($p = 0.0322$) presented with HTN and/or DM. In addition, a family history of hypertension or diabetes (31.1%; $p = 0.0005$) and physical inactivity (<150 minutes/week; $p = 0.0031$) were also significantly associated with HTN/DM.

These results are presented in Table 4 below, with condition-specific findings detailed in Appendix 4. (see Table 7,8,9, and 10 in the appendix)

Table 4: Participants’ Characteristics and Risk Factors for HTN and/or DM status

Characteristics	Overall: N=1046 N (%)	HTN and/or DM		p-value
		No: N (%)	Yes: N (%)	
Male	314 (30.0)	190 (60.5)	124 (39.5)	0.2007
Female	732 (70.0)	475 (64.9)	257 (35.1)	
Age category				
Below 30 years	147 (14.1)	103 (70.1)	44 (29.9)	0.0009***
30- 49 years	402 (38.4)	275 (68.4)	127 (31.6)	
50 or more years	497 (47.5)	287 (57.7)	210 (42.3)	
Body Mass Index (BMI) Category*				
Extreme Obesity	23 (2.3)	11 (47.8)	12 (52.2)	0.0002***
Normal	508 (50.1)	339 (66.7)	169 (33.3)	
Mild obesity	112 (11.0)	52 (46.4)	60 (53.6)	
Moderate Obesity	41 (4.0)	21 (51.2)	20 (48.8)	
Overweight	279 (27.5)	183 (65.6)	96 (34.4)	
Underweight	52 (5.1)	38 (73.1)	14 (26.9)	
Waist-Hip Ratio				
High risk	667 (63.8)	418 (62.7)	249 (37.3)	0.0583
Normal	379 (36.2)	247 (65.2)	132 (34.8)	
Waist Circumference Ratio				
High risk	338 (32.3)	196 (58.0)	142 (42.0)	0.0322*
Moderate risk	248 (23.7)	162 (65.3)	86 (34.7)	
Normal	460 (44.0)	307 (66.7)	153 (33.3)	
Waist-Height ratio*				
Normal	301 (32.1)	197 (65.4)	104 (34.6)	0.0016**
High risk	213 (22.7)	111 (52.1)	102 (47.9)	
Moderate risk	424 (45.2)	279 (65.8)	145 (34.2)	
Family History of Hypertension and Diabetes				
No	721 (68.9)	484 (67.1)	237 (32.9)	0.0005***
Yes	325 (31.1)	181 (55.7)	144 (44.3)	

Smoking				
Never	920 (88.0)	591 (64.2)	329 (35.8)	0.0519
Used to take in the past/sometimes	108 (10.3)	61 (56.5)	47 (43.5)	
Daily	18 (1.7)	13 (72.2)	5 (27.8)	
Alcohol Use				
No	946 (90.4)	604 (63.8)	342 (36.2)	0.0502
Yes	100 (9.6)	61 (61.0)	39 (39.0)	
Moderate Physical Activity				
At least 150 minutes a week	794 (75.9)	525 (66.1)	269 (33.9)	0.0031**
Less than 150 minutes a week	252 (24.1)	140 (55.6)	112 (44.4)	

Table legend: * Missing data in the Waist-height ratio and BMI also had minor gaps due to incomplete anthropometric measurements, which were excluded in the analysis. *p<0.05, **p<0.01, and ***p<0.001

These results are presented in Table 5, with condition-specific findings detailed in Appendix 4 (Tables 7, 8,9, and 10).

Generalized linear model (GLM) models, presented in Table 5, identified key risk factors for having either HTN, DM, or both conditions. The GLM analysis identified physical inactivity (<150 min/week; OR = 0.507, p = 0.002) and family history of hypertension or diabetes (OR = 0.492, p = 0.002) as significant risk factors for HTN, DM, and their comorbidity, underscoring the need for targeted screening in these groups. (see Table 5 below)

Table 5: GLM-Identified Risk Factors for having Hypertension and/or Diabetes

Predictor	OR	Std. Error	z value	p-value
(Intercept)	0.2884	0.6714	0.43	0.668
Age Category				
Age 30–49 years	-0.0615	0.2364	-0.26	0.795
Age ≥50 years	0.4467	0.2353	1.899	0.058
Sex				
Female (vs Male)	-0.5465	0.201	-2.719	0.007**
Waist-Hip Ratio				
Waist-Hip Ratio (Normal vs High)	0.1188	0.1703	0.698	0.485
Waist Circumference				
Waist Circumference (Normal vs Moderate risk)	-0.0404	0.2268	-0.178	0.859
Waist Circumference (Normal vs High risk)	-0.5476	0.2927	-1.871	0.061
Waist-Height Ratio				
Waist-to-Height Ratio (High Risk vs Normal)	-0.1945	0.351	-0.554	0.579
Waist-to-Height Ratio (Moderate Risk vs Normal)	-0.3501	0.2354	-1.487	0.137
BMI				
BMI (Normal vs Overweight)	0.4314	0.685	0.1370	0.556
BMI (Normal vs Underweight)	1.894	1.231	1.946	0.382
Smoking				
Smoking (Past/Sometimes vs Never)	0.0802	0.2448	0.328	0.743
Smoking (Daily vs Never)	-0.7239	0.6121	-1.183	0.237
Alcohol				
Alcohol (Yes vs No)	0.0373	0.2878	0.13	0.897
Physical Activity				
Recommended Physical Activity (k ≥150 min/week)	0.5068	0.1675	3.027	0.002**
Family History				
Family History (Yes vs No)	0.4919	0.155	3.174	0.002**

Table legend: *p<0.05, **p<0.01, and ***p<0.001

The GLM analysis (Appendix 4) identified associations between risk factors and either one or both of the conditions. Having hypertension or diabetes without being aware was associated with a younger age. Older adults (OR = 1.471, $p < 0.001$), female sex (OR = 1.073, $p < 0.001$), and having a normal waist circumference (OR = 1.369, $p = 0.001$) had lower odds of being undiagnosed.

Discussion

Prevalence of Known and Unknown Cases of Hypertension, Diabetes, and Comorbidity

This study assessed the prevalence of hypertension, diabetes, and their comorbidity in a rural population in Western Kenya. It also examined the previously undiagnosed cases and key risk factors associated with these conditions in a rural western Kenya population of Siaya County.

The results revealed that 13.9% of adults were known cases (previously diagnosed) with hypertension, 8.7% were known cases of diabetes, and 4.9% were living with both conditions concurrently. These figures highlight a substantial burden of these conditions in this rural community. The prevalence of hypertension observed here is consistent with earlier rural Kenyan studies reporting rates between 12% and 30% [34]. Similarly, the prevalence of diabetes is similar to regional estimates. The prevalence of known diabetes in our study is broadly comparable to findings from other population-based surveys in sub-Saharan Africa, which report rates ranging from 3% to 6% in Kenya [35,36] and 5% to 7% in Tanzania and Uganda [37-39], and 10.2% undiagnosed diabetes in Ethiopia.

Importantly, our study also documented a high burden of previously undiagnosed disease. In our community screening, nearly one-third of participants not previously aware of any condition were referred for diagnostic testing, and of these, 16.7% were confirmed hypertensive, 9.3% diabetic, and 9.7% having both conditions. This underpins the rationale for intensifying community-based screening programs, linkage to care, and awareness campaigns, as advocated in the WHO Package of Essential Noncommunicable Disease Interventions (WHO PEN). Additionally, raising awareness alongside screening interventions could further enhance community dialogue and health-seeking behavior as well as improve cultural perceptions of chronic diseases. Addressing both supply- and demand-side factors simultaneously is a critical approach to achieving effective reductions in the burden of hypertension and diabetes in Africa and similar settings. Evidence from Nigeria underscores the importance of policy frameworks [42], while findings from Kenya highlight the need to strengthen health system capacity [40]. Complementary lessons from Iran's Health Transformation Program demonstrate that financial protection mechanisms are essential to ensure equitable access and sustainability [43]. Together, these perspectives illustrate that integrated strategies are required to achieve meaningful progress in NCD control.

This study confirms well-established knowledge about risk factors for hypertension and diabetes in a rural Kenyan population [2,3,41,45–47].

Strengths and Limitations of the Study

The study reports findings from a rural Western Kenyan population, a region often underrepresented in NCD research, thereby filling a critical gap in national and regional evidence. Moreover, by quantifying comorbidity, the study allows examining the emerging double burden of two dominant non-communicable diseases in rural populations.

However, the study has limitations. Self-reported data on lifestyle behaviors may be affected by recall or social desirability bias. Other limitations are: a cross-sectional design, which does not allow for causal inferences about associations, and a lack of data on other comorbidities. The study may be subject to sampling bias as 70 percent of the participants were women, which may limit generalizability to the broader population. This disproportionate representation could limit the generalizability of the findings, particularly with respect to male participants. A possible explanation for this imbalance is cultural: in many rural settings, women are more likely to remain at home to manage household responsibilities, while men are often away working to support the family, or maybe women live longer than men, and most homes have widows.

Implications for Research and Practice

Our findings underscore the need to strengthen community-level screening and preventive programs for NCDs in rural populations. With community health workers (CHWs) now professionalized within Kenya's health system, efforts should prioritize their training, supervision, and provision of low-cost diagnostic tools. Rather than a one-time event, community screening functioned as a continuum of care, linking detection with referral and follow-up. This practical approach reflects the value of standardized risk assessment guides and toolkits when adapted to local outreach, supporting early identification and re-engagement of patients who may have disengaged from formal care [41,48].

Importantly, diagnosis alone does not guarantee effective disease management. Among those previously diagnosed, 69% of hypertensive and 66.7% of comorbid participants required further clinical review, highlighting gaps in adherence, monitoring, and follow-up. These challenges, irregular medication use, limited health education, financial barriers, and weak continuity of care, are common in rural settings. Embedding household-level follow-up, led by CHWs and family caregivers, within the primary healthcare model is therefore essential to ensure sustained disease control beyond health facilities.

Conclusion

This study demonstrates a substantial burden of both diagnosed and undiagnosed hypertension and diabetes in a rural Western Kenyan community. The high prevalence of undetected cases underscores the need for expanded community-based screening, improved follow-up, and integration of NCD care into primary health services to strengthen population health outcomes. Many individuals with prior diagnoses exhibited abnormal blood pressure or glucose levels, highlighting suboptimal disease control

and the importance of adherence support, household-level monitoring, lifestyle modification, and regular risk assessment. Caregiver toolkits and risk assessment guides could further reinforce these efforts. Community-based screening served a dual role: identifying new cases and flagging poorly controlled patients already in care. This reinforces its value as part of a continuum of care that bridges community health initiatives with formal health systems.

Overall, the findings emphasize the urgency of integrating routine NCD screening, lifestyle interventions, and consistent follow-up within rural health systems. Strengthening these components is essential for improving early detection, enhancing disease control, and reducing long-term complications. Community-level screening emerges as a critical tool for surveillance, linkage, and continuity, ensuring that hypertension and diabetes care is continuous, coordinated, and population-centered.

Declarations

Data availability

The datasets generated and analyzed during the current study are not publicly available due to institutional requirements. However, they can be accessed upon reasonable request through the corresponding author (SOO). Any data sharing will be subject to compliance with the approved ethical protocols and the principles governing research conduct at the University of Antwerp and within the VLIR scholarship framework.

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Contributions

SOO conceptualized the study, conducted the literature review, developed data collection tools, analyzed the data, and wrote the manuscript. AO, JO, DA, JB, OJO, and JVO contributed to the study conception and reviewed the manuscript. SOO and OJO helped with programming data collection tools in REDCap. SOO and OJO handled data cleaning and analysis. AO, JO, JB, and JVO provided technical guidance and critical feedback on the manuscript. All authors read and approved the final version. SOO assumes full responsibility for the study, including data access and publication decisions.

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Ethics declarations

Ethics approval and consent to participate

The study protocol was reviewed and approved by multiple ethics committees and regulatory bodies: Jaramogi Oginga Odinga Teaching and Referral Hospital Institutional Scientific and Ethics Review Committee (JOOTRH–ISERC/JOOTRH/026/24), Jaramogi University of Science and Technology Ethics Review Committee (JOOUST–ERC/5/24-06), the National Commission for Science, Technology, and Innovation (NACOSTI–License Nos. NACOSTI/P/23/25192 and NACOSTI/P/24/32866), the University of Antwerp Hospital Ethics Committee (Project ID 7496), and the Siaya County Government Research Review Committee (CGS/CHD/RESEARCH/141/VOL.VI (4)). Written informed consent was obtained from all participants before blood pressure, blood sugar, and anthropometric measurements. The consenting process emphasized the voluntary nature of participation, ensuring that individuals understood the study’s risks and benefits before agreeing to take part. Participants provided consent both before and during the study period. All study procedures were carried out in accordance with relevant guidelines and standards, including the Declaration of Helsinki, and adhered strictly to the approved protocol.

Consent for Publication

Not applicable.

Competing interests

The authors declare no competing interests.

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Figures

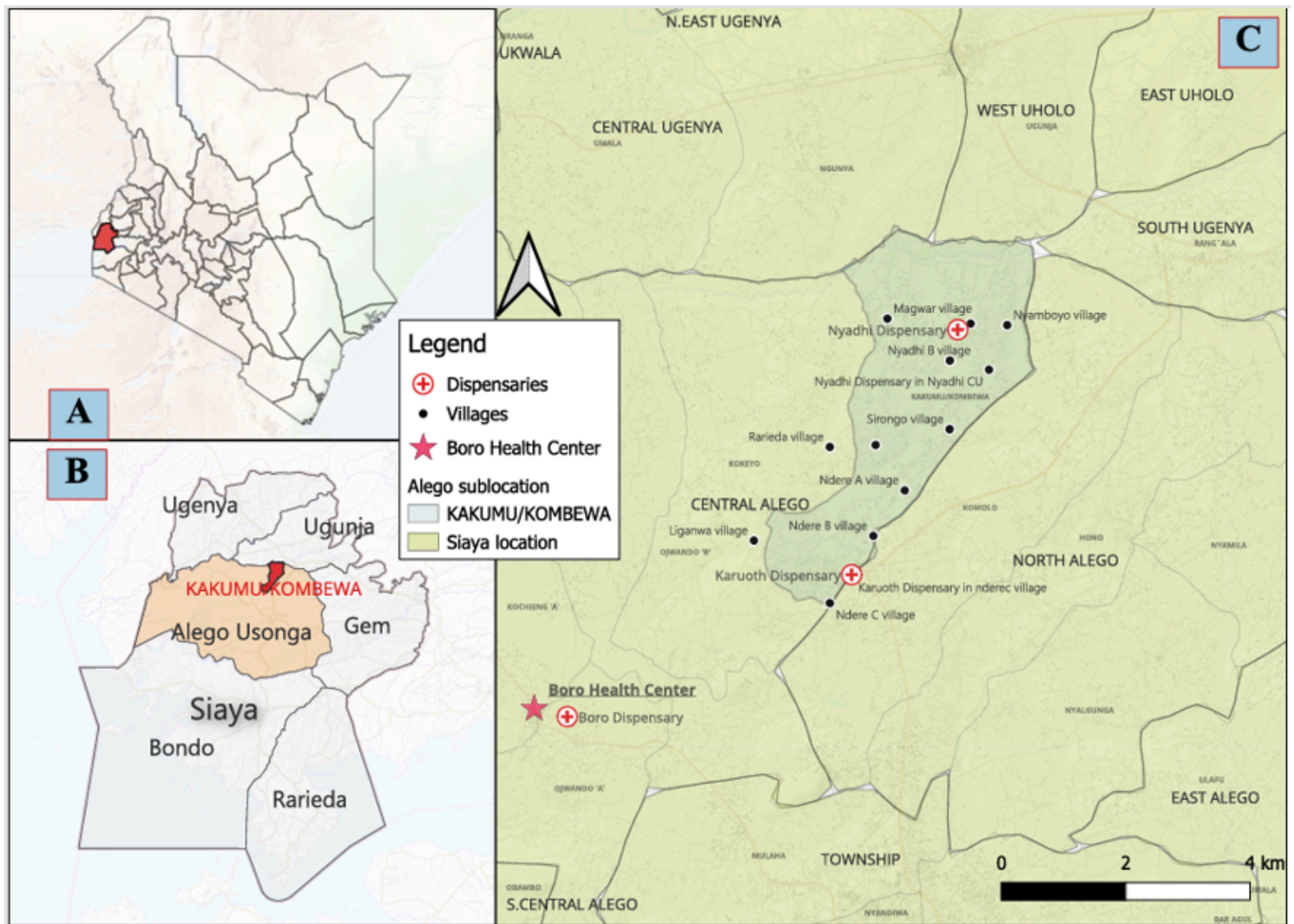


Figure 1

Map of the study area: Kakum-Kombewa Sub-location, Alego-Usonga Sub-County, Siaya County, Kenya.

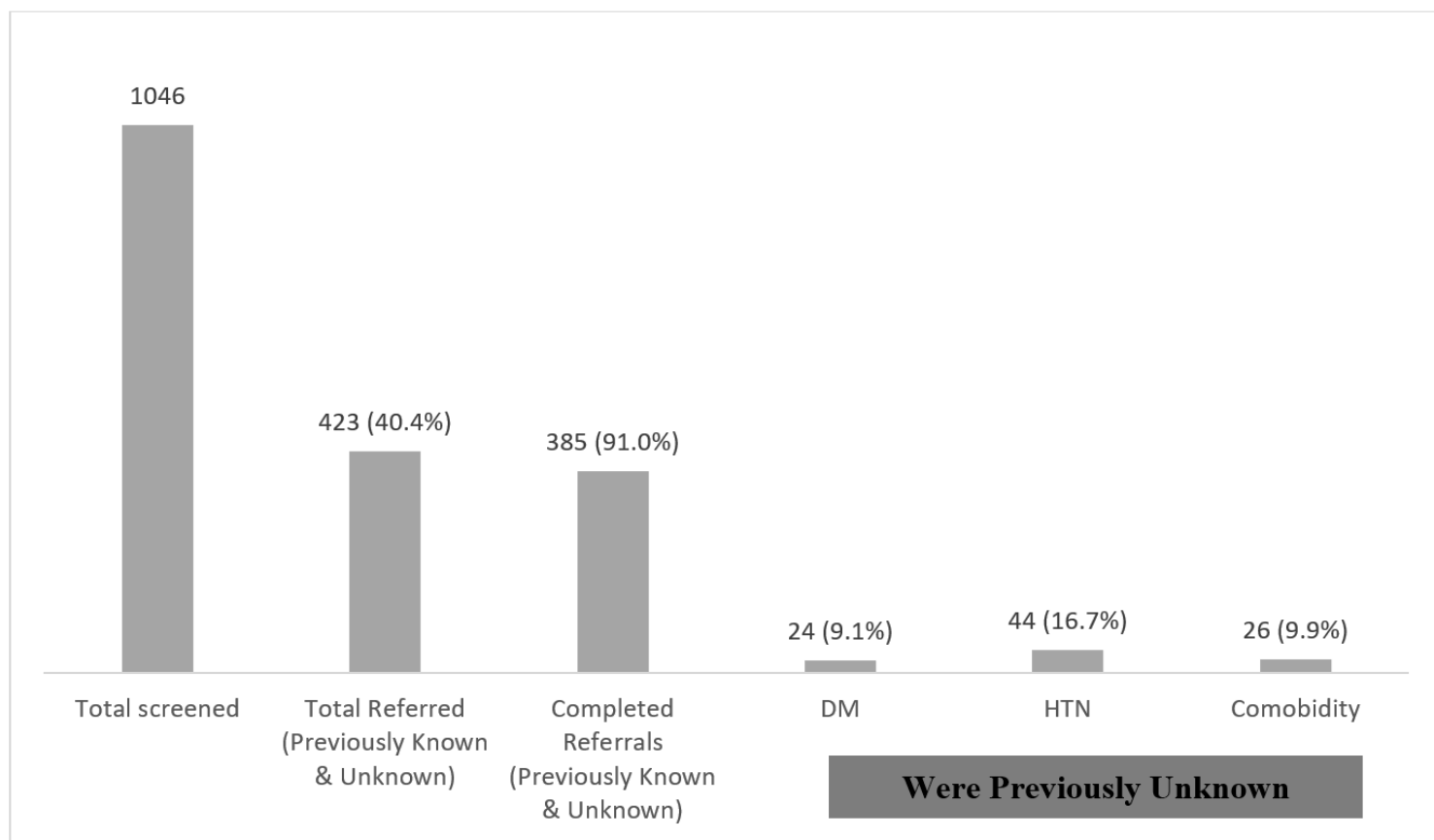


Figure 2

Newly Identified Hypertension, Diabetes, and Comorbidities (N=263)

Figure legend: DM= Diabetes.; HTN= Hypertension; EBP=Elevated Blood Pressure; EBS= Elevated Blood Sugar

Supplementary Files

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