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Prevalence of hypertension and associated factors among users of the Centre Hospitalier Médico-Diététique Père Morand Kleiber in Butembo, DRC: A quantitative cross-sectional study

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Research Article

Keywords: Hypertension, associated factors, abdominal obesity, physical inactivity, smoking, Butembo, Democratic Republic of the Congo

Posted Date: November 12th, 2026

DOI: https://doi.org/10.21203/rs.3.rs-11652639/v1

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Additional Declarations: No competing interests reported.

Abstract

Background

Hypertension is a major public health concern, particularly in low- and middle-income countries. However, local evidence on its burden and associated factors in Eastern Democratic Republic of the Congo (DRC) remains limited. This study aimed to determine the proportion of hypertension and identify its associated factors among users of the Centre Hospitalier Médico-Diététique Père Morand Kleiber in Butembo.

Methods

A quantitative cross-sectional study was conducted from June 2025 to May 2026 among 145 adults aged 25 years and older. Participants were selected using non-probability convenience sampling. Data on sociodemographic characteristics, behavioral factors, anthropometric measurements, blood pressure, and biochemical parameters were collected. Binary logistic regression was performed to identify factors independently associated with hypertension.

Results

Among the 145 participants, 65 (44.8%) were hypertensive. The proportion of hypertension increased with age, from 13.6% among participants aged 25–34 years to 80.0% among those aged 65 years and older. In multivariable analysis, abdominal obesity (adjusted odds ratio [aOR] = 3.1; 95% confidence interval [CI]: 1.7–5.8; $p < 0.001$), male sex (aOR = 2.1; 95% CI: 1.2–3.9; $p = 0.009$), current smoking (aOR = 2.1; 95% CI: 1.0–4.5; $p = 0.049$), sedentary lifestyle (aOR = 1.9; 95% CI: 1.1–3.5; $p = 0.03$), and increasing age (aOR = 1.04 per year; 95% CI: 1.01–1.07; $p = 0.01$) were independently associated with hypertension. Unhealthy diet and alcohol consumption were not significantly associated with hypertension after adjustment.

Conclusion

A high proportion of participants had hypertension, with age, male sex, abdominal obesity, smoking, and sedentary lifestyle identified as independently associated factors. Strengthening routine blood pressure screening, waist circumference assessment, and lifestyle interventions may improve hypertension prevention and management in Butembo. Larger population-based studies are needed to confirm these findings.

Introduction

Hypertension is a major public health problem and one of the leading modifiable risk factors for cardiovascular diseases worldwide. It is a chronic condition characterized by persistently elevated blood pressure and is associated with an increased risk of stroke, ischemic heart disease, heart failure, chronic kidney disease, and premature mortality. Despite the availability of effective preventive and therapeutic interventions, hypertension remains inadequately detected, treated, and controlled in many populations, particularly in low- and middle-income countries. Its growing burden represents a major challenge for health systems, especially those with limited resources.

In 2019, approximately 1.28 billion adults aged 30–79 years were estimated to be living with hypertension worldwide. The number of affected individuals had nearly doubled since 1990, largely because of population growth and ageing. Although effective and relatively inexpensive interventions are available, substantial gaps remain in the detection, treatment, and control of hypertension, particularly in low- and middle-income countries [1].

The burden of hypertension is particularly important in sub-Saharan Africa, where epidemiological transition, urbanisation, changes in dietary habits, and increasingly sedentary lifestyles contribute to the growing prevalence of cardiovascular risk factors. A recent review highlighted that hypertension remains highly prevalent in the region, while awareness, treatment, and control rates remain inadequate. These challenges are compounded by limited access to preventive services, insufficient screening, and difficulties in maintaining long-term treatment [2]. A systematic review and meta-analysis of African studies also reported a pooled hypertension prevalence of 28.5%, with higher estimates among older adults and urban populations [3].

Hypertension is a multifactorial condition resulting from interactions between non-modifiable and modifiable determinants. Increasing age and sex are important demographic factors, while abdominal obesity, overweight, physical inactivity, tobacco use, excessive alcohol consumption, and unhealthy dietary patterns are commonly reported behavioral and metabolic risk factors. Abdominal obesity is particularly relevant because it reflects central fat accumulation and is closely linked to insulin resistance, metabolic abnormalities, and increased cardiovascular risk. Evidence from East African studies has similarly identified obesity, abdominal obesity, smoking, and alcohol consumption among factors associated with hypertension [4].

In the Democratic Republic of the Congo (DRC), hypertension is an important emerging public health concern. However, available evidence remains limited and varies according to the population studied and the diagnostic criteria applied. A cross-sectional study conducted among 1,281 students at the University of Kinshasa reported a hypertension prevalence of 7.3% using the JNC 7 criteria and 26.4% using the 2017 American College of Cardiology/American Heart Association criteria. Smoking, alcohol consumption, overweight, male sex, older age, and low physical activity were associated with hypertension in that population [5]. Although these findings provide useful national evidence, they concern university students and cannot necessarily be extrapolated to older adults or individuals attending healthcare facilities for medical and nutritional services.

In Butembo, North Kivu Province, identifying hypertension and its associated factors is essential for strengthening cardiovascular disease prevention and improving clinical practice. Healthcare facilities provide opportunities to detect elevated blood pressure and assess associated behavioral and metabolic risk factors. A recent study involving 211 hypertensive patients from Katwa, Butembo, and Musienene reported 56.4% medication non-adherence and low quality-of-life scores, highlighting challenges in the long-term management of hypertension in Eastern DRC [6]. However, local evidence on the proportion of hypertension and its associated factors among adult healthcare-facility users remains limited. Further context-specific research is therefore needed to guide screening, risk assessment, health education, and clinical interventions.

Against this background, this study aimed to determine the proportion of hypertension among users aged 25 years and older attending the Centre Hospitalier Médico-Diététique Père Morand Kleiber in Butembo, Democratic Republic of the Congo, and to identify the demographic, behavioral, and metabolic factors associated with hypertension. By examining these factors within a healthcare-based population, the study seeks to contribute locally relevant evidence to the prevention and management of hypertension in this setting.

Materials and methods

Study design, period, and setting

This was a quantitative cross-sectional study with descriptive and analytical components. It was conducted from June 2025 to May 2026 at the Centre Hospitalier Médico-Diététique Père Morand Kleiber in Butembo, located in North Kivu Province, in the Democratic Republic of the Congo (DRC).

Study population and sampling

The study population consisted of individuals aged 25 years and older who attended the Centre Hospitalier Médico-Diététique Père Morand Kleiber during the study period.

A non-probability convenience sampling technique was used. A total of 145 participants who met the eligibility criteria were included in the final analysis. Of these, 80 (55.2%) were women and 65 (44.8%) were men.

Eligibility criteria

- Inclusion criteria: Participants were eligible if they were aged 25 years or older; were users of the Centre during the study period; and provided voluntary informed consent.
- Exclusion criteria: Individuals were excluded if they were pregnant at the time of the study; had a severe acute illness likely to cause transient alterations in the clinical or biochemical parameters under investigation; or explicitly declined to participate.

Study variables and measurements

The dependent variable was hypertension status, categorized as hypertensive (HTN+) or non-hypertensive (HTN−). The independent variables included sociodemographic characteristics, behavioral risk factors, anthropometric measurements, clinical parameters, and biochemical indicators.

Sociodemographic characteristics

The sociodemographic variables collected included age and sex. Age was categorized into five groups for bivariate analysis: 25–34, 35–44, 45–54, 55–64, and 65 years or older. For multivariable logistic regression, age was treated as a continuous variable to assess the change in the odds of hypertension associated with each additional year of age.

Anthropometric and clinical measurements

Anthropometric measurements included body weight (kg), height (m), and waist circumference (cm). Body mass index (BMI) was calculated as body weight in kilograms divided by the square of height in meters (kg/m^2).

Systolic blood pressure (SBP) and diastolic blood pressure (DBP) were measured on the left arm using a validated blood pressure monitor. Measurements were performed with participants in a seated position after at least five minutes of rest.

Biochemical measurements

Fasting blood samples were collected to determine total cholesterol, low-density lipoprotein cholesterol (LDL-C), high-density lipoprotein cholesterol (HDL-C), triglycerides, fasting blood glucose, and serum uric acid levels.

These biochemical parameters were classified into normal and abnormal categories according to the operational thresholds adopted in this study. The resulting metabolic indicators were used to assess their associations with hypertension status.

Behavioral risk factors

- Dietary habits: Dietary patterns were assessed based on the frequency of consumption of foods rich in salt and saturated fats, as well as fruit and vegetable intake. Consumption of fewer than five portions of fruits and vegetables per day was considered unfavorable.
- Sedentary lifestyle: Defined as engaging in less than 150 minutes of moderate-intensity physical activity per week.
- Current smoking: Defined as any current tobacco use, whether daily or occasional.
- Alcohol consumption: Defined as the consumption of at least one standard alcoholic drink per week.

Operational definitions

- Arterial hypertension: Systolic blood pressure (SBP) ≥ 140 mmHg and/or diastolic blood pressure (DBP) ≥ 90 mmHg, or current use of antihypertensive medication.
- General obesity: BMI ≥ 30 kg/m².
- Abdominal obesity: Waist circumference ≥ 94 cm in men and ≥ 80 cm in women.
- Hypercholesterolemia: Total cholesterol ≥ 2.0 g/L (5.2 mmol/L).
- Elevated LDL cholesterol: LDL-C ≥ 1.6 g/L (4.1 mmol/L).
- Low HDL cholesterol: HDL-C less than 0.4 g/L in men and less than 0.5 g/L in women.
- Hypertriglyceridemia: Triglyceride level ≥ 1.5 g/L (1.7 mmol/L).
- Hyperglycemia: Fasting blood glucose ≥ 1.26 g/L (7.0 mmol/L).
- Hyperuricemia: Serum uric acid level greater than 70 mg/L in men and 60 mg/L in women.

Statistical analysis

Data were coded, entered, and analyzed using the Statistical Package for the Social Sciences (SPSS), version 26.0.

Descriptive statistics were used to summarize the characteristics of the study population. Categorical variables were presented as frequencies and percentages. Participants were classified according to their hypertension status into hypertensive (HTN+) and non-hypertensive (HTN−) groups.

Bivariate analyses were performed to assess the associations between hypertension and sociodemographic characteristics, behavioral risk factors, and metabolic indicators. Pearson's chi-square test or Fisher's exact test, where appropriate, was used to compare proportions between hypertensive and non-hypertensive participants. Crude odds ratios (ORs) and their corresponding 95% confidence intervals (CIs) were calculated using the Woolf method to estimate the strength of the observed associations.

Multivariable binary logistic regression analysis was subsequently performed to identify factors independently associated with arterial hypertension. The final model included age (as a continuous variable), sex, abdominal obesity, current smoking, sedentary lifestyle, unhealthy diet, and alcohol consumption. The results were expressed as adjusted odds ratios (aORs) with corresponding 95% confidence intervals.

All statistical tests were two-sided, and a p-value of less than 0.05 was considered statistically significant.

Ethical considerations

The study was conducted in accordance with the ethical principles of the Declaration of Helsinki governing research involving human participants.

Written informed consent was obtained from each participant before inclusion in the study. Participation was entirely voluntary, and participants were informed of their right to withdraw from the study at any time without affecting their access to healthcare services.

Anonymity and confidentiality of all collected information were maintained throughout the research process. Individual data were used exclusively for scientific and research purposes.

Results

Study population and hypertension status

A total of 145 participants were included in the analysis. Sixty-five (44.8%) were hypertensive (HTN+), and 80 (55.2%) were not hypertensive (HTN−). The distribution of participants by hypertension status, age group, sex and risk factors is shown in Table I.

Participants were distributed across five age groups. The 45–54 age group was the largest (n = 42; 29.0%), followed by the 35–44 (n = 38; 26.2%), 55–64 (n = 28; 19.3%), 25–34 (n = 22; 15.2%) and ≥ 65 (n = 15; 10.3%) groups. Women outnumbered men (n = 80, 55.2% vs. n = 65, 44.8%), giving a male-to-female sex ratio of 0.81.

The proportion of hypertensive participants increased steadily with age: 13.6% (3/22) in the 25–34 group, 31.6% (12/38) at 35–44, 50.0% (21/42) at 45–54, 60.7% (17/28) at 55–64 and 80.0% (12/15) in participants aged 65 years and over. By sex, 47.7% of men (31/65) and 42.5% of women (34/80) were hypertensive.

Table I: Bivariate association between hypertension status and age group, sex, and behavioral and metabolic risk factors

Characteristic	HTN+ (n = 65)	HTN− (n = 80)	Total (N = 145)	OR	95% CI	p-value
Age group (years)						**< 0.001**
25–34	3	19	22	1 (ref.)	—	—
35–44	12	26	38	2.92	[0.72–11.81]	0.122
45–54	21	21	42	6.33	[1.63–24.67]	0.004
55–64	17	11	28	9.79	[2.33–41.09]	< 0.001
≥ 65	12	3	15	25.33	[4.38–146.65]	< 0.001
Sex						
Female	34	46	80	1 (ref.)	—	—
Male	31	34	65	1.23	[0.64–2.38]	0.532
Behavioral risk factors						
Sedentary lifestyle	43	38	81	2.16	[1.10–4.25]	0.025
Current smoking	18	11	29	2.40	[1.04–5.55]	0.037
Unhealthy diet	32	30	62	1.62	[0.83–3.14]	0.156
Alcohol consumption	23	24	47	1.28	[0.64–2.57]	0.491
Metabolic risk factors						
Abdominal obesity	45	33	78	3.20	[1.61–6.39]	< 0.001
General obesity (BMI ≥ 30)	17	13	30	1.83	[0.81–4.11]	0.143
Hypercholesterolemia	30	29	59	1.51	[0.77–2.94]	0.227
High LDL cholesterol	26	25	51	1.47	[0.74–2.91]	0.273
Low HDL cholesterol	39	36	75	1.83	[0.94–3.56]	0.072
Hypertriglyceridemia	31	26	57	1.89	[0.96–3.72]	0.063
Hyperglycemia	14	13	27	1.41	[0.61–3.27]	0.416
Hyperuricemia	25	21	46	1.76	[0.87–3.56]	0.116

Values are numbers of participants. OR: crude odds ratio (exposed vs. not exposed; age groups and sex compared with their reference category); CI: confidence interval (Woolf method); p-values from Pearson's chi-square test (overall chi-square for age group, p = 0.0002, shown on the age heading). HTN: arterial hypertension; BMI: body mass index; LDL/HDL: low-/high-density lipoprotein.

Behavioral risk factors

Sedentary lifestyle was the most frequent behavioral risk factor, affecting 81 participants (55.9%), followed by unhealthy diet (n = 62; 42.8%), alcohol consumption (n = 47; 32.4%) and current smoking (n = 29; 20.0%).

All four factors were more frequent among hypertensive than non-hypertensive participants: sedentary lifestyle (66.2% vs. 47.5%), current smoking (27.7% vs. 13.8%), unhealthy diet (49.2% vs. 37.5%) and alcohol consumption (35.4% vs. 30.0%).

Metabolic risk factors

Abdominal obesity was the most frequent metabolic abnormality (n = 78; 53.8%), followed by low HDL cholesterol (n = 75; 51.7%), hypercholesterolemia (n = 59; 40.7%), hypertriglyceridemia (n = 57; 39.3%), high LDL cholesterol (n = 51; 35.2%) and hyperuricemia (n = 46; 31.7%). General obesity (BMI ≥ 30) and hyperglycemia were less common, affecting 30 (20.7%) and 27 (18.6%) participants, respectively.

Every metabolic abnormality was more frequent in the HTN+ group than in the HTN− group. The largest differences were observed for abdominal obesity (69.2% vs. 41.3%), low HDL cholesterol (60.0% vs. 45.0%) and hypertriglyceridemia (47.7% vs. 32.5%). Differences were smaller for hyperglycemia (21.5% vs. 16.3%) and general obesity (26.2% vs. 16.3%).

Factors associated with hypertension: bivariate analysis

Age group was strongly associated with hypertension status (overall $p < 0.001$; Table I). Compared with participants aged 25–34 years, the odds of hypertension were not significantly higher at 35–44 years (OR = 2.92; 95% CI 0.72–11.81; $p = 0.122$) but were significantly higher at 45–54 years (OR = 6.33; 95% CI 1.63–24.67; $p = 0.004$), 55–64 years (OR = 9.79; 95% CI 2.33–41.09; $p < 0.001$) and ≥ 65 years (OR = 25.33; 95% CI 4.38–146.65; $p < 0.001$). The confidence intervals for these estimates are wide because the reference group included only three hypertensive participants. Male sex was not associated with hypertension in the bivariate analysis (OR = 1.23; 95% CI 0.64–2.38; $p = 0.532$).

Among behavioral factors, sedentary lifestyle (OR = 2.16; 95% CI 1.10–4.25; $p = 0.025$) and current smoking (OR = 2.40; 95% CI 1.04–5.55; $p = 0.037$) were significantly associated with hypertension. Unhealthy diet (OR = 1.62; $p = 0.156$) and alcohol consumption (OR = 1.28; $p = 0.491$) were not.

Among metabolic factors, abdominal obesity showed the strongest association (OR = 3.20; 95% CI 1.61–6.39; $p < 0.001$). Low HDL cholesterol (OR = 1.83; 95% CI 0.94–3.56; $p = 0.072$) and hypertriglyceridemia (OR = 1.89; 95% CI 0.96–3.72; $p = 0.063$) approached but did not reach statistical significance. General obesity, hypercholesterolemia, high LDL cholesterol, hyperglycemia and hyperuricemia were not significantly associated with hypertension (all $p > 0.10$).

Independent determinants of arterial hypertension

The multivariable binary logistic regression model identified five factors independently associated with hypertension (Table II, Fig. 1).

Table II: Factors independently associated with hypertension (binary logistic regression)

Exposure factor	Adjusted odds ratio (aOR)	95% confidence interval	p-value
Abdominal obesity	3.1	[1.7–5.8]	< 0.001
Male sex	2.1	[1.2–3.9]	0.009
Current smoking	2.1	[1.0–4.5]	0.049
Sedentary lifestyle (physical inactivity)	1.9	[1.1–3.5]	0.03
Age (per additional year)	1.04	[1.01–1.07]	0.01
Unhealthy diet	1.6	[0.9–2.8]	0.09
Alcohol consumption	1.2	[0.6–2.3]	0.50

aOR: adjusted odds ratio. Values of p < 0.05 were considered statistically significant.

Abdominal obesity was the strongest determinant, associated with roughly three times higher odds of hypertension (aOR = 3.1; 95% CI 1.7–5.8; p < 0.001). Men had about twice the odds of hypertension compared with women (aOR = 2.1; 95% CI 1.2–3.9; p = 0.009), an association that was not apparent in the crude analysis. Current smokers had twice the odds of hypertension (aOR = 2.1; 95% CI 1.0–4.5; p = 0.049), although the lower bound of the interval lay at the null value. A sedentary lifestyle was associated with 90% higher odds (aOR = 1.9; 95% CI 1.1–3.5; p = 0.03), and each additional year of age with 4% higher odds (aOR = 1.04; 95% CI 1.01–1.07; p = 0.01), assuming a linear effect on the log-odds scale.

Unhealthy diet (aOR = 1.6; 95% CI 0.9–2.8; p = 0.09) and alcohol consumption (aOR = 1.2; 95% CI 0.6–2.3; p = 0.50) were not significantly associated with hypertension after adjustment.

Squares: adjusted odds ratios; horizontal lines: 95% confidence intervals; dark blue: statistically significant (p < 0.05); grey: not significant. Dashed line: OR = 1 (no association).

Discussion

Principal findings

In this cross-sectional study of 145 participants, 44.8% were hypertensive. The proportion of hypertensive participants rose steadily with age, from 13.6% at 25–34 years to 80.0% at 65 years and

over. Five factors were independently associated with hypertension: abdominal obesity (aOR = 3.1), male sex (aOR = 2.1), current smoking (aOR = 2.1), sedentary lifestyle (aOR = 1.9) and age (aOR = 1.04 per year). Unhealthy diet and alcohol consumption were not significantly associated with hypertension after adjustment.

Burden of hypertension and the role of age

The proportion of hypertensive participants (44.8%) exceeds global estimates of about one-third of adults aged 30–79 years (32% of women and 34% of men in 2019) [1] and the pooled prevalence of 30% (95% CI 27–34) reported in a meta-analysis of surveys in sub-Saharan Africa [7]. It is closer to the figures reported among workers in West Africa, where crude prevalence rose from 12.9% in studies published in the 1980s to 34.4% in those published in 2010–2014 [8]. These comparisons should be made cautiously, because our sample is not population-representative our participants were recruited from a single medical and nutrition centre using non-probability convenience sampling rather than from a representative community-based sample, and prevalence depends strongly on the age structure of the sample.

The age gradient we observed is consistent with the literature. The sub-Saharan Africa meta-analysis predicted prevalences of 16%, 26%, 35% and 44% at mean participant ages of 30, 40, 50 and 60 years [7], and older age is among the most frequent determinants of hypertension in African adults [9]. Our age-specific proportions at 45–54 and 55–64 years (50.0% and 60.7%) are higher than these predictions. The odds ratios for the oldest groups should be read with caution: the reference group (25–34 years) contained only three hypertensive participants, which explains the very wide confidence intervals (for example OR = 25.33; 95% CI 4.38–146.65 at ≥ 65 years). The adjusted estimate for age as a continuous variable (aOR = 1.04 per year) corresponds, if the effect is log-linear, to about 48% higher odds per additional decade. The same meta-analysis found that only 27% of hypertensive individuals were aware of their status, 18% were treated and 7% had controlled blood pressure [7], and treatment and control have changed little in most sub-Saharan countries since 1990 [1]. This supports early screening in the age groups where prevalence reaches 50% or more.

Abdominal obesity

Abdominal obesity was the strongest independent determinant (aOR = 3.1; 95% CI 1.7–5.8; $p < 0.001$), and the estimate was almost identical to the crude odds ratio (3.20), indicating that the association was not explained by the other factors in the model. This agrees with studies from West and Central Africa. In young adults in Cameroon, waist circumference was an independent predictor of hypertension, with about 9% higher odds per additional centimetre [10]. In a Nigerian study, abdominal obesity was associated with hypertension and physical inactivity, and 60.0% of adults with abdominal obesity were hypertensive [6]; the corresponding figure in our sample was 57.7% (45/78), against 29.9% (20/67) in participants without abdominal obesity. A systematic review of older African adults likewise identified overweight and obesity as consistent determinants, with the highest adjusted odds ratios [9]. Visceral fat accumulation, insulin resistance and activation of the sympathetic and renin–angiotensin systems are

the mechanisms usually proposed. General obesity (BMI ≥ 30) was not significantly associated with hypertension in the bivariate analysis (OR = 1.83; p = 0.143), which suggests that waist circumference may be more informative than BMI in this population, although our data cannot test this directly.

Male sex

Male sex was not associated with hypertension in the crude analysis (OR = 1.23; p = 0.532) but became significant after adjustment (aOR = 2.1; 95% CI 1.2–3.9). This shift suggests confounding: one or more factors in the model are distributed differently between men and women and are related to hypertension. Abdominal obesity and physical inactivity are plausible candidates, since both were more frequent among women in the Nigerian study cited above [11]. Sex-specific distributions of risk factors in our sample were not tabulated and should be examined because sex-specific distributions of abdominal obesity and physical inactivity were not tabulated, we cannot determine whether these factors explain the change in the sex estimate after adjustment. A higher risk in men agrees with data from West African workers [8] and with the general pattern of lower blood pressure in premenopausal women, with sex differences narrowing or reversing after menopause [12]. Other African studies, however, report female sex among the frequent determinants in older adults [9], so the direction of the sex effect probably depends on the age structure of the population. Given the width of the confidence interval, the magnitude of the male excess is uncertain.

Current smoking

Current smoking was associated with hypertension in the crude analysis (OR = 2.40; p = 0.037), and the adjusted estimate (aOR = 2.1; 95% CI 1.0–4.5; p = 0.049) was borderline, with the lower bound of the interval at the null value. The literature on smoking and blood pressure is more nuanced than the association alone suggests. In a Mendelian randomization meta-analysis of 23 population-based studies (141,317 participants), current smokers had lower blood pressure and a lower hypertension risk than never smokers in observational analyses, and genetic analyses did not support a strong causal effect of smoking heaviness on blood pressure or hypertension, although smoking raised resting heart rate [13]. Our result should therefore not be read as proof of a causal effect on blood pressure, especially as only 29 participants were smokers. It does not reduce the relevance of smoking cessation, because the cardiovascular risk of smoking extends beyond blood pressure [13].

Sedentary lifestyle

A sedentary lifestyle was independently associated with hypertension (aOR = 1.9; 95% CI 1.1–3.5; p = 0.03). Prospective evidence points the same way: a meta-analysis of cohort studies found 19% lower risk of hypertension with high recreational physical activity compared with low activity [14], another found a 6% lower risk for each 10 MET-h/week increment in leisure-time activity [15], and in a Spanish cohort higher total sedentary behaviour was associated with incident hypertension (HR = 1.48; 95% CI 1.01–2.18, upper vs. lower quartile) [16]. Our odds ratio is larger than these relative risks. Part of the difference is methodological: when the outcome is common, as here (44.8%), an odds ratio overstates the corresponding risk or prevalence ratio [17, 18]. For example, hypertension was present in 53.1%

(43/81) of sedentary participants and 34.4% (22/64) of the others, a prevalence ratio of about 1.5. Because of the cross-sectional design, reverse causation (hypertensive people reducing their activity) cannot be excluded.

Factors not independently associated with hypertension

Unhealthy diet (aOR = 1.6; 95% CI 0.9–2.8; p = 0.09) was not significant after adjustment, but the point estimate and its interval are compatible with a clinically meaningful increase, and the study may have been underpowered to detect it. Alcohol consumption showed no association (crude OR = 1.28; aOR = 1.2). A binary indicator of any consumption cannot capture dose, whereas meta-analyses of prospective studies show that the risk of hypertension increases with the amount consumed and differs between men and women [19]. Among biochemical markers, none was significantly associated with hypertension in the bivariate analysis, but all were more frequent in hypertensive participants, and low HDL cholesterol (OR = 1.83; p = 0.072) and hypertriglyceridemia (OR = 1.89; p = 0.063) approached significance. For hyperuricemia the direction of effect (OR = 1.76; 95% CI 0.87–3.56) is consistent with a meta-analysis of prospective cohorts that reported an adjusted risk ratio of 1.41 (95% CI 1.23–1.58) for incident hypertension [20]. Larger samples are needed to establish whether these markers contribute independently of abdominal obesity.

Strengths and limitations

This study assessed a broad set of behavioral and metabolic factors and presented both crude and adjusted estimates, which allowed the effect of adjustment (notably for male sex) to be seen. Several limitations should be considered. First, the cross-sectional design prevents any conclusion about temporality or causality. Second, the sample was small: with 65 hypertensive participants and seven factors in the final model, there were roughly nine events per variable, which makes the estimates unstable and their intervals wide. Third, the sample may not represent the source population participants were recruited by convenience sampling among adults aged 25 years and older attending a single medical and nutrition centre in Butembo; people attending such a facility may differ from the general population in health status and healthcare-seeking behaviour, creating potential selection bias. Fourth, behavioral factors were probably self-reported and dichotomized, which introduces misclassification and loses information on dose blood pressure was measured in the left arm with a validated sphygmomanometer after five minutes of seated rest, and hypertension was defined as systolic blood pressure ≥ 140 mmHg and/or diastolic blood pressure ≥ 90 mmHg or current antihypertensive treatment. Sedentary lifestyle was defined as less than 150 minutes of moderate physical activity per week; current smoking included daily or occasional smoking; alcohol consumption was defined as at least one standard drink per week; unhealthy diet reflected high salt or saturated-fat intake and/or consumption of fewer than five portions of fruit and vegetables per day; and abdominal obesity was defined by waist circumference ≥ 94 cm in men and ≥ 80 cm in women. Fifth, odds ratios overstate prevalence ratios for a common outcome [17, 18]; a log-binomial or modified Poisson model would give directly interpretable prevalence ratios [18]. Sixth, p-values were not adjusted for multiple comparisons, and residual

confounding (for example by salt intake, family history, socioeconomic status or medication) cannot be ruled out.

Implications and perspectives

These findings support routine measurement of waist circumference and blood pressure in primary care, with emphasis on adults aged 45 years and over, in whom half or more of participants were hypertensive. Preventive efforts should prioritize weight control and physical activity, which are both modifiable and independently associated with hypertension here. Larger, population-based and longitudinal studies, using prevalence ratios and measuring dietary salt, alcohol dose and sex-specific risk profiles, are needed to confirm these results.

Conclusion

This study found a high proportion of arterial hypertension (44.8%) among users of the Centre Hospitalier Médico-Diététique Père Morand Kleiber in Butembo, Democratic Republic of the Congo. The occurrence of hypertension increased progressively with age, reaching 80.0% among participants aged 65 years and older.

Multivariable analysis identified five factors independently associated with hypertension: abdominal obesity, male sex, current smoking, sedentary lifestyle, and increasing age. Abdominal obesity was the strongest associated factor, with hypertensive participants having approximately three times higher odds of hypertension. Male sex and current smoking were each associated with approximately twice the odds, while sedentary lifestyle was associated with nearly twice the odds of hypertension. Each additional year of age was associated with a 4% increase in the odds of hypertension.

Although unhealthy dietary habits and alcohol consumption showed positive associations with hypertension, these relationships were not statistically significant after adjustment. Similarly, none of the individual biochemical abnormalities demonstrated a statistically significant association in the bivariate analysis.

These findings highlight the importance of strengthening hypertension screening and prevention strategies in healthcare settings in Butembo, particularly among older adults and individuals with abdominal obesity or unhealthy behavioral habits. Routine blood pressure measurement, assessment of waist circumference, promotion of regular physical activity, weight management, and tobacco cessation should be prioritized as components of cardiovascular disease prevention.

However, given the cross-sectional design, relatively small sample size, and non-probability sampling approach, the findings should be interpreted cautiously and cannot establish causal relationships or be generalized to the entire population of Butembo. Further large-scale, population-based and longitudinal studies are warranted to confirm these findings and better understand the determinants of hypertension in this setting.

Declarations

Ethics approval and consent to participate

Ethical approval was obtained from the Ethics Committee of the Université Catholique du Graben. All study procedures involving human participants were conducted in accordance with the relevant institutional and national ethical guidelines and regulations and the principles of the Declaration of Helsinki. Written informed consent was obtained from each participant. Interviews were conducted in a setting intended to protect participants' privacy, and responses were coded for analysis. Data would be stored securely for five years and subsequently destroyed. As recruitment involved participant referrals, referral names and contact details were to be stored separately from research responses and deleted once recruitment was complete.

This study was not a clinical trial.

Consent for publication

Not applicable. No individually identifiable participant information is reported in this manuscript.

Competing interests

The authors declare that they have no competing interests.

Funding

No external funding was obtained for this study.

Author Contribution

B.M., G.M. contributed to conceptualization, data curation, formal analysis, investigation, methodology, project administration, resources, software, supervision, validation, visualization, and writing of the original draft and review and editing of the manuscript. J.M., L.L., G.M., R.M1., G.M., N.V. contributed to conceptualization, resources, software, supervision, validation, visualization, and writing of the original draft and review and editing of the manuscript. R.M.M. contributed to conceptualization, data curation, formal analysis, investigation, methodology, project administration, resources, software, supervision, validation, visualization, and writing of the original draft and review and editing of the manuscript. L.P.S. contributed to conceptualization, methodology, project administration, resources, software, supervision, validation, visualization, and writing of the original draft and review and editing of the manuscript. All authors reviewed and approved the manuscript.

Acknowledgement

R.M.M. acknowledges the support of the Bourse d'Excellence Bringmann aux Universités Congolaises (BEBUC Scholarship), the Else Kröner-Fresenius Stiftung, and the Holger Pöhlmann Foundation during his studies.

Data Availability

The datasets used and/or analyzed during the current study are available from the corresponding author upon reasonable request.

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Figures

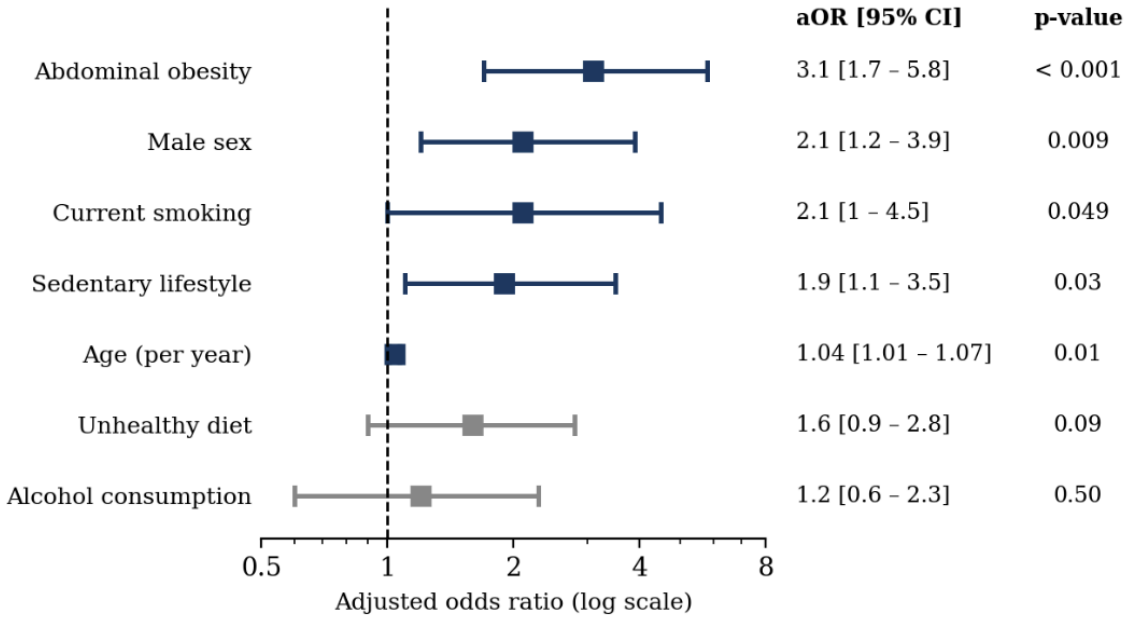


Figure 1

Forest plot of factors independently associated with hypertension (adjusted odds ratios, binary logistic regression)

Squares: adjusted odds ratios; horizontal lines: 95% confidence intervals; dark blue: statistically significant ($p < 0.05$); grey: not significant. Dashed line: OR = 1 (no association).