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Original Research Article

Economic costs of treating high blood pressure in the Adamaoua region of Cameroon

Njoumemi Zakariaou[1,2]*, Djoulay-Hatou[1,2]

[1]Department of Public Health, Faculty of Medicine and Biomedical Sciences (FMSB), University of Yaoundé 1, Yaounde, Cameroon
[2]Health Economics and Policy Research and Evaluation for Development Results Group (HEREG), Yaounde, Cameroon

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***Correspondence:**
Dr. Njoumemi Zakariaou,
E-mail: njoumemiz@gmail.com

ABSTRACT

Background: High blood pressure constitutes a major public health problem in Cameroon with a prevalence of 30.9% making it a major driver of healthcare costs. This study evaluated the economic cost of high blood pressure treatment in the Adamaoua region, in Cameroon.
Methods: A cross-sectional medico-economic evaluation using the cost analysis was conducted. Costing approach used a bottom-up micro-costing with unit costs for diagnostic and therapeutic interventions and nonmedical and indirect costs. An average cost of treatment per patient was presented as mean, median and standard deviation. The linear regression was used to identify factors influencing the cost variations. The significance threshold was set at p<5%.
Results: A total number of 179 patients were sampled, including 112 patients with uncomplicated and 67 with complicated high blood pressure. The average annual total economic costs of uncomplicated high blood pressure to patients were estimated at XAF 220,276.76±75,743 (US$363.15±124.87) with the direct medical costs representing the highest proportion with (89.4%), following by the total indirect costs (7.3%), while the economic costs of treating complicated high blood pressure were estimated at XAF 346,516.05±292,081 (US$571.27±481.53) which mainly made up of direct medical costs (70.49%) followed by direct nonmedical cost (21.67%). Factors such as hospitalization, diet and transportation were statistically significant; while 33% of variability in expenses was related to hospitalization.
Conclusions: The economic costs of uncomplicated and complicated high blood pressure imply the policy for eliminating the financial barriers by including the treatment of high blood pressure in the second phase of the universal health coverage.

Keywords: Economic cost, High blood pressure, Adamaoua-Cameroon

INTRODUCTION

High blood pressure (HBP) defined as having a blood pressure reading of 130/80 mm Hg or higher, constitutes a major public health problem worldwide since it is a worrying condition and critical risk factor for heart disease and stroke.[1,2] This common, deadly disease leads to stroke, heart attack, heart failure, kidney damage and many other health problems. HBP is a chronic disease that is widespread worldwide with a prevalence of 31.1%, while it is the leading cause of cardiovascular disease and premature death (14%) worldwide.[3] HBP is the leading preventable cause of death and disability worldwide, as having healthy lifestyle behaviors—like eating a diet high in fruits and vegetables and low in sodium and being physically active—can help prevent HBP.[4,5] The overall impact of HBP is epidemiological enormous with, HBP affecting 1 in 3 adults worldwide, an estimated 1.28 billion adults aged 30 to 79 who are living with HBP, nearly half of people with HBP globally are currently unaware of their condition, with more than three-quarters of adults with HBP living in low- and middle-income countries, while the disease is estimated to cause 10.8 million avoidable deaths annually and contributes to 235 million years of life lost or

lived with disability.[6,7] In sub-Saharan Africa, in 2023, its prevalence varies between 30-31%.[8]

Despite its serious health consequences, approximately 4 out of every 5 people with HBP are not adequately treated, 46% of adults with HBP are unaware of their condition, only 42% receive treatment, and just 1 in 5 have their blood pressure adequately controlled, but if countries can scale up coverage, an increase in the number of patients effectively treated for HBP to levels observed in high-performing countries could prevent 76 million deaths, 120 million strokes, 79 million heart attacks, and 17 million cases of heart failure between 2023 and 2050.[9,10] The economic costs for individuals, healthcare systems, and societies are also substantial thereby using both epidemiological and economic burdens, as one of the global targets for non-communicable diseases for reducing the prevalence of HBP significantly between 2010 and 2030.[10,11] HBP has repercussions on at least one of these target organs, namely: heart, vessels, brain, eyes and kidneys, the most serious of which is renal failure that can develop into chronic kidney disease (CKD). This is a real public health problem in Cameroon, 13% of the adult population suffers from CKD and most have arterial HBP as their basic nephropathy, i.e. 43.5%.[12]

In the framework of the high morbidity and mortality, the HBP can easily be treated with safe, widely available, low-cost generic medications using programs such as WHO's HEARTS technical package for cardiovascular disease management in primary health care and the guideline for the pharmacological treatment of HBP in adults which provide proven and practical steps to deliver effective HBP care in primary health care settings.[13] However, the HBP presents a significant economic burden for the patient, the family, the caregiver and the health system. The economic costs associated with treating HBP are substantial and are projected to continue rising due to factors like population growth and increasing prevalence of the condition.[13,14] In the US, the healthcare cost attributable to HBP is estimated to increase from $160 billion in 2020 to $513 billion in 2050, according to the American Heart Association Journals.[15] This increase is driven by both rising per-person costs and population growth. Globally, HBP affects a large portion of the population, and these costs are expected to increase as the population ages and prevalence of HBP rises.[14] Economic costs of HBP encompass several aspects including direct medical costs and indirect costs. Direct medical costs include costs associated with doctor visits, medications, and hospitalizations related to HBP management while indirect costs take into account costs associated with lost productivity due to illness and premature mortality related to HBP.[16] Cost-effectiveness studies show that team-based care for blood pressure control is cost-effective, but the median intervention cost per patient per year can vary, while the economic burden of HBP can vary significantly across regions and countries, as one study in Iran found that the total economic burden of HBP to be 1% of the country's GDP in 2020.[14,17-19] The economic burden of HBP is projected to increase significantly in the coming decades due to aging populations and increasing prevalence of HBP.[20,21] Among the factors influencing costs, population growth is an indication, as the population ages, the number of people with HBP is expected to increase, leading to higher overall costs.[22,23] Economic evaluation studies demonstrate the financial impact of a disease on individuals and governments, serving as a factor for evaluating preventive interventions and determining health research priorities, while estimating the economic costs is not limited to the expenses associated with the treatment of HBP alone, as the economic burden of HBP is significantly underestimated.[16]

In Cameroon, it is estimated at 30.9% of hypertensive people out of approximately 22 million inhabitants in 2024.[24] The prevalence of HBP is a major driver of healthcare costs, therefore increasing prevalence means more people will require more treatment and management costs.[21] The costs of medications, diagnostic tests, and other treatments for HBP can vary depending on the specific interventions and the healthcare settings. The quality of care provided for HBP can also impact both the effectiveness of treatment and the associated costs. Studies have shown that team-based care can be cost-effective in managing blood pressure. Socioeconomic status can play a role in HBP risk and access to care, which can impact the costs associated with the condition. Strategies for mitigating costs include early detection and treatment as early diagnosis and management of HBP can prevent or delay the onset of more serious complications, potentially reducing long-term healthcare costs. Preventive measures like lifestyle modifications, such as healthy diet, regular exercise, and reduced salt intake, can help prevent or delay the onset of HBP. Implementing cost-effective interventions, such as team-based care and self-measured blood pressure monitoring, can help manage HBP more efficiently. Public health campaigns and initiatives can raise awareness about HBP and promote healthy lifestyles, which can help reduce the prevalence of the condition. Investing in research to develop new and more effective treatments for HBP can help improve outcomes and potentially reduce long-term costs. Given the facts the control of HBP incurred high costs and associated complications, it has become one of the main health challenges of public health interventions in low and middle income countries. In Cameroon, there is a dare lack of comprehensive information on the economic costs of HBP. In the context of universal health coverage, there is an emerging interest and need for policymakers and health planners to understand the economic costs of HBP and its related diseases. Understanding economic costs estimation can serve as effective evidence for health policymakers to accurately evaluate the extent of health problems in the population and provide motivation for designing interventions to address them thereby including the costly and less affordable ones into the benefit package of universal health coverage. Given these facts, understanding the economic costs of HBP, can provide the evidence for decision-makers and health planners to take

appropriate and effective actions for the control (prevention and treatment) of HBP. Therefore, this study aimed to evaluate the economic cost of HBP in the Adamaoua region, in order to inform decision-makers, health professionals and the community for the cost effective management of cases in Cameroon.

METHODS

Study design

A cross-sectional medical-economic evaluation study using the cost analysis of HBP case management was conducted in 3rd and 4th category hospitals in the city of Ngaoundéré with a HBP management unit by cardiologists, nephrologists or general practitioners. This study therefore adopted a mixed approach, combining qualitative and quantitative methods.

Source population

All patients with confirmed HBP and whose treatment was initiated at least 3 months ago in two selected 3rd and 4th hospitals' categories in the city of Ngaoundéré, the main town of the Adamaoua region in Cameroon.

Target population

Patients with HBP for more than 3 months, monitored and under treatment; hospitalized or not for a complication of the disease in a local HBP case management unit.

Inclusion criteria

All patients admitted for HBP emergency or admitted for outpatient consultation for HBP and who agreed verbally and/or in writing to participate in the study were included.

Exclusion criteria

All patients who did not give their consent or who decided to voluntarily withdraw from the study, patients who died on admission to the emergency department and those referred outside the region were not included in this study.

Sampling

The minimum sample size of n=179, was calculated based on the hospital prevalence of HBP in the study sites, using Open-EPI software version 3.

Collection tools

Data collection used a codified questionnaire including sociodemographic, clinical and cost aspects of HBP, along with participant information sheet and an informed consent form. Each questionnaire's interview lasted in average 30 minutes and contains 53 questions.

Procedures of costing

Point of view or perspective of costing

The cost data were evaluated from the perspective of patients in the context of progress towards universal health coverage.

Interventions

These consisted of routine clinical practices (including diagnosis, examinations, treatment, and medication prescription) for the management of HBP in the specialized units of the selected hospitals.

Time horizon

The estimate of economic costs for this study was based on data collected from questionnaire using patient interviews for the annual/yearly costs for period of one-year management of HBP from 01 January to 31 December 2023. Data were collected over a period of 4 months, from January 2024 to April 2024.

Costing/cost evaluation approach

This study used a bottom-up micro-costing with specific unit costs for diagnostic and therapeutic interventions as well as other nonmedical and indirect costs for each patient with HBP condition in the selected hospitals. Indeed, the economic costs of HBP includes direct (medical and non-medical), indirect and intangible costs. The medical direct costs are expenses incurred due to the use of medical products and services for the prevention, diagnosis and treatment of the disease and its complications, while these expenses include hospitalization costs, physician visits, laboratory tests and imaging, home care by nurses and prescribed medications.[17] Non- medical direct costs include travel expenses, accommodation in the city, food and herbal treatments, while indirect costs include absenteeism from work for the patient and their caregiver, as well as premature death resulting from the disease (potential lost productivity).[18] The last type of costs is intangible costs such as pain, anxiety and stress; the total of these costs constitutes the economic costs of a disease.[17] However, in this study, the intangible costs were excluded. Thus, the following formulas were used to estimate the economic costs of HBP case management in the study settings.

$$Evaluation\ of\ direct\ medical\ costs\ (DMC) = Cost\ of\ medical\ consultation + medical\ card + medical\ file + HBP\ assessments + HBP\ treatment\ with\ appropriate\ drugs + medical\ care + hospitalization + Dietician\ consultation$$

$$Evaluation\ of\ direct\ non-medical\ cost\ (DNMC) = Diet + Transportation + Communication$$

$$Evaluation\ of\ indirect\ cost\ (IC) = loss\ of\ earnings\ or\ loss\ of\ income\ during\ illness$$

$$Evaluation\ of\ economic\ cost = CDM + CDNM + CI$$

Overall, the data collected were: the profile (clinical/ pathological, socio-economic and demographic) of the patients, the additional examinations (biological and imaging) prescribed, the medical-nursing acts performed, the prescribed medications and the length of stay in the hospitalized room, the non-medical expenses, and the indirect costs. The cost valuation was made based on the official selected hospitals' price list and the prices observed for inputs purchased outside the hospital which were estimated from the Medindex application such as the price of the medication/drugs that was calculated based on the Med Index application.

Data analysis

In this analysis, an average cost of treatment per patient was estimated by dividing the total cost of all patients by the number of patients. Unit of measurement: Central African Francs (XAF) and US dollars' official rate for the 2023 yearly average ($1=606.57 XAF). The quantitative cost data were presented by statistical parameters in the form of mean and standard deviation for those following a normal distribution and otherwise in the form of median and interquartile range. The univariate analysis was used to identify the relevant variables of the overall cost of HBP case management.

The multiple linear regression was used to analyze the factors influencing the total cost of HBP to patients. The significance threshold was set at p<10% for the univariate analysis, while the statistical significance for the multivariate analysis was set at p<5%.

RESULTS

Sociodemographic and economics of HBP patients

Thist study was undertaked to estimate the economic costs of HBP in 2023 in Cameroon. In this purpose, the annual costs to patients of high bloob pressure case management were calculated. A total number of 179 patients were sampled in this study, including 112 patients with uncomplicated HBP and 67 with complicated HBP. Regarding uncomplicated HBP, the median age of patients was 52 years±IQ [45.66] years with a female predominance of 60%; the majority (93%) resided in the city; about 60% of patients worked in the informal sector, while 37% of patients had an income below the minimum wage.

Indeed, the guaranteed minimum wage in Cameroon has been fixed at XAF 43,969 (US$72.51) per month since 23 February 2024, meaning that no worker may be paid below this amount.

Direct medical, nonmedical and indirect costs of uncomplicated HBP

Table 1 presents the average yearly total direct medical costs of uncomplicated HBP. These average annual total direct medical costs of uncomplicated HBP were estimated at XAF 196,977±42,548 (US$ 324.74±70.15). These direct medical costs were mainly made up of the cost of HBP medication/drugs (74%), followed by the cost of assessments (20.84%).

The average annual total direct nonmedical cost of uncomplicated HBP was estimated at XAF 7,151±7,032 (US$11.79±11.59) as presented in Table 2. These costs were mainly composed of the cost of diet (86%) followed by transportation (12%). The relative low level of direct nonmedical costs can be explained by the fact that the majority of patients reside in the city, hence the predominance of the cost of food being for therapeutic purposes.

The average annual total indirect cost of uncomplicated HBP was estimated at XAF 16,148±26,163 (US$ 26.62±43.13). It is mainly made up of lost earnings. This result can be explained by the fact that HBP patients took few times to seek the treatment of uncomplicated case, during this regular period of healthcare seeking behavior for HGP, the patients no longer perform their usual earning's activities.

Economic costs of uncomplicated HBP in Cameroon

Overall, the average annual total economic costs of HBP to patients were estimated at XAF 220,276.76±75,743 (US$363.15±124.87) as shown in Table 3. The direct medical costs represent the highest proportion with about 89.4%, following by the total indirect costs with 7.3% of the average annual total economic costs of uncomplicated HBP.

Factors influencing economic costs of uncomplicated HBP

Table 4 presents both univariate and multivariate analysis. The increase in economic costs of managing uncomplicated HBP are influenced by some key factors among which the duration of HBP (p<0.03); hospitalization (p<0.01) and transportation (p<0.01) with a statistically significant difference. It is worth to note about that 28% of variability in economic costs of uncomplicated HBP was related to hospitalization with a statistically significant difference (p<0.01).

Cost analysis of complicated HBP in the Adamaoua region

With regards to HBP with complications; the most common was a stroke (45%) followed by heart failure and hypertensive nephropathy (22%). Figure 1 presents the

distribution of different types of complicated HBP in the study settings.

Direct and indirect costs of complicated HBP in the Adamaoua region

The average annual total direct medical costs of complicated HBP were estimated at XAF 244,273.70±164440 (US$402.71±271.09). As presented in Table 5, these direct medical costs of complicated HBP were mainly made up of the cost of complicated HBP medication/drugs (55.86%), followed by the cost of assessments (17.20%) and care package for complications (12.81%).

The direct non-medical cost of complicated HBP with complications was calculated at XAF 74,880.76 (US$ 121.80); predominated by the cost of diet 98%. This means that diet remains the non-pharmacological component of complicated HBP and also allows good blood pressure balance and therefore complements better management. Table 6 presents the details of average yearly total direct non-medical costs of uncomplicated HBP.

The indirect costs of complicated HBP was estimated at XAF 27,264.58±42,144 (US$44.95±69.48) as shown in Table 7. These indirect costs were mainly made up of lost earnings (72.8%) followed by nursing special foods (13.7%) and transportation (12.9%).

Economic costs of complicated HBP in Cameroon

The economic costs of managing complicated HBP were estimated at XAF 346,516.05±292,081 (US$571.27±481.53) annually. As shown in Table 8, it is mainly made up of DMC (70.49%) followed by CDNM (21. 67%) of complicated HBP.

Factors influencing economic costs of complicated HBP

The costs of hospitalization represented about 33% of variability in expenditures related to complicated HBP. Factors such as hospitalizations, diet and transportation are statistically significant with a value of $p<0.05$, while all other factors (duration, treatment, assessments, complications related tests, complications related medication, communication) impacted the costs of complicated HBP but they were statistically non-significant.

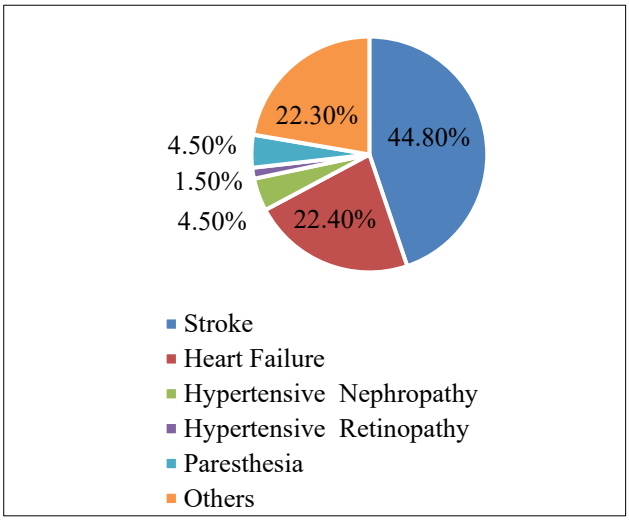

Figure 1: Distribution of complicated HBP in the Adamaoua region.

Table 1: Average annual total direct medical costs of uncomplicated high blood pressure in XAF (US$) (n=112).

Variables	Mean±SD	Median	IQ	[Min-max]	% of total costs
Medical consultation	2294.64±458 (3.78±0.76)	2,000 (3.30)	[2,000-3,000] [(3.30-4.95)]	[2,000-3,000] [(3.30-4.95)]	2.37
Medication/drugs	146,360±71,184 (241.29±117.35)	162,000 (267.08)	[6,875-197,850] [(11.33-326.18)]	[23,400-328,200] [(48.57-541.08)]	74.30
Cost of HBP assessments	41,053.57±24,388 (67.68±4.02)	56000 (92.32)	[0-56000] [(0.00-92.32)]	[0-56000] [(0.00-92.32)]	20.84
Medical card	300±0 (0.49±0.00)	300 (0.49)	[300-300] [(0.49-0.49)]	[300-300] [(0.49-0.49)]	0.15
Medical record/file	281.25±588 (0.46±0.96)	0 (0)	0 (0)	[0-1500] [(0.00-2.47)]	0.14
Hospitalization	241.07± 819 (0.46±1.35)	0 (0)	0 (0)	[0-3000] [(0.00-4.95)]	0.12
Care package	6,550.96±10,139 (10.80±16.72)	2,000 (3.30)	[0-9,000] [(0.00-14,84)]	[0-70,000] [(0.00-115.40)]	3.33
Dietician consultation	133.93±222 0.22±0.37	0 (0)	[0-500] [(0.00-0.82)]	[0-500] [(0.00-0.82)]	0.07
Average annual total DMC of uncomplicated HBP	196,977.75±42,548 (US$ 324.74±70.15)	222,300 (36.63)	[9,175-266,650] [(15.13-439.60)]	[330,500-462,500] [(544.87-762.48)]	100

Table 2: Average annual total direct non-medical costs of uncomplicated HBP in XAF (US$).

Variables	Mean±SD	Median	IQ	[Min-max]	% of total costs
Diet	6,189.29±5,529 (10.20±9.12)	4,000 (6.59)	[4,000-8,000] [(6.59-13.18)]	[0-40,000] [(0.00 65.94)]	86.55
Communication	102.23±204 (0.02±0.03)	150 (0.25)	[0-150] [(0.00-0.25)]	[0-1500] [(0.00-2.47)]	1.43
Transportation	859.82±1300 (14.18±2.14)	600 (0.99)	[400-1,000] [(0.66-1.66)]	[400-1,000] [(0.66-1.66)]	12.02
Average annual total NMC of uncomplicated HBP	7,151.34±7032 (US$11.79±11.59)	4,750 (7.83)	[4,400-9,150] [(7.25-15.08)]	[400-42,500] [(0.66-70.07)]	100

Table 3: Average annual total economic costs of uncomplicated HBP in XAF (US$).

Variables	Mean±SD	Median	IQ	[Min-max]	% of total costs
DMC-uncomplicated HBP	196,977.75±42548 (324.74±70.14)	222,300 (366.48)	[9,175-266,650] [(15.12-439.60)]	[330,500-462,500] [(544.87-762.48)]	89.42
DNMC-uncomplicated HBP	7,151.34±7032 (11.79±11.59)	4750 (7.83)	[4,400-9,150] [(7.25-15,08)]	[400-42,500] [(0,66-70.06)]	3.25
IDC-uncomplicated HBP	16,147.67±26163 (26.62±43.13)	8,333 (1.37)	[2,500-19230] [(4.12-31.70)]	[1,666-188,461] [(2.74-310.69)]	7.33
Average annual total economic costs uncomplicated HBP	220,276.76±75,743 (363.15±124.87)	235,383 388.05	[16,075-295,030] [(26.50-486.39)]	[332,566-523,846] [(548.27-863.62)]	100

Table 4: Univariate and multivariate analysis of factors associated with increased costs of uncomplicated HBP.

Variables	Mean±SD	Univariate		Multivariate	
		Correlation coefficient	P value	Correlation coefficient	P value
Duration of HBP	8.21±7	0.178*	0.061	0.178**	0.030
Medication of HBP	12,196.7±5932 (20.11±9.78)	0.044	0.645	0.044	0.540
Medical assessment of HBP	41,053.57±24,388 (67.68±40.20)	0.103	0.281	0.103	0.141
Hospitalization for HBP	6,550.96±10139 (10.80±16.71)	0.534***	0.001	0.534***	0.001
Special diet for HBP	6,189.29±5528 (10.20±9.11)	-0.009	0.924	-0.009	0.380
Transportation for attending traitment unit	859.82±1299 (1.41±2.14)	0.301***	0.001	0.301***	0.001
Communication for seeking care of HBP	102.23±204 (0.16±0.33)	0.064	0.503	0.064	0.630

*Significance at 10%; **significance at 5%, ***significance at 1%

Table 5: Average total annual direct medical costs of complicated HBP in XAF (US$) (n=67).

Variable	Mean±SD	Median	IQ	[Min-max]	% of cost total
Medical consultation	2,522.39±503 (4.16±0.83)	3,000 (4.94)	[2,000-3,000] [(3.29-4.94)]	[2,000-3,000] [(3.29-4.94)]	1.03
Medicine/drugs of complicated HBP	136,470.12±75036 (224.98±123.70)	128700 (212.17)	[82200-207000] [(135.51-341.26)]	[23400-328200] [(38.57-541.07)]	55.86
Complicate HBP assessments	42,029.85±23,734 (69.29±39.12)	54,000 (89.02)	[54,000-56,000] [(89.02-92,32)]	[0-56,000] [(0-92.32)]	17.20

Continued.

Variable	Mean±SD	Median	IQ	[Min-max]	% of cost total
Medication/drugs for complications	17,899.1±19842 (29,51±32.71)	15,000 (24.73)	[1,225-25,200] [(2.02-41.54)]	[0-65850] [(0-108.56)]	7.32
Medical card	300±0 (0.49±0)	300 (0.49)	[300-300] [(0.49-0.49)]	[300-300] [(0.49-0.49)]	0.12
Care package for complications	31,298.51±20459 (51.60±33.73)	35,000 (57.70)	[3,000-50,000] [(4.94-82.43)]	[0-50,000] [(0-82.43)]	12.81
Medical record/ file	626.87±745 (1.03±1.22)	0 (0)	[0-1,500] [(0-2.47)]	[0-1,500] [(0-2.47)]	0.26
Hospitalization for complicated HBP	12,985.07±23891 (21.41±39.38)	6,000 (9.89)	[3,000-14,000] [(4.94-23.08)]	[0-150,000] [(0-247.29)]	5.31
Dietician consultation	141.79±227 (0.23±0.37)	0 (0)	[0-500] [(0-0.82)]	[0-500] [(0-0.82)]	0.06
Average annual total DMC-complicated HBP	244,273.70±164440 (402.71±271.09)	242,000 (398.96)	[70,375-167,725] [(116.02-276.51)]	[25700-355350] [(42.37-585.83)]	100.00

Table 6: Average annual total direct non-medical costs of complicated HBP in XAF (US$).

Variable	Average	Standard deviation	Median	IQ	[Min-max]	% of total costs
Diet	73,880.76 (121.80)	84,124.47 (138.68)	48,000 (79.13)	[2,000-8,000] [(3.29-13.18)]	[0-40,000] [(0-6.59)]	98.54
Transportation	1,029.85 (1.69)	1,289.587 (2.12)	600 (0.99)	[400-1,000] [(0.66-1.65)]	[200-7,000] [(0.33-11.54)]	1.37
Communication	67.16 (0.11)	83,735 (0.14)	0 (0)	[0-150] [(0-0.25)]	[0-300] [(0-0.49)]	0.09
Average annual total DNMC - complicated HBP	74,977.77 (123.61)	85,497,792 (140.95)	48,600 (80.12)	[2,400-9,150] [(3.95-15.08)]	[200-47,300] [(0.33-77.98)]	100

Table 7: Average annual total indirect costs of complicated HBP in XAF (US$) (n=67).

Variable	Mean±SD	Median	IQ	[Min-max]	% of total cost
Loss of earnings	19,837.6±29113 (32.70±47.99)	10,000 (16.48)	[3,333-25,000] [(5.49-41.21)]	[0-150,000] [(0-247.29)]	72.8
Transportation	3,509.07±4418 (5.78±7.28)	2,400 (3.95)	[300-4,000] [(0.49-6.59)]	[0-21,000] [(0-34.62)]	12.9
Communication	173.13±205 (0.28±0.33)	150 (0.25)	[0-300] [(0-0.49)]	[0-1000] [(0-1.65)]	0.6
Nursing special food	3,744.78±8409 (6.17±13.86)	0 (0)	[0-3,000] [(0-4.94)]	[0-45,000] [(074.18)]	13.7
Average annual total IC-complicated HBP	27,264.58±42,144 (44.95±69.48)	12,550 (20.69)	[3,633-32,300] [(5.99-53.25)]	[0-217,000] [(0-357.75)]	100.0

Table 8: Average annual total economic cost of uncomplicated HBP in XAF (US$) in the Adamaoua region, Cameroon (n=67).

Variable	Mean±SD	Median	IQ	[Min-max]	% total of costs
DMC-C.HBP	244,273.70±164440 (402.71±271.09)	242,000 (398.96)	[70,375-167,725] [(116.02-276.51)]	[25,700-355,350] [(42.37-585.83)]	70.49
DNMC - C. HBP	74,977.77±85497 (123.61±140.95)	48,600 (80.12)	[2,400-9,150] [(3.95-15.08)]	[200-47,300] [(0.33-77.98)]	21.64
IC-C. HBP	27,264.58±42,144 (44.95±69.48)	12,550 (20.69)	[3,633-32,300] [(5.99-53.25)]	[0-217,000] [(0-357.75)]	7.87

Continued.

Variable	Mean±SD	Median	IQ	[Min-max]	% total of costs
Average annual total economic costs of complicated HBP	346,516.05±292,081 (571.27±481.53)	303,150 (499.78)	[76,408-209,175] [(125.97-344.85)]	[25,900-619,650] [(42.70-1,021.56)]	100

Table 9: Bivariate and multivariate analysis of factors associated with increased spending in XAF (US$).

Variable	Mean±SD	Univariate		Multivariate	
		Correlation coefficient	P value	Correlation coefficient	P value
Duration of complicated HBP	6.3±6	-0.147	0.118	-0.147	0.47
Costs of complicated HBP treatment	11,372.51±6,253 (18.75±10.31)	-0.081	0.258	-0.081	0.22
Cost of complicated HBP assessments	42,029.85±23,734 (69.29±39.13)	-0.03	0.405	-0.03	0.64
Cost of HBP complications-related tests	31,298.51± 20,460 (51.60±33.73)	-0.097	0.219	-0.097	0.20
Cost of HBP complications-related medication	17,899.1±37,382 (29.51±61.62)	0.13	0.147	0.13	0.147
Costs of complicated HBP hospitalization	12,985.07±19,842 (21.41±32.71)	0.577***	0.001	0.577***	0.001
Cost of dietary regimens for complicated HBP	6,156.73±23,891 (10.15±39.38)	0.309***	0.005	0.309***	0.005
Transportation costs for complicated HBP	1,029.85±7,029 (1.69±11.59)	0.39***	0.001	0.39***	0.001
Communication costs for complicated HBP	67.16±67 (0.11±0.11)	0.037	0.384	0.037	0.384

*Significance at 10%; **significance at 5%, ***significance at 1%

DISCUSSION

This study aimed to estimate the economic costs of treating HBP in the Adamaoua region of Cameroon using cost- of-illness method from a patient's perspective. With regards to socioeconomic characteristics, the median age of the participants was 52 years ±IQ [45.66] years with a female predominance (60%). This could be explained by the fact that the stiffness of the vessels occurs with age and also age is a cardiovascular risk factor. The female predominance could be explained by the fact that in in Cameroon and particularly in the Adamaoua region, the result of the demographic survey shows a female predominance with 51% of women. This finding is consistent with the results of a previous study on the variations in the costs of hospital care for strokes in Douala, Cameroon that found an average age of the participants varied between 47 and 73 years.[26] Similarly, another study in Cameroon found among HBP patients, an average age of 44.5±15.7 years with a ratio of 1.4 with a female predominance.[27]

In the cost analysis, the direct costs included the direct medical and direct nonmedical costs of HBP included all expenses related to healthcare services and treatment processes, while the indirect costs considered the loss of income related earnings and productivity because of illness. The average annual total direct costs of uncomplicated HBP were XAF 204,129.09±49, 580 (US$336.53±81.74), while the average annual total direct costs of complicated HBP treatment were XAF 319,251.47±249,937 (US$526.32±412.05). Of these annual total direct costs, 96.5% and 76.51% were attributed to direct medical costs for uncomplicated and complicated HBP treatment respectively, while 3.51% and 23.49% were respectively attributed to direct nonmedical costs of uncomplicated and complicated HBP in the study settings. The average annual total indirect costs of uncomplicated HBP of XAF 16,148±26,163 (US$ 26.62±43.13) were mainly composed of the cost of lost earnings and productivity (100%), while these costs of complicated HBP of XAF27,264.58±42144 (UD$44.95±69.48) were mainly made up of lost earnings

(72.8%) followed by nursing special foods (13.7%) and transportation (12.9%). This result is explained by the fact that the patients with complicated HBP were deprived of their daily income-generating activities during their hospital stay. These findings are consistent with the results Iran that found that the total costs of coronary heart disease (CHD), ischaemic stroke (IS) and haemorrhagic stroke (HS) in the whole country were approximately 65.7%, 27.6% and 6.8% of the total attributable costs of hypertension respectively.[14] The breakdown of the annual total direct costs of HBP treatment was as follows: medicine 71.7% and 48.35% for uncomplicated and complicated HBP respectively, laboratory tests and diagnostic examination assessments 20.1% and 13.17% for uncomplicated and complicated HBP respectively, diet regimens 3% and 23.14% for uncomplicated and complicated HBP respectively, healthcare packages 3.2% and 9.8% for uncomplicated and complicated HBP respectively, hospitalization 0.1% and 4.1% for uncomplicated and complicated HBP respectively, medical consultation 1.1% and 0.8% for uncomplicated and complicated HBP respectively, medical card and record/file 0.3% for uncomplicated and complicated HBP respectively, dietician consultation 0.1% and 0.04% for uncomplicated and complicated HBP respectively, transportation 0.45% and 0.02% for uncomplicated and complicated HBP respectively, and communication 0.05% and 0.32% for uncomplicated and complicated HBP respectively. These findings corroborate with the results of a study conducted in Poland in 2014 aiming to estimate the direct medical and non-medical costs of arterial hypertension treatment (costs of hypertension treatment) over a 1 year calendar period (2010) from a social perspective, which revealed that the largest portion of the overall cost structure related to HBP treatment in Poland was allocated to medical consultation costs with laboratory tests and diagnostic examinations at 35.04%, medication costs at 32.95% and hospital stays at 19.12%, while the smallest portion was attributed to transportation costs for patients travelling to outpatient clinics for hypertension diagnosis and treatment, accounting for 12.89%.[21] This implies that present study's findings align somewhat with the cost distribution for various types of HBP healthcare services to the study conducted in Poland, where consultation visit and lab testing costs have been integrated thereby giving the diverse range of HBP patients, including pre- hypertension and various degrees of no complications and complications across demographics, low- risk groups often only require specialized doctor's visits, justifying the relative expensive cost of visits and medical examinations' assessments. The findings of this study were somewhat consistent with the results of a Malaysian's study that retrospectively estimated the direct and indirect costs associated with HBP treatment with an exchange rate of 1 Malaysian Ringgit (MYR)=XAF133 and (US$1.00=4.25 MYR), the direct costs for different hypertension stages were 1612.38 MYR for pre-hypertension, 1741.85 MYR for stage one hypertension and 2718.21 MYR for stage two hypertension with the corresponding indirect costs of 8078.70 MYR, 6654.52 MYR and 7511.41 MYR, respectively, where direct medical costs included expenses for physician services, medications and lab tests as well as nursing and transportation costs, while indirect costs were calculated based on productivity loss.[22] However, the direct costs reported in the present study were slightly lower compared with the Malaysia's study, likely because of lower medical and laboratory service fees in Cameroon.

Overall, the average annual total economic costs of uncomplicated HBP to patients were estimated at XAF 220,276.76±75,743 (US$363.15±124.87) with the direct medical costs representing the highest proportion with (89.4%), following by the total indirect costs (7.3%), while the economic costs of managing complicated HBP were estimated at XAF 346,516.05±292,081 (US$571.27±481.53) which mainly made up of direct medical costs (70.49%) followed by direct nonmedical cost (21.67%). The increase in economic costs of managing uncomplicated HBP were significantly influenced by factors such as the duration of HBP ($p<0.03$); hospitalization ($p<0.01$) and transportation ($p<0.01$) with about 28% of variability in economic costs related to hospitalization with a statistically significant difference ($p<0.01$). With regards to complicated HBP, the costs of hospitalization represented about 33% of variability in expenditures, and the factors such as hospitalizations, diet and transportation were statistically significant with a value of $p<0.05$, while all other factors (duration, treatment, assessments, complications related tests, complications related medication, communication) impacted non significantly the economic costs of complicated HBP. These findings are in with the results of a previous study in China that showed that the hospitalization costs of patients with HBP were mainly influenced by the length of stay; payment methods of medical insurance.[29] The international literature also indicated that when considering in the lost productivity of HBP patients, the total economic costs (direct and indirect costs) in the present study were significantly higher than those in the Malaysian study.[22]

Moreover, in this study, the economic costs of treating uncomplicated and complicated HBP represent respectively 42% and 66% of Cameroon national minimum wages. These findings contrast with the results of other study evaluating the cost of management of complications of arterial HBP (stroke) in Cameroon calculated at XF621,795 (US$1,025.1) about 117% or 1.17 times of Cameroon national minimum wages.[26] On the other issues, a study has shown that the costs of treating hyper tension account for only 12.1% of the total costs associated with HBP.[30] Another study estimated that the treatment costs of HBP comprise approximately 21% of the costs related to HBP, while cardiovascular complications account for 27%, and other diseases account for 52%.[31] In the Global Burden of Disease report in 2015, among the risk factors, the economic burden of elevated systolic blood pressure was even higher than smoking and obesity.[32,33] Based on the high costs and associated complications of HBP, it has become one of the main

health challenges of the present century. Due to the lack of comprehensive information on the economic burden of HBP and its costs in Iran, as well as the interest and need of policymakers and health planners to assess the economic costs of HBP and its related diseases, economic burden estimation can serve as tangible evidence for health policymakers to accurately evaluate the extent of health problems in the population and provide motivation for designing interventions to address them.[34,35] While this study exhibited strength by estimating the economic costs incurred by patients in seeking treatment of HBP, it does have some limitations.

Limitations

This study was the first in the Adamaoua region of Cameroon that evaluates the economic costs of HBP treatment from the patient's perspective, but it had some limitations.

The study used a cross-sectional design and was carried out in two hospitals (3rd and 4th categories) which employed at least one cardiologist but it would have been good to conduct this study in all or more hospitals providing healthcare to substantial number of HBP patients in the region. One of the limitations was the low monthly income of the participants which delayed their early diagnosis and treatment thereby attending hospitals at the stage of complications. The data were collected from patients seeking treatment at hospitals, they may not provide a comprehensive items of patient costs, ensuring that all direct medical and nonmedical and indirect costs were fully collected and considered the analysis. The direct cost of HBP treatment was calculated using a treatment protocol, while direct non- medical and indirect costs were estimated using patients' recalls of their expenses and loss of productivity with possible recall information bias as we relied on the answers given by participants, their consultation notebooks and file for the estimation of the costs of their HBP treatment. The cost of complications was not estimated by pathology since it would have been better elucidated if we evaluated these costs by identified complications.

CONCLUSION

The HBP constitutes one of the most dangerous, costly, but preventable chronic disease that leaded to a substantial economic burden worldwide and particularly in African countries such as Cameroon. The average annual total direct costs of uncomplicated and complicated HBP treatment were substantial and mainly attributed to both direct medical and nonmedical costs in the study settings. The average annual total indirect costs of uncomplicated HBP were mainly composed of the cost of lost earnings and productivity, while these costs of complicated HBP were mainly made up of lost earnings followed by nursing special foods and transportation. The average annual total economic costs of uncomplicated HBP to patients were substantial with the direct medical costs representing the highest proportion, following by the total indirect costs, while the economic costs of managing complicated HBP were more expensive mainly made up of direct medical costs followed by direct nonmedical cost. The breakdown of costs pointed out the main contributors were pharmacological treatments; laboratory assessments and the complications and their management. Therefore, it is necessary to implement a national prevention strategy based on health promotion to identify and reduce cardiovascular risk factors with a view to holistic prevention. It is policy relevant to include the case management of HBP in the second phase of the universal health coverage in order to make affordable by eliminating the financial barriers in accessing to quality healthcare for all patients in the country. Finally, the elimination of user fees in seeking healthcare for HBP would contribute to reduce the incidence of CKD thereby reducing the morbidity and mortality of these diseases in Cameroon.

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