International Journal of Health Economics and Policy
2025, Vol. 10, No. 3, pp. 130-139
https://doi.org/10.11648/j.hep.20251003.15

Research Article

Economic Impact of Dialysis on Household Welfare in Buea and Bamenda, Cameroon

Therence Nwana Dingana[1, 2], Njong Mom Aloysius[5], Fuein Vera Kum[5], Leo Fosso Fozeu[4], Neh Chang Ngasa[1, 3], Stewart Ndutard Ngasa[1, 3, *]

[1]Medical Research and Careers Organisation, Buea, Cameroon
[2]Tubah District Hospital, Regional Delegation of Public Health, Tubah, Cameroon
[3]Pennine Care NHS Foundation, Manchester, United Kingdom
[4]Ndop District Hospital, Regional Delegation of Public Health, Ndop, Cameroon
[5]Faculty of Economics and Management Science, University of Bamenda, Bamenda, Cameroon

Abstract

Background: Noncommunicable diseases, such as kidney failure, diabetes, and cancer, are among the leading causes of death worldwide. There is a sharp increase in the incidence and prevalence of patients with kidney failure requiring replacement therapy. This has led to a very high cost, especially in resource-limited settings like Cameroon. The aim of this study is to determine the effects of direct and indirect costs of kidney failure treatment on household welfare. *Methods:* A descriptive cross-sectional study was conducted between May and July 2022 among 133 chronic hemodialysis patients at the Buea and Bamenda Regional Hospitals. Participants were selected through stratified purposive sampling. A pre-tested questionnaire, adapted from the WHO's economic impact tool for chronic disease, was used to collect data on direct costs (consultations, diagnostics, medications, and dialysis fees) and indirect costs (transportation, accommodation, and caregiver time). Data were analyzed using Stata version 14. Descriptive statistics were used for baseline characteristics, while Ordinary Least Squares (OLS) and multivariate linear regression analyses were employed to explore associations between treatment costs and household expenditure. Statistical significance was set at $p < 0.05$. *Results:* The mean age of participants was 44.6 ±15.5 years, with 60.2% male and 62.4% married. Most (59.4%) were unemployed, and 60.9% paid out-of-pocket, as none had health insurance. The annual household expenditure ranged from $488.38 to $5,469.83 (mean = $2,519.59), while the total annual cost of treatment ranged from $793.89 to $15,267.18 (mean = $3,320.00). While total direct and indirect treatment costs showed negative but non-significant associations with household expenditure, disaggregated analysis revealed important patterns. Consultation and diagnostic test costs had significant negative associations with household expenditure ($\beta = -0.293$, $p = 0.001$ and $\beta = -0.358$, $p < 0.001$), which implies that as spending on these items increased, overall household expenditure decreased due to a resource crowding-out effect. Conversely, spending on medications and self-medication had significant positive associations ($\beta = 0.189$, $p = 0.028$ and $\beta = 0.327$, $p < 0.001$), indicating a direct increase in financial burden and a corresponding reduction in household welfare. *Conclusion*: Kidney failure has a significant negative effect on the household welfare of patients on dialysis. Health insurance schemes and universal health coverage should target patients on hemodialysis. Universal health coverage in Cameroon should aim to specifically cover the cost of consultation, laboratory tests, medications, and transportation for dialysis patients in these regions.

*Corresponding author: stewart.ndutard3@gmail.com (Stewart Ndutard Ngasa)

Received: 24 June 2025; **Accepted:** 31 July 2025; **Published:** 25 August 2025

Keywords

Economic Impact, Kidney Failure, Dialysis, Healthcare Cost, Household Welfare, Cameroon

1. Background

Globally, disease burden is rising, ranging from noncommunicable diseases (NCDs), malnutrition, neglected tropical diseases, and infectious disease illnesses [1] While much global attention has focused on infections like HIV, tuberculosis, and COVID-19, NCDs such as heart disease, cancer, kidney failure, chronic respiratory conditions, and diabetes are now the leading causes of death and represent a growing international health threat. These conditions are responsible for 41 million deaths annually—over 70% of global mortality—surpassing the toll from communicable diseases [2].

Kidney failure, a major NCD, remains under-addressed, particularly in resource-limited settings. There is a notable increase in the number of individuals requiring dialysis, a treatment that is often prohibitively expensive [3]. The International Society of Nephrology projects that by 2030, 14.5 million people will need treatment for kidney failure, yet only 5.4 million will receive it due to economic and systemic barriers [4].

Dialysis and kidney transplantation have significantly improved outcomes for patients over the past decades, particularly in high-income countries where such treatments have been widely accessible for over 50 years [5]. The use of dialysis varies regionally due to differences in population demographics, the prevalence of End-Stage Renal Disease (ESRD), and, most specifically, access to and provision for Renal Replacement Therapy (RRT) [6, 7]. The cost of managing renal failure is disproportionately high, placing a severe burden on families and communities, especially in low-income countries. While data on Renal Replacement Therapy (RRT) costs are available in wealthier nations, there is a scarcity of such information in sub-Saharan Africa [8, 9]. For example, the U.S. spends about $28 billion yearly on ESRD-related medical expenses. The UK allocates 1-2% of NHS funding to a population segment representing just 0.05% [10]. In contrast, countries like Cameroon rely heavily on out-of-pocket payments, forcing many households into financial hardship. This system exacerbates inequality, as wealthier families manage costs more easily while poorer households face catastrophic health expenditures and often reduce or abandon treatment [11]. Consequently, poor households quickly face catastrophic health expenditures, become financially drained, income depleted, and unmanageable in the context of kidney failure [12].

As treatment modalities for CKD become increasingly precise and intensive, they require consultations, lab tests, and lifestyle changes. These accumulate significant financial costs that can overwhelm patients, particularly those without health insurance or with minimal government support for healthcare expenditures. Studies highlight that chronic health conditions like CKD place severe economic strain on families, resulting in a lowered quality of life and increased reliance on informal and less effective coping measures, including traditional medicine or prayer [13]. Furthermore, the current healthcare financing frameworks in many LMICs often leave the poorest populations at a disadvantage, ultimately limiting both access to and the quality of care received by those suffering from kidney failure [14]. In countries like the U. S., dialysis patients benefit from national insurance schemes like Medicare [15]. All these are very costly and can be challenging for the patients to cope with. In most developed countries like the United States, patients receiving dialysis are insured by Medicare, a robust single-payer dominant system, which is more cost-effective [16]. In developing countries, it may not be cost-effective [17, 18]. Limited resources, poor access, and high treatment costs contribute to the under-diagnosis of kidney failure. Even those who are diagnosed often receive inadequate care or turn to ineffective alternatives such as prayer or traditional medicine, resulting in poor health outcomes [19, 20].

The current socio-political crisis plaguing the English-speaking part of Cameroon has brought more challenges to these patients, in terms of abandonment of settlements, death of breadwinners, cost of transportation, lockdown days, and travel risks, etc., all of these will increase the socioeconomic burden of kidney failure [20]. Although kidney failure and its treatment impose significant economic burdens globally, most existing research focuses on high- and middle-income countries. In low-income settings like Cameroon, especially conflict-affected regions such as Buea and Bamenda, there is a lack of data on how the cost of dialysis impacts household welfare [21]. This gap in localized evidence limits informed policy-making and targeted healthcare interventions. We, therefore, resorted to evaluating the economic effects of kidney failure treatment on the household welfare of patients in the dialysis centers of Buea and Bamenda, where the need is critical, and to determine the effects of direct and indirect costs of kidney failure treatment on their household income.

2. Methods

2.1. Study Design, Setting, and Participants

Cameroon's South West and North West regions, with a population of about 3.52 million, are faced with a dual emergency: the socio-political crisis, which turned violent in November 2017, and, recently, the COVID-19 disease. These regions have approximately 400 patients requiring dialysis and have two hemodialysis centers, the Buea Regional Hospital and the Bamenda Regional Hospital. The Buea Regional Hospital in the South West Region currently has 10 dialysis treatment posts, whilst the dialysis unit in the North West region has six treatment posts with just four functional machines. Each treatment session lasts for 4 hours. These units offer two sessions per day, a morning and an afternoon session.

The financial burden of kidney failure affects many levels: the government, firms, society, and households. This study was focused on the economic burden at the household level. The content of the economic effect in this study is composed of the direct and indirect costs of kidney failure. The monthly expenses were analyzed and projected for one year (2022). Dialysis patients for acute kidney injury and other causes like hyperkalemia requiring just a few dialysis sessions were excluded. Patients who initiated dialysis less than a month ago were exempted from the study.

2.2. Sampling and Data Collection

We used the descriptive cross-sectional study design, and data collection took place from May 2022 to July 2022. We used a purposive sampling technique to collect data using a self-administered pre-tested questionnaire for the economic impact of chronic disease [22]. The questionnaire has mainly closed-ended questions and is divided into three main sections. Section A is general information and household socio-demography and household expenditure, Section B is the direct cost of kidney failure, and Section C is the indirect cost of kidney failure. All collected data was anonymised.

2.3. Description of Main Variables

The study assessed several economic factors related to kidney failure treatment. Household expenditure (Y) was quantified in CFA francs, which involved approximating the patients' monthly spending. This was then converted to dollar equivalence (USD) at the time ($1 = 655FCFA). To determine the average annual household expenditure, the average monthly spending was multiplied by 12.

Direct cost (X1) represented the total annual cost of treating kidney failure, encompassing expenses such as consultation fees, laboratory tests, medication costs, medical devices, self-medications, other treatments like special diets, dialysis costs, and additional expenses related to dialysis. These costs were projected for a one-year duration.

Indirect cost (X2) referred to the average annual expenses associated with kidney failure treatment but not directly linked to medical procedures. This included transport expenses, parking fees, accommodation costs, caregiver fees, informal caregiver expenses, the cost of accompanying persons, caregiver accommodation, and other related costs. Like direct costs, these expenses were projected over a one-year period.

To examine the impact of these factors on household expenditure and, consequently, household welfare, the study employed an ordinary least squares (OLS) approach due to the continuous nature of the dependent variables. OLS estimators involve linear functions of the household expenditure (Y) values, connected through weights that are a non-linear function of the direct and indirect cost values (X1 and X2). The analysis was conducted using the software SPSS, which generated values for the unknowns ($\beta 0$, $\beta 1$, β 2) in the linear model equation.

The research employed the Ordinary Least Squares regression model to investigate the relationship between the direct and indirect costs of kidney failure treatment and household welfare. Household welfare was considered the dependent variable, while direct and indirect costs were treated as independent variables. This relationship can be summarized by the following function:

Household welfare (HW) = F (direct cost, indirect cost);

$$HW = F\ (DC, IC) \tag{1}$$

In our study, we measured household welfare by measuring household consumption in terms of household expenditure as specified by the World Bank (2000).

Using the multiple regression models, we transformed the function into a multiple regression equation for empirical verification as follows:

$$Y_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \varepsilon_i \tag{2}$$

Where:

Yi= HE (household expenditure), the dependent variable, and a measure of household welfare.

X1= Direct cost (DC) and X2= Indirect cost (IC) are the independent variables.

Ɛi, = Error term, which constitutes other predictors of household welfare not considered in our model.

Our data set will then help us to get estimates for $\beta 0$, $\beta 1$, and $\beta 2$.

2.4. Sample Size Calculation

We determined the sample size for this work based on Taro Yamane's approach to finite populations

$$n=N/(1+N(e)^2) \tag{3}$$

Where

n = the minimum sample size

N = the finite population out of which the sample was taken

e = the acceptable sampling error (or limit of tolerable error)

The total number of patients permanently on dialysis in Buea is 105, and Bamenda is 95, giving a total of 200, setting the significance level at 0.05 or 5%. Therefore, the minimum sample size (n) was calculated as

$$n=200/(1+200(0.05)^2)=133.33=133 \text{ patients} \quad (4)$$

A stratified sampling technique was employed to ensure representation from key demographic groups—men, women, and children. Within each stratum, purposive sampling was initially used to identify individuals from these categories, followed by random sampling within each subgroup to select participants for the study.

In total, 133 participants were recruited and took part in the study.

2.5. Statistical Methods and Data Analysis

Data were entered into a Microsoft Excel spreadsheet for initial cleaning and organization, then exported to Stata version 14 for statistical analysis, chosen for its capacity to handle health-related and economic data with precision. Descriptive statistics were used to summarize the characteristics of the study population. For continuous variables (such as monthly household income and dialysis-related expenses), results were presented as means and standard deviations (SD) to describe the average values and the extent of variation. For categorical variables (such as gender, marital status, and employment type), results were reported as frequencies and percentages to illustrate their distribution across the sample. To assess the relationship between individual factors and household welfare, bivariate analysis was conducted using Ordinary Least Squares (OLS) regression. This method was appropriate for identifying linear associations between the continuous outcome variable (household welfare score or expenditure) and potential predictors, including direct and indirect costs of kidney failure treatment. For a more comprehensive assessment, multivariate linear regression was used to control for potential confounding variables and determine which factors had independent associations with household welfare. This technique allowed for the simultaneous evaluation of multiple predictors in relation to a continuous dependent variable, providing a clearer understanding of the most influential economic factors. A p-value of <0.05 was considered statistically significant, indicating that the observed associations were unlikely to have occurred by chance.

2.6. Ethics Approval and Consent to Participate

Ethical clearance was obtained from the Institutional Review Board of the Regional Delegation of Health for the Northwest Region and the Regional Delegation of Health for the Southwest Region. The respondents were adequately informed using the participant's information section about all the relevant aspects of the study, including its aim, procedures, and anticipated benefits, before data were collected. All participants provided verbal and/or written consent to participate in this study. Assent was obtained for children (less than 21 years)

3. Results

3.1. Sociodemographic Characteristics of Participants

The patient ages exhibited a normal distribution and varied from 13 to 80 years, with an average age of 44.6±15.5 years. The majority of patients fell in the age range of 30 to 60 years, making up 63.9% of the sample (refer to Table 1). Out of the 133 participants, 80 (60.2%) were male, while 53 (39.8%) were female. In terms of marital status, the majority of patients (83 or 62.4%) were married, 38 (28.6%) were single, 10 (7.5%) were widows or widowers, and 2 (1.5%) were divorced. Regarding employment, 79 (59.4%) of the patients were unemployed, while 54 (41%) were employed. Educational backgrounds varied, with 55 (41.4%) having attended secondary education, 38 (28.6%) having completed primary education, 39 (29.3%) having tertiary education, and one patient having no formal education.

Only a small proportion (39 or 29.3%) of patients had no comorbidities. Among the 94 (70.6%) patients with comorbidities, 86 (64.7%) had chronic hypertension, 12 (9.0%) had diabetes, 3 (2.3%) had heart disease, and 3 (2.3%) had other chronic illnesses, such as liver failure. Ten (7.5%) of the patients had both hypertension and diabetes. Household density ranged from 2 to 15 individuals per household, with an average of 5.7±2.8 persons per household. The duration of time the patients had been on dialysis ranged from 1 month to 168 months (equivalent to 14 years), with an average duration of 28.9±36.4 months (approximately 2.4±3.0 years). The time spent in the hospital for each dialysis session varied widely, spanning from 5 to 48 hours, with an average duration of 17.5±11.1 hours. The time patients needed to travel to the hospital ranged from 0 minutes (for those residing in the hospital) to 240 minutes (4 hours), with a mean travel time of 57.2±45.8 minutes.

None of the patients had their medical bills covered by health insurance. The majority (60.9%) were responsible for paying their own bills, while 24 (18.0%) had their bills covered by their parents. Additionally, 18 (13.5%) patients had their children covering the bills, 7 (5.3%) had their spouses paying the bills, and 3 (2.3%) had their bills covered through alternative means, such as by their siblings.

3.2. Total Household Expenditures

The annual household expenditure ranged from $488.38 to $5,469.83. The mean, median, and standard deviation of annual household expenditures were $2,519.59, $2,441.89, and $1,272.85, respectively.

Table 1. Sociodemographic characteristics of Participants.

Variable	Number	Percentage
Gender		
Male	80	60.2
Female	53	39.8
Marital Status		
Married	83	62.4
Single	38	28.6
Divorced	2	1.5
Widow	10	7.5
Employment status		
Employed	54	40.6
Unemployed	79	59.4
Level of education		
None	1	0.8
Primary	38	28.6
Secondary	55	41.4
Tertiary	39	29.3
Who pays bills		
Self	81	60.9
Parents	24	18.0
Insurance	0	0.0
Spouse	7	5.3
Children	18	13.5
Others	3	2.3
Comorbidities		
None	39	29.3
Heart disease	3	2.3
Diabetes	12	9.0
Hypertension	86	64.7
Other	3	2.3
Variable	Mean ± SD	Median (IQR)
Age (years)*	44.6 ± 15.5	43 (34 - 55.5)
Duration on dialysis (months)	28.9 ± 36.4	12 (7 - 33)
Household density	5.7 ± 2.8	6 (4 - 7)

Variable	Number	Percentage
Duration in hospital per session (hours)	17.5 ±11.1	15 (7.5 - 24)
Time spent travelling (mins)	57.2 ±45.8	45 (30 - 90)
Annual household income (USD)	2519,59 ±1272,85	2441,89 (2441,89- 3418,65)

3.2.1. Direct Cost of Kidney Failure

The annual direct cost of kidney failure treatment ranged from $846.52 to $11,655.96 with a mean and standard deviation of $2,683.11 and $1,975.94, respectively.

Table 2. *Annual Direct, Annual Indirect, and Total annual expenditure on kidney failure treatment.*

Statistic	Annual Direct Cost	Annual Indirect Cost	Total Annual Expenditure on Kidney Failure
N	133	133	133
Mean	$2,515.83	$746.92	$3,261.57
Median	$1,964.89	$475.19	$2,567.18
Std. Deviation	$1,851.53	$946.10	$2,350.25
Minimum	$793.89	0 USD	$793.89
Maximum	$10,901.53	$5,481.30	$15,267.18
Percentiles	$1,485.11	$103.05	$1,875.95
	$1,964.89	$475.19	$2,567.18
	$2,576.98	$930.53	$3,545.80

3.2.2. Indirect Cost of Kidney Failure

The annual indirect cost of kidney failure treatment ranged from 0 USD to $5,481.30 with a mean and standard deviation of $746.92 and $946.10, respectively (Table 2). The annual total cost of kidney failure treatment ranged from $793.89 to $15,267.18, with a mean and standard deviation of $3,320 and $2,350.08. To estimate the effect of kidney failure treatment on household welfare, we used household consumption measured in terms of household expenditure. The annual direct and indirect costs of kidney failure treatment both have negative regression coefficients of -0.022 and -0.147, respectively ($p=0.814$ and $p=0.114$, respectively). The net effect of spending on kidney failure treatment had a regression coefficient of -0.119 ($p=0.172$) on household expenditure.

Table 3. *OLS analysis for the direct, indirect, and total annual costs associated with average annual household expenditure.*

Variables	β_0	β coef	p-value	R squared
	$2,557.56			
Annual Direct cost		-0.022	0.814	0.024
Annual Indirect cost		-0.147	0.113	
Total annual cost		-0.119	0.172	

From equation (2) above,

$$Yi = \beta 0 + \beta 1X1 + \beta 2X2 + \mathcal{E} \quad (5)$$

This implies,

$$Household\ Expenditure = 1{,}676{,}982 - 0.022\ Direct\ Cost - 0.147\ Indirect\ Cost + \mathcal{E} \quad (6)$$

3.2.3. Effects of the Direct Cost Components of Kidney Failure Treatment on the Household Expenditure of Dialysis Patients

Multiple linear regression was used to examine the relationship between various components of direct costs and average annual household expenditure. The analysis revealed that both drug costs and other drug costs (including self-medication) had positive regression coefficients of 0.189 and 0.327, respectively, indicating that increases in these costs were associated with higher annual household expenditure. These associations were statistically significant, with p-values of 0.028 and <0.001, respectively, as shown in Table 4. Conversely, other direct cost components, such as consultation cost, test cost, and cost of medical equipment, had negative coefficients, suggesting a potential inverse relationship with household expenditure. Among these, consultation and test costs were statistically significant predictors, while the cost of other treatments and medical equipment did not show significant associations. High expenditure on consultations and diagnostic tests may reflect early-stage or well-managed disease, where patients are more compliant with follow-up care. In economic terms, the negative beta coefficients observed here imply that early and appropriate spending reduces the need for costly interventions later. Thus, while spending on consultations and tests increases, the total cost burden (especially on expensive treatments or complications) declines.

Table 4. Multiple linear regressions for the direct costs associated with average Annual household expenditure.

Variables	β coef	p-value	R squared
Consultation cost	-0.293	0.001	0.264
Tests cost	-0.358	<0.001	
Drugs cost	0.189	0.028	
Other drugs cost	0.327	<0.001	
Other treatments cost	-0.005	0.95	
Cost of medical equipment	-0.07	0.427	

3.3.4. Effects of the Indirect Cost of Kidney Failure Treatment on the Household Expenditure of Dialysis Patients

The regression analysis of each indirect cost component showed that the cost of transportation, caregiver accommodation, informal caregiver cost, and other costs on caregivers had negative regression coefficients of -0.131, -0.055, -0.059, and -0.094, respectively, as shown in Table 5. However, none of these were statistically significant.

Parking cost, accommodation cost, caregiver cost, and caregiver transport cost all had positive regression coefficients of 0.164, 0.012, 0.004, and 0.127, respectively; however, none of them were statistically significant.

Table 5. Multiple linear regressions for the indirect cost of kidney failure treatment associated with average annual household expenditure.

Variables	β coef	p-value	R squared
Transport cost	-0.131	0.26	0.264
Parking cost	0.164	0.087	
Accommodation cost	0.012	0.884	

Variables	β coef	p-value	R squared
Caregiver cost	0.004	0.958	
Caregiver accommodation cost	-0.055	0.509	
Caregiver transport cost	0.127	0.309	
Informal caregiver cost	-0.059	0.483	
Other caregiver costs	-0.094	0.242	

4. Discussion

4.1. Direct Cost of Kidney Failure

The annual direct cost of kidney failure treatment ranged from $793.89 to $10,916.03, with a mean and standard deviation of $2,514.22 and $1,851.52, respectively, as shown in Table 2. This was way too low compared to the $11,713.61 obtained by Halle and collaborators in tertiary hospitals in Cameroon; this is simply because their study was not focused on household expenditure. They had a 30% cost covered by out-of-pocket, while we had 100% out-of-pocket payments. Computing 30% of their value ($11,713.61) gives $3,515.27, which is very close to the figure obtained in our study.

4.2. Indirect Cost of Kidney Failure

The annual indirect cost of kidney failure treatment ranged from 0USD to $5,481.30, with a mean and standard deviation of $746.92 and $946.10, respectively, as shown in Table 2. This was very similar to the mean value of $809.14 obtained by Halle and collaborators in tertiary hospitals in Cameroon [5]. However, their study was not a household-based study like ours.

Total cost of kidney failure

The annual total cost of kidney failure treatment ranged from 520,000($793.89) FCFA to 10,000,000FCFA ($15,267.18) with a mean and standard deviation of 2,137,556FCFA ($3 320) and 1,541,163FCFA ($2,350.08), respectively, as shown in Table 2. Our annual cost was approximately $3,320, with out-of-pocket payments being the main payment method. The annual cost of dialysis has been estimated at $87,500 in the USA [23], $5,736 in India [24], between $22,000 - $55,000 in Nigeria [25], $27,440 in Tanzania [9]. One of the reasons for our lower cost is that we did not include the staff and building costs, as has been done in other studies, and all the costs considered are household expenditures and not general costs like in the other studies.

Effects of kidney failure treatment on the household welfare of dialysis patients.

This study measured household welfare using total household expenditure, with the assumption that higher healthcare spending reduces disposable income for other needs, thereby diminishing household welfare. The regression analysis showed that both direct and indirect annual costs of kidney failure treatment had negative regression coefficients: -0.022 and -0.147, respectively. These findings suggest that as treatment-related costs increase, total household expenditure decreases—likely due to the diversion of funds from other consumption areas. This implies households are forced to cut back on other essentials to accommodate the burden of care. However, these effects were not statistically significant ($p = 0.814$ and $p = 0.114$), indicating a weak relationship. The net treatment cost also had a negative but non-significant coefficient ($\beta = -0.119$, $p = 0.172$), as shown in Table 3. These findings hint at a potential coping mechanism whereby households suppress other expenditures to afford treatment, thus protecting residual welfare in constrained settings.

Effects of the direct cost components of kidney failure treatment on the household expenditure of dialysis patients.

Disaggregating the direct costs revealed that consultation costs ($\beta = -0.293$, $p = 0.001$) and laboratory test fees ($\beta = -0.358$, $p < 0.001$) were significantly associated with reduced household expenditure. These negative coefficients suggest that as patients spend more on these services, they reduce consumption in other areas—likely due to budget constraints—ultimately pointing to worsened household welfare. The costs of other treatments (e.g., nutritional supplements) and medical devices had negative coefficients ($\beta = -0.005$ and $\beta = -0.07$, respectively), but these were not statistically significant, suggesting a similar trend but without sufficient evidence to confirm impact.

Conversely, drug costs ($\beta = 0.189$, $p = 0.028$) and auto-medication (other drugs) costs ($\beta = 0.327$, $p < 0.001$) had positive and statistically significant coefficients, implying that increased spending on these items was associated with higher overall household expenditure. This indicates a greater economic burden on households, with possible reductions in welfare due to the depletion of resources that would otherwise be used for food, education, or housing. Though significant, these findings are concerning, as higher spending on drugs does not ideally correlate with better welfare.

Effects of the indirect cost of kidney failure treatment on the household expenditure of dialysis patients

The regression analysis of indirect costs revealed that expenses such as transportation (β = -0.131), caregiver accommodation (β = -0.055), informal caregiver costs (β = -0.059), and other caregiver-related expenses (β = -0.094) all had negative coefficients, though none were statistically significant. This implies that increased spending on these items may lead households to reduce total expenditure, possibly due to income constraints and forced prioritization. These trends, although not strong statistically, align with the pattern observed in direct costs, where certain medical expenditures lead to decreased overall household spending.

Remarkably, parking fees (β = 0.164), caregiver accommodation (β = 0.012), caregiver costs (β = 0.004), and caregiver transportation (β = 0.127) had positive coefficients, suggesting that greater spending on these items correlates with higher total household expenditure—possibly indicating welfare decline. These were also not statistically significant but may reflect households with relatively higher incomes who can afford such additional costs or those not yet forced to adjust their spending patterns.

5. Conclusion

This multi-center study demonstrated that the cost of hemodialysis at the household level in Cameroon is exceptionally high compared with the cost of living and is mainly due to the cost of consultation, drugs, and laboratory investigation. Despite the state subsidy, most patients are at a low socioeconomic level; out-of-pocket expenditure is extremely high and unaffordable for patients and their relatives in the long term. Hemodialysis is an economic burden on households, so strategies to cut these costs should be implemented. The cost of consultation, laboratory tests, other treatment costs (nutrition), and the cost of medical devices had negative correlations. This implies that increasing the use of these commodities/services at the best minimal cost will decrease the household burden of kidney failure. The indirect cost components showed that the cost of transportation, caregiver accommodation, informal caregiver cost, and other costs on caregivers had a negative correlation; therefore, increasing the use of these commodities/services at best minimal cost will decrease the household burden of kidney failure.

The government should hasten universal health coverage in Cameroon to specifically cover the cost of consultation, laboratory tests, medications, and transportation for dialysis patients in these regions.

Kidney disease screening and prevention programs are necessary to reduce the number of persons in need of dialysis and kidney transplants. This remains the only cost-effective and sustainable approach, especially in developing countries like Cameroon. Therefore, the government should implement a policy of annual kidney disease screening, especially for people at risk.

Abbreviations

CKD	Chronic Kidney Dissease
Covid	Corona Virus Dissease
ESRD	End Stage Renal Dissease
LMIC	Low and Middle Income Countries
NCD	Non Comunicable DIsseases
NHS	National Health Statistics
OLS	Ordinary Least Square
RRT	Renal Replacement Therapy
UHC	Universal Health Coverage

Acknowledgments

Our sincere gratitude goes to all the patients at the Dialysis Centres of the Buea and Bamenda Regional Hospitals. We also thank the directors of the above centres for giving us the administrative clearance needed to complete this piece of work.

Author Contributions

Therence Nwana Dingana: Conceptualisation, Project administration, Resources

Njong Mom Aloysius: Supervision, Conceptualisation, Methodology, Validation

Fuein Vera Kum: Conceptualisation, Writing-original draft, Investigation.

Leo Fosso Fozeu: Data curation, Formal analysis, Resources

Neh Chang Ngasa: Resources, Writing - review & editing

Stewart Ndutard Ngasa: Resources, Writing - review & editing, Methodology

Funding

The authors declare that no external funding sources were used to fund this piece of work.

Availability of Data and Materials

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

Conflicts of Interest

The authors declare that they have no competing interests.

References

[1] A. Chrifi Alaoui *et al.*, "Management of Chronic Kidney Disease in Morocco: A Cost-of-Illness Study," *Cureus*, Jun. 2023, https://doi.org/10.7759/cureus.40537

[2] D. K. Behera and U. Dash, "Impact of macro-fiscal determinants on health financing: empirical evidence from low-and middle-income countries," *Glob. Health Res. Policy*, vol. 4, no. 1, Dec. 2019, https://doi.org/10.1186/s41256-019-0112-4

[3] G. Eknoyan *et al.*, "The burden of kidney disease: Improving global outcomes," *Kidney Int.*, vol. 66, no. 4, pp. 1310-1314, Oct. 2004, https://doi.org/10.1111/j.1523-1755.2004.00894.x

[4] J. Himmelfarb, R. Vanholder, R. Mehrotra, and M. Tonelli, "The current and future landscape of dialysis," *Nat. Rev. Nephrol.*, vol. 16, no. 10, pp. 573-585, Oct. 2020, https://doi.org/10.1038/s41581-020-0315-4

[5] M. P. Halle, N. N. Jimkap, F. F. Kaze, H. Fouda, E. P. Belley, and G. Ashuntantang, "Cost of care for patients on maintenance haemodialysis in public facilities in Cameroon," *Afr. J. Nephrol.*, vol. 20, no. 1, Mar. 2017, https://doi.org/10.21804/20-1-2548

[6] A. J. Collins *et al.*, "US Renal Data System 2012 Annual Data Report".

[7] J. V *et al.*, "Chronic kidney disease: global dimension and perspectives," *PubMed*, 2013, https://pubmed.ncbi.nlm.nih.gov/23727169/

[8] A. F. De Vecchi, M. Dratwa, and M. E. Wiedemann, "Healthcare systems and end-stage renal disease (ESRD) therapies—an international review: costs and reimbursement/funding of ESRD therapies," *Nephrol. Dial. Transplant.*, vol. 14, no. suppl_6, pp. 31-41, Dec. 1999, https://doi.org/10.1093/ndt/14.suppl_6.31

[9] L. Mushi, M. Krohn, and S. Flessa, "Cost of dialysis in Tanzania: evidence from the provider's perspective," *Health Econ. Rev.*, vol. 5, no. 1, Dec. 2015, https://doi.org/10.1186/s13561-015-0064-4

[10] "NSF Renal Services Part One: Dialysis and Transplantation." Accessed: Jul. 23, 2025. [Online]. Available: https://assets.publishing.service.gov.uk/media/5a7b21e540f0b66a2fc05612/National_Service_Framework_for_Renal_Services_Part_One_-_Dialysis_and_Transplantation.pdf

[11] Pockros, Benjamin M, Finch, Daniel J., and Weiner, Daniel E., "Dialyssis and Total Health Care Costs in the United States and Worldwide: The Financial Impact of a Single-Payer Dominant System in the US," *J. Am. Soc. Nephrol.*, vol. 32, no. 9, 2021, https://doi.org/https://doi.org/10.1681/asn.2021010082

[12] Ke Xu, David B. Evans, Guy Carrin, and Ana Mylena Aguilar-Rivera, *designing health financing systems to reduce catastrophic health expenditure*. in Technical Briefs for policy-makers, no. 2. World Health Organization, 2005.

[13] H. C. Opara, I. L. Okoronkwo, N. Ifeoma, and C. A. Achukwu, "Enrollees' Satisfaction with Health Service Provision Under the Formal Sector Social Health Insurance Scheme in South Eastern Nigeria: https://dx.doi.org/10.4314/ajhs.v36i3

[14] H. O. Egharevba, "A Comparison of Healthcare Funding Systems between Low- /Medium-Income and High-Income Countries: Equity, Equality, and Fairness in the Rationing of Healthcare Resources," *J. Health Med. Sci.*, vol. 7, no. 2, Jun. 2024, https://doi.org/10.31014/aior.1994.07.02.315

[15] "Choosing a Treatment for Kidney Failure - NIDDK." Accessed: Jul. 23, 2025. [Online]. Available: https://www.niddk.nih.gov/health-information/kidney-disease/kidney-failure/choosing-treatment

[16] OECD, *OECD Reviews of Health Systems: Russian Federation 2012*. in OECD Reviews of Health Systems. OECD, 2012. https://doi.org/10.1787/9789264168091-en

[17] L. Mushi, P. Marschall, and S. Fleßa, "The cost of dialysis in low and middle-income countries: a systematic review," *BMC Health Serv. Res.*, vol. 15, no. 1, p. 506, Nov. 2015, https://doi.org/10.1186/s12913-015-1166-8

[18] D. D. Alasia, P. Emem-Chioma, and F. S. Wokoma, "A Single-Center 7-Year Experience with End-Stage Renal Disease Care in Nigeria—A Surrogate for the Poor State of ESRD Care in Nigeria and Other Sub-Saharan African Countries: Advocacy for a Global Fund for ESRD Care Program in Sub-Saharan African Countries," *Int. J. Nephrol.*, vol. 2012, pp. 1-7, 2012, https://doi.org/10.1155/2012/639653

[19] M. Dutta, P. Mohan, S. B. Mohan, V. Ponnappan, and P. Satyavageeswaran, "Financing primary healthcare for rural areas," *J. Fam. Med. Prim. Care*, vol. 9, no. 11, pp. 5516-5522, Nov. 2020, https://doi.org/10.4103/jfmpc.jfmpc_1131_20

[20] J. B. Aseneh, B.-L. A. Kemah, S. Mabouna, M. E. Njang, D. S. M. Ekane, and V. N. Agbor, "Chronic kidney disease in Cameroon: a scoping review," *BMC Nephrol.*, vol. 21, no. 1, Dec. 2020, https://doi.org/10.1186/s12882-020-02072-5

[21] O. Paltiel, E. Berhe, A. H. Aberha, M. H. Tequare, and D. Balabanova, "A public-private partnership for dialysis provision in Ethiopia: a model for high-cost care in low-resource settings," *Health Policy Plan.*, vol. 35, no. 9, pp. 1262-1267, Nov. 2020, https://doi.org/10.1093/heapol/czaa085

[22] A. M. Adam, "Sample Size Determination in Survey Research," *J. Sci. Res. Rep.*, pp. 90-97, Jun. 2020, https://doi.org/10.9734/jsrr/2020/v26i530263

[23] A. J. Collins, R. N. Foley, D. T. Gilbertson, and S. C. Chen, "United States Renal Data System public health surveillance of chronic kidney disease and end-stage renal disease," *Kidney Int. Suppl.*, vol. 5, no. 1, pp. 2-7, Jun. 2015, https://doi.org/10.1038/kisup.2015.2

[24] V. J. J, S. G. J, J. R, A. T. Et, and P. J. G, "Out-of-pocket expenditures, catastrophic household finances, and quality of life among hemodialysis patients in Kerala, India," *PubMed*, 2022, https://doi.org/10.1111/hdi.13037

[25] C. Okafor and C. Kankam, "Future Options for the Management of Chronic Kidney Disease in Nigeria," *Gend. Med.*, vol. 9, no. 1, Supplement, pp. S86-S93, Feb. 2012, https://doi.org/10.1016/j.genm.2011.10.002