

When Healthcare Breaks the Bank: Catastrophic Healthcare Expenditure and Impoverishment Among Chronic Disease Patients Across Public Healthcare Facility Tiers in Lagos, Nigeria

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WHEN HEALTHCARE BREAKS THE BANK: CATASTROPHIC HEALTHCARE EXPENDITURE AND IMPOVERISHMENT AMONG CHRONIC DISEASE PATIENTS ACROSS PUBLIC HEALTHCARE FACILITY TIERS IN LAGOS, NIGERIA

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ABSTRACT

Background: Chronic diseases impose sustained financial demands in settings with high out-of-pocket healthcare payments. Evidence on catastrophic health expenditure (CHE) and impoverishment across public care tiers in Nigeria remains limited. This study assessed economic burden, CHE prevalence, impoverishment, and their predictors among chronic disease patients attending primary, secondary, and tertiary public facilities in Lagos.

Methods: Facility-based cross-sectional study among 480 adults with chronic illnesses receiving outpatient care in six public facilities. Data was collected via interviewer-administered questionnaire covering socio-demographics, household economics, direct and indirect costs, and insurance status. CHE was estimated using two thresholds: out-of-pocket expenditure exceeding 10% of household income (CHE1) and 40% of non-food expenditure (CHE2). Impoverishment was defined using the World Bank poverty line. Descriptive analyses, chi-square tests, and multivariable logistic regression examined prevalence and predictors across facility levels.

Results: Participants had a mean age of 56.5 years (SD 14.9), 60.2% were female, and 85.8% were uninsured. Hypertension was most common (60.4%), while diabetes, cancer, kidney disease, and thyroid disease concentrated at tertiary level. Median monthly household income declined from NGN 250,000 (\$151.52) before illness to NGN 200,000 (\$121.21) after illness; median per-capita income fell from NGN 44,000 (\$26.67) to NGN 32,000 (\$19.39) after healthcare payments. Median monthly out-of-pocket expenditure was NGN 37,250 (\$22.58), increasing sharply by facility tier from NGN 21,800 (\$13.21) primary level to NGN 95,500 (\$57.88) (tertiary; $p < 0.001$). Medicines and investigations dominated costs; missed workdays did not differ across care levels. CHE was high under both definitions and increased significantly with facility tier: CHE1 affected 68.1% overall (54.4% primary, 68.8% secondary, 93.8% tertiary; $p < 0.001$), while CHE2 affected 66.0% overall (56.3%, 65.8%, 86.3%; $p < 0.001$). Pre-payment poverty affected 79.6% and post-payment poverty 83.1%, with modest variation across tiers. After adjustment, tertiary care remained a strong predictor of CHE1 (AOR 13.94; 95% CI 5.19–37.42) and CHE2 (AOR 5.33; 95% CI 2.56–11.09), while insurance was protective against CHE1 (AOR 0.47; 95% CI 0.26–0.86). Older age and larger household size predicted impoverishment, but facility level did not.

Conclusion: Chronic disease care in Lagos public facilities causes severe financial hardship driven by direct treatment costs, especially medicines and diagnostics. Catastrophic spending rises steeply with care level, particularly at tertiary facilities, whereas impoverishment reflects healthcare costs interacting with widespread pre-existing poverty. Strengthening financial risk protection requires deeper insurance coverage, targeted subsidies for medicines and diagnostics, and more efficient purchasing across all care levels.

KEYWORDS: Catastrophic health expenditure, impoverishment, chronic diseases, healthcare financing.

INTRODUCTION

Chronic illnesses including hypertension, diabetes, cardiovascular diseases, cancers, chronic respiratory conditions, mental disorders, and other non-communicable diseases (NCDs) remain leading causes of global morbidity and mortality, imposing substantial public health and economic burdens at individual, national, and global levels [1,2]. Chronic diseases are long-term, non-infectious conditions that do not resolve spontaneously, are rarely cured, and typically require prolonged management [3]. The World Health Organization (WHO) identifies cardiovascular diseases, cancer, chronic respiratory diseases, and diabetes as the principal contributors to chronic disease-related deaths, while other conditions such as mental disorders, sensory impairments, musculoskeletal disorders, genetic diseases, and inflammatory autoimmune conditions also constitute a significant share of the global disease burden [3,4].

The burden of chronic diseases and their risk factors is increasing worldwide, particularly in low- and middle-income countries (LMICs) such as Nigeria, where prolonged treatment costs exacerbate poverty and constrain development [3-5]. Chronic diseases account for approximately 74% of global deaths annually, with about 73% occurring in LMICs and 86% of premature deaths affecting individuals aged 30-69 years [4,5]. Nigeria is experiencing an epidemiological transition, with nearly 30% of all deaths attributable to chronic conditions and a 22% probability of premature death from major NCDs among adults aged 30-69 years [6]. Globally, chronic diseases are projected to result in an accumulated economic loss of US\$47 trillion by 2030, representing nearly 75% of global GDP [7].

Poverty and limited health insurance coverage further intensify the financial impact of chronic illnesses in Nigeria. In 2024, the World Bank estimated that 56% of Nigerians approximately 129 million people live below the international poverty line, with most lacking health insurance coverage [8,9]. Only about 5% of the population is enrolled in the National Health Insurance Scheme (NHIS), leaving the majority reliant on out-of-pocket (OOP) payments for healthcare [8,10]. This reliance exposes households, particularly those with chronic illnesses, to catastrophic health expenditure (CHE) and impoverishment, often leading to reduced consumption, delayed care, worsening health outcomes, and avoidable mortality [7].

Catastrophic health expenditure lacks a universally accepted definition. The World Bank defines CHE as OOP medical spending exceeding 10% of total household income or expenditure [11], while the WHO's capacity-to-pay approach considers health spending catastrophic when it exceeds 40% of household income after subsistence needs are met [12]. Impoverishment on the other hand occurs when healthcare spending pushes households below the poverty line despite previously being non-poor [13,14]. The WHO-World Bank Universal Health Coverage (UHC) Global Monitoring Report (2023) estimates that about 2 billion people globally face severe financial hardship due to OOP healthcare payments, reflecting stagnation of the world in progress toward UHC [10].

Chronic diseases substantially drive CHE due to their long-term nature, frequent service utilization, and associated productivity losses. One in three adults globally live with multiple chronic conditions and face significant financial strain when accessing care [6,15]. In Nigeria, high NCD prevalence combined with heavy reliance on OOP payments further heightens the risk of CHE and care avoidance [11,16]. Despite global efforts toward UHC, over 1 billion people incurred OOP health expenditures exceeding 10% of household budgets in 2019, with 344 million pushed into extreme poverty, largely due to chronic conditions [17,18].

Globally, the incidence of CHE is estimated at 11.7%, affecting about 808 million people [19]. Evidence from low-income settings underscores the severity of this burden. In sub-Saharan Africa, pooled CHE incidence ranges from 8.7% to 16.5%, with higher rates among households affected by NCDs, HIV/AIDS, and tuberculosis [20]. Country-specific studies report CHE incidences of 23% in Uganda, 41.83% among uninsured patients in Kenya, and 6-57% in Togo, with notable levels of impoverishment [21-23].

In Nigeria, studies consistently document high CHE among patients with chronic conditions [16,24-26]. For example, Ogaji et al. reported a CHE prevalence of 72.6% among households managing diabetes or hypertension, with nearly half experiencing impoverishment [24]. Other studies reveal higher CHE in private facilities compared to public ones, while treatment of conditions such as chronic kidney disease imposes near-universal catastrophic expenditure due to high out-of-pocket dialysis costs [24,25].

Conceptually, this study is anchored on the cost-of-illness approach, which is widely used to assess the economic burden of chronic disease by accounting for direct medical and non-medical costs alongside indirect productivity losses borne by patients and households [27–29]. Consistent with this framework, evidence from sub-Saharan Africa indicates that these direct and indirect costs can be substantial and may delay or deter care seeking [30–34]. In Nigeria, chronic illness management has likewise been associated with high monthly direct costs and significant productivity losses [16], underscoring the urgent need for health financing reforms

Despite extensive literature on this subject, there remains limited evidence on CHE and impoverishment across the different tiers of Nigeria's public healthcare system, where most citizens access care. This study addresses this gap by examining the direct and indirect impacts, as well as the prevalence of CHE and impoverishment among patients with chronic illnesses across primary, secondary, and tertiary public hospitals in Lagos, Nigeria. Based on this backdrop, this study will address the following research questions:

1. What are the direct and indirect economic costs incurred by chronic disease patients across primary, secondary, and tertiary public healthcare facilities in Lagos, Nigeria?
2. What is the prevalence of catastrophic health expenditure and impoverishment among chronic disease patients attending public healthcare facilities in Lagos, Nigeria, and how does this vary across facility levels?
3. What are the sociodemographic, clinical, and cost-related predictors of catastrophic health expenditure and impoverishment among chronic disease patients across public healthcare facility levels in Lagos, Nigeria?

METHODOLOGY

Study Setting

Lagos State is one of the 36 states of Nigeria and is located in south-western Nigeria along the coastal plain of the Bight of Benin. It is bounded by Ogun State to the north and east, the Republic of Benin to the west, and the Bight of Benin to the south [35]. The Lagos Lagoon Barrier coast extends for approximately 180 km along the Bight of Benin, predominantly covering the Lagos State coastline from the Benin Republic boundary to the Ibeju-Lekki fringe [36]. Lagos covers approximately 3,577 km², accounting for about 0.4% of Nigeria's land area; about 75,755 hectares of the state are wetlands, making it the nation's smallest state by land mass [37]. Administratively, it is organized into five divisions- Ikeja, Badagry, Ikorodu, Lagos/Eko, and Epe- which are

further divided into 20 local government areas and 37 local council development areas [38]. Politically, Lagos State is divided into three senatorial districts: Lagos Central, Lagos East, and Lagos West [39].

Due to its strategic coastal location and economic importance, Lagos is Nigeria's most populous city and a major urban commercial center in West Africa. The Lagos State Government estimates the state's population at more than 22 million residents [40]. The male-to-female ratio was estimated at approximately 1.08:1 in the Lagos State local government statistics [38]. Lagos is also one of the world's fastest-growing large urban centers; if current growth continues, it has been projected to become one of the world's most populous large cities, behind only Tokyo and Delhi. [41]. The healthcare system in Lagos is delivered through a mixed public-private network. Obubu and colleagues reported 2,333 hospitals and clinics in Lagos State, comprising 458 public and 1,875 private facilities; by level of care, 1,574 were primary, 756 were secondary, and three were tertiary facilities, corresponding to approximately 67.5% primary, 32.4% secondary, and 0.1% tertiary facilities [37]. Lagos State Ministry of Health listings further distinguish primary healthcare facilities at the community level and state-owned secondary facilities, including general hospitals, while tertiary and specialist care is provided through specialist and teaching hospitals. [42,43].

Study Design

A health facility-based cross-sectional design to assess catastrophic health expenditure (CHE) and Impoverishment among individuals with chronic illnesses attending outpatient clinics across the three tiers of healthcare facilities in Lagos, Nigeria.

Population of the Study

The study population comprised of adults living with chronic illnesses who were receiving outpatient care in public healthcare facilities across the three tiers of the healthcare system (primary, secondary, and tertiary) in Lagos State, Nigeria. The study adopted a health facility-based cross-sectional design and focused on individuals managing long-term conditions that require continuous medical attention.

Eligible participants were adults aged 18 years and above who resided in Lagos State and were receiving care within the outpatient departments of randomly selected public hospitals. Participants were required to have a definitive diagnosis of at least one chronic illness and to have accessed treatment or healthcare services for a minimum period of three months prior to the study to allow for adequate assessment of healthcare-related financial burden.

Patients receiving care in private health facilities were excluded from the study to maintain focus on publicly funded healthcare services. Individuals who were severely ill or unable to participate in the interview process, those below the age of 18 years, patients not receiving care in the selected public facilities, and individuals who declined to provide informed consent were also excluded from participation.

Sample Size

The minimum sample size was determined using the standard formula for descriptive studies, with a standard normal deviation of 1.96, a proportion of 0.5 for maximum variability, and a margin of error of 0.05. The sample size for this descriptive cross-sectional study was estimated using the single-population proportion formula, commonly referred to in health research as Fisher's formula:

$$N = Z^2 \cdot P \cdot (1-P) / E^2 \text{ [44].}$$

Where:

n = required sample size

Z = standard normal deviation (1.96 for a 95% confidence level)

p = estimated proportion of the population (assumed to be 0.5 for maximum variability)

E = margin of error (0.05)

Calculate the sample size without accounting for nonresponse:

$$n = (1.96)^2 \cdot 0.5 \cdot (1-0.5) / (0.05)^2$$

$$n = 3.8416 \cdot 0.25 / 0.0025$$

$$n = 0.9604 / 0.0025$$

$$n = 384.16$$

The calculated minimum sample size is approximately **384**.

Adjusting sample size for nonresponse rate:

Since we expect a 20% nonresponse rate, the sample was adjusted to gather enough responses. The adjusted sample size *n_{adjusted}* can be calculated using:

$$n_{adjusted} = n / (1 - \text{nonresponse rate})$$

For a 20% nonresponse rate (0.20), the formula becomes:

$$n_{adjusted} = 384 / 1 - 0.20$$

$$n_{adjusted} = 384 / 0.80$$

$$n_{adjusted} = 480$$

Therefore, accounting for a 20% nonresponse rate, the sample size was adjusted to **480**

Sampling Technique

The multistage sampling technique was employed in this study to ensure a representative sample of respondents from primary, secondary, and tertiary public healthcare facilities across Lagos State. The technique involved multiple stages of selection to achieve a diverse and valid sample with robust generalizability.

Stage One: Stratified Sampling of Local Government Areas (LGAs) by Senatorial Districts (Stratification)

Lagos State was stratified into its three senatorial districts- Lagos West, Lagos Central, and Lagos East- which together comprise 20 LGAs [39]. Each senatorial district was treated as a distinct stratum to capture population

diversity and variations in healthcare access across the state. Lagos West consists of ten LGAs, including Agege, Ajeromi-Ifelodun, Alimosho, Amuwo-Odofin, Badagry, Ifako-Ijaiye, Ikeja, Mushin, Ojo, and Oshodi-Isolo [39]. Lagos Central comprises five LGAs, namely Apapa, Eti-Osa, Lagos Island, Lagos Mainland, and Surulere, while Lagos East also includes five LGAs: Epe, Ibeju-Lekki, Ikorodu, Kosofe, and Somolu [39]. This stratification approach ensured balanced representation across the state and minimized sampling bias by accounting for geographic, demographic, and healthcare access differences among the districts.

Stage Two: Random Selection of LGAs from Each Stratum (Simple Random Sampling)

From each senatorial district, two (2) LGAs were selected randomly using a random number generator [45] after assigning a number to each local government area, hence ensuring unbiased selection. This gave a total of six (6) LGAs (2 per stratum).

Stage Three: Selection of Healthcare Facilities by Convenience Sampling

Within each of the selected LGA, one hospital was selected. The hospitals selected reflected a mix of primary, secondary, and tertiary healthcare levels to ensure that a diverse sample of healthcare services and patient experiences were represented. This yielded a total of 6 healthcare facilities across the 6 selected LGAs.

Stage Four: Proportionate Sample Size Allocation

To maintain an even number of respondents from each facility, the total sample size (480) was divided by the total number of selected hospitals (6), $480 \text{ total respondents} / 6 \text{ hospitals} = 80 \text{ respondents per hospital}$.

Stage Five: Systematic Random Sampling of Participants within Selected Facilities

At each selected facility, data was collected from the General or Medical Outpatient Department (GOPD), which served as the primary point of participant recruitment. The patient appointment register was used as the sampling frame to identify eligible patients attending the clinic. A systematic sampling technique was applied by determining the sampling interval (K), calculated as the ratio of the total number of eligible patients (N) to the required sample size of 80 participants per facility. A random starting point between 1 and K was selected, after which every Kth patient was recruited until the target sample size was achieved. This approach ensured even distribution of participants and minimized selection bias. This is expressed in Table 1 below.

Table 1. Summary of multistage sampling procedure employed in the study by senatorial district

Five-stage multistage sampling across three senatorial districts, six local government areas, and six public healthcare facilities. Total sample: N=480.

Senatorial District	Local Government Areas	Selected LGAs	Selected Healthcare Facilities	Sample Size (n)
Lagos West	Agege, Ajeromi-Ifelodun, Alimosho, Amuwo-Odofin, Badagry, Ifako-Ijaiye, Ikeja, Mushin, Ojo, Oshodi-Isolo	Ikeja	LASUTH (Tertiary)	80
		Alimosho	Rauf Aregbesola PHC (Primary)	80
Lagos Central	Apapa, Eti-Osa, Lagos Island, Lagos Mainland, Surulere	Lagos Mainland	Harvey Road General Hospital (Secondary)	80
		Surulere	Akerele PHC (Primary)	80
Lagos East	Epe, Ibeju-Lekki, Ikorodu, Kosofe, Somolu	Kosofe	Gbagada General Hospital (Secondary)	80

Senatorial District	Local Government Areas	Selected LGAs	Selected Healthcare Facilities	Sample Size (n)
		Ikorodu	Ikorodu General Hospital (Secondary)	80
3 districts	20 LGAs total	6 LGAs	6 facilities (1 Tertiary, 3 Secondary, 2 Primary)	480

PHC = Primary Healthcare Centre. LASUTH = Lagos State University Teaching Hospital.

Facility tier classification: LASUTH = Tertiary; Harvey Road General Hospital, Gbagada General Hospital, Ikorodu General Hospital = Secondary; Rauf Aregbesola PHC, Akerele PHC = Primary.

LGA = Local Government Area.

Study Instrument and Data collection Technique

A previously validated instrument from an earlier study [16] was adapted to develop a comprehensive interviewer-administered questionnaire covering sociodemographic characteristics, economic circumstances, household composition, employment status, productivity loss due to illness, income losses, direct out-of-pocket healthcare expenditures, and government support received. To ensure reliable and consistent data collection, trained research assistants administered the questionnaire. They received standardized training on interview techniques, questionnaire administration, and ethical considerations to minimize inter-observer measurement bias.

The reliability of the instrument was assessed during a pilot study conducted in a comparable facility one week before the main survey. The pilot yielded Cronbach's alpha score of 0.82, indicating good internal consistency. Feedback from this phase informed minor refinements to improve clarity and validity, after which the instrument was formally revalidated. A total of 520 questionnaires were administered, with 480 completed and included in the analysis, while 40 were excluded due to incomplete responses.

Data Analysis and Management

All administered questionnaires were serially numbered to facilitate tracking and quality control. Completed questionnaires were checked for completeness and consistency, after which the data were cleaned, anonymized, and entered into Stata version 19.5 for analysis. Descriptive statistics for sociodemographic, economic, and clinical variables were summarized using frequencies, percentages, and charts. Inferential analysis included chi-square tests to assess differences in the prevalence of catastrophic health expenditure (CHE) and impoverishment across primary, secondary, and tertiary public healthcare facilities. Multivariable logistic regression analysis was employed to examine the direct and indirect effects of CHE among patients with chronic illnesses across health facility tiers while controlling for potential confounders, including age, educational level, employment status, household income, and health insurance coverage. Statistical significance was determined at a p-value of less than 0.05 and all data collected was anonymized, while adhering to strict protocols to protect participants' information.

Calculating Catastrophic Expenditure (CHE1 and CHE2) and Impoverishment

The Out-of-pocket (OOP) Expenditure on managing Chronic Diseases (CDs) was calculated by aggregating all direct cost components associated with chronic disease management, which included consultation fees, medications, diagnostics, hospitalization, and transportation costs.

To ensure robust findings two distinct prevalence measures of catastrophic health expenditure (CHE) were adopted for this study and then calculated.

The first, CHE1, employs the World Bank's budget-share threshold, classifying expenditure as catastrophic when OOP payments for chronic disease care exceed 10 % of the total household income [11]. The second measure, CHE2, follows the World Health Organization's capacity-to-pay approach, defining catastrophic spending as OOP health expenses exceeding 40 % of non-food consumption expenditure [12]. By implications, CHE1 and CHE2 capture financial risk at different spending intensities, allowing policymakers to identify households experiencing early financial stress as well as those facing severe economic hardship. Using both thresholds supports more comprehensive health financing policies that address prevention and protection across the full spectrum of catastrophic spending.

CHE1 and CHE2 were calculated using formulas adapted from (Ipinimo et al.) [25].

$$\text{CHE1} = \text{OOPE} / \text{Inct}$$

Where OOPE= Out-of-pocket health expenditure on CDs

And Inct= Total income

CHE1 is present if $\text{OOPE} / \text{Inct} \geq 0.1$ but absent if $\text{OOPE} / \text{Inct} < 0.1$ [46]

While,

CHE2 was calculated using the formula:

$$\text{CHE2} = \text{OOPE} / (\text{Expt} - \text{Expf})$$

Where Expt= Total household expenditure

And Expf= Household food expenditure

CHE2 is present if $\text{OOPE} / (\text{Expt} - \text{Expf}) \geq 0.4$ and absent if $\text{OOPE} / (\text{Expt} - \text{Expf}) < 0.4$ [47,48].

To estimate impoverishment, i.e., the proportion of patients pushed into poverty after health-related expenses, the World Bank's 2022 international poverty line of \$2.15 per person per day (an equivalent of ₦3,547.50 /day at an approximate exchange rate of ₦1,650/US\$ around May 2025) was applied. A household was considered to be pushed into poverty when OOP expenditure on chronic diseases dropped the total income of the household below the international poverty line of \$2.15 per person per day ($\text{Inct} - \text{OOPE} < \$2.15$ per head per day) [49].

Ethical Approval

Ethical approval/clearance was sought and obtained from the Health Research Ethics Committee of the University of Geneva (CUREG-MM-2024-05-91), Lagos State University Teaching Hospital, Ikeja (LREC/06/10/2651). The research was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki [50]. Verbal and written consent was duly acquired from all participants, while ensuring confidentiality, voluntary participation, and the possibility of enforcing their right to withdraw from the study at any point in time.

RESULTS

Table 2. Sociodemographic and clinical characteristics of chronic disease patients at public health facilities by facility level.

Chi-square test for categorical variables; one-way ANOVA (F) for normally distributed continuous variables; Kruskal–Wallis H-test for skewed continuous variables.

Variable	Total (n=480)	Primary (n=160)	Secondary (n=240)	Tertiary (n=80)	Test statistic	p-value
Facility level, n (%)						
Primary	160 (33.3)	—	—	—	—	—
Secondary	240 (50.0)	—	—	—	—	—
Tertiary	80 (16.7)	—	—	—	—	—
Sex, n (%)						
Female	289 (60.2)	103 (64.4)	146 (60.8)	40 (50.0)	$\chi^2 = 7.16$	0.128
Male	191 (39.8)	57 (35.6)	94 (39.2)	40 (50.0)		
Age group, n (%)						
18–35 years	40 (8.3)	12 (7.5)	19 (7.9)	9 (11.3)	$\chi^2 = 6.44$	0.376
36–50 years	114 (23.8)	35 (21.9)	54 (22.5)	25 (31.3)		
51–65 years	187 (39.0)	70 (43.8)	91 (37.9)	26 (32.5)		
≥66 years	139 (29.0)	43 (26.9)	76 (31.7)	20 (25.0)		
Age (years)						
Mean (SD)	56.5 (14.9)	56.4 (13.6)	57.2 (15.0)	54.6 (17.0)	F = 0.89	—
Median [IQR]	58 [47–67]	58 [48–67]	58 [47.5–68]	53.5 [43.5–65.5]	H = 0.89	—
Marital status, n (%)						
Married	297 (61.9)	100 (62.5)	145 (60.4)	52 (65.0)	$\chi^2 = 4.21$	0.649
Separated/Divorced	17 (3.5)	5 (3.1)	11 (4.6)	1 (1.3)		
Single	51 (10.6)	14 (8.8)	26 (10.8)	11 (13.8)		
Widowed	115 (24.0)	41 (25.6)	58 (24.2)	16 (20.0)		
Educational level, n (%)						
No formal education	25 (5.2)	9 (5.6)	16 (6.7)	0 (0.0)	$\chi^2 = 12.23$	0.057
Primary	69 (14.4)	23 (14.4)	38 (15.8)	8 (10.0)		
Secondary	167 (34.8)	55 (34.4)	88 (36.7)	24 (30.0)		
Tertiary	219 (45.6)	73 (45.6)	98 (40.8)	48 (60.0)		

Variable	Total (n=480)	Primary (n=160)	Secondary (n=240)	Tertiary (n=80)	Test statistic	p-value
Employment status, n (%)						
Employed	104 (21.7)	26 (16.3)	48 (20.0)	30 (37.5)	$\chi^2 = 25.27$	<0.001
Self-employed	227 (47.3)	86 (53.8)	113 (47.1)	28 (35.0)		
Not economically active	123 (25.6)	36 (22.5)	72 (30.0)	15 (18.8)		
Unemployed	26 (5.4)	12 (7.5)	7 (2.9)	7 (8.8)		
Religion, n (%)						
Christian	354 (73.8)	120 (75.0)	175 (72.9)	59 (73.8)	$\chi^2 = 1.16$	0.885
Islam	125 (26.0)	40 (25.0)	64 (26.7)	21 (26.3)		
Atheist/Other†	1 (0.2)	0 (0.0)	1 (0.4)	0 (0.0)		
Health insurance, n (%)						
No	412 (85.8)	137 (85.6)	210 (87.5)	65 (81.3)	$\chi^2 = 1.94$	0.380
Yes	68 (14.2)	23 (14.4)	30 (12.5)	15 (18.8)		
Household size category, n (%)						
1–4 members	192 (40.0)	74 (46.3)	92 (38.3)	26 (32.5)	$\chi^2 = 6.66$	0.354
5–7 members	254 (52.9)	75 (46.9)	132 (55.0)	47 (58.8)		
8–10 members	31 (6.5)	11 (6.9)	14 (5.8)	6 (7.5)		
≥11 members	3 (0.6)	0 (0.0)	2 (0.8)	1 (1.3)		
Household size (persons),						
Mean (SD)	4.97 (1.90)	4.77 (1.76)	4.98 (1.98)	5.31 (1.89)	F = 2.22	—
Median [IQR]	5 [4–6]	5 [4–6]	5 [4–6]	6 [4–6]	H = 5.15	—
Chronic disease profile, n (%)‡						
Hypertension	290 (60.4)	119 (74.4)	148 (61.7)	23 (28.8)	$\chi^2 = 46.74$	<0.001
Diabetes	116 (24.2)	28 (17.5)	50 (20.8)	38 (47.5)	$\chi^2 = 29.10$	<0.001
Bone/joint disease	55 (11.5)	21 (13.1)	32 (13.3)	2 (2.5)	$\chi^2 = 7.60$	0.022
Cancer	32 (6.7)	2 (1.3)	17 (7.1)	13 (16.3)	$\chi^2 = 19.42$	<0.001
Kidney disease	25 (5.2)	3 (1.9)	11 (4.6)	11 (13.8)	$\chi^2 = 15.61$	<0.001
Thyroid disease	12 (2.5)	0 (0.0)	1 (0.4)	11 (13.8)	$\chi^2 = 49.91$	<0.001
Cardiovascular disease	29 (6.0)	7 (4.4)	19 (7.9)	3 (3.8)	$\chi^2 = 3.01$	0.222
Respiratory disease	29 (6.0)	11 (6.9)	15 (6.3)	3 (3.8)	$\chi^2 = 0.95$	0.621

Variable	Total (n=480)	Primary (n=160)	Secondary (n=240)	Tertiary (n=80)	Test statistic	p-value
<i>Chronic liver disease</i>	11 (2.3)	5 (3.1)	4 (1.7)	2 (2.5)	$\chi^2 = 0.93$	0.628
<i>Mental health condition</i>	10 (2.1)	3 (1.9)	7 (2.9)	0 (0.0)	$\chi^2 = 2.55$	0.279
<i>Sickle cell anemia</i>	6 (1.3)	0 (0.0)	6 (2.5)	0 (0.0)	$\chi^2 = 6.08$	0.048
Multimorbidity, n (%)						
<i>Single condition</i>	358 (74.6)	125 (78.1)	178 (74.2)	55 (68.8)	$\chi^2 = 2.52$	0.284
<i>Two conditions</i>	108 (22.5)	31 (19.4)	54 (22.5)	23 (28.8)		
<i>Three conditions</i>	14 (2.9)	4 (2.5)	8 (3.3)	2 (2.5)		
<i>Any multimorbidity (2+ conditions)</i>	122 (25.4)	35 (21.9)	62 (25.8)	25 (31.3)		

† Atheist/Other category in religion (n=1) should be interpreted with caution due to small cell size.

‡ Chronic disease categories are not mutually exclusive; patients may have more than one condition.

In table 2, a total of 480 patients were recruited from primary (33.3%), secondary (50.0%), and tertiary (16.7%) public healthcare facilities. The participants were primarily female (60.2%), with a mean age of 56.5 years (SD 14.9) and a median age of 58 years (IQR 47-67). The majority were married (61.9%), employed or self-employed (69.0%), and possessed tertiary education (45.6%). Employment status varied markedly among facility tiers ($p<0.001$), with formal employment being more prevalent in tertiary institutions, but educational attainment exhibited a marginal variation ($p=0.057$). The majority of respondents were uninsured (85.8%), exhibiting no substantial variation between facility levels. Hypertension was the predominant condition (60.4%), succeeded by diabetes (24.2%), with a substantial variation in case mix among tiers for hypertension, diabetes, cancer, kidney disease, and thyroid disease (all $p<0.001$). Hypertension was prevalent in primary care, but diabetes, cancer, kidney disease, and thyroid disease were more concentrated in tertiary care. Multimorbidity impacted 25.4% of individuals and showed no significant variation by facility level.

Table 3. Household economic status of chronic disease patients at public health facilities*All values presented as median [25th–75th percentile] in Nigerian Naira (NGN) per month.*

Variable	Median (NGN)	25th Percentile	75th Percentile
Section A: Household income (NGN per month)			
<i>Household income before illness</i>	250,000 (≈USD 152)	135,000	500,000
<i>Personal income before illness</i>	100,000 (≈USD 61)	50,000	245,000
<i>Household income after illness</i>	200,000 (≈USD 121)	100,000	400,000
<i>Personal income after illness</i>	100,000 (≈USD 61)	48,000	200,000
Section B: Per capita income (NGN per month)			
<i>Per capita income before OOOPE</i>	44,000 (≈USD 27)	22,000	90,000
<i>Per capita income after OOOPE</i>	32,000 (≈USD 19)	12,000	76,000
Section C: Household expenditure (NGN per month)			
<i>Total household expenditure</i>	200,000 (≈USD 121)	110,000	320,000
<i>Food expenditure</i>	100,000 (≈USD 61)	70,000	150,000
<i>Non-food expenditure</i>	116,000 (≈USD 70)	70,000	200,000
<i>Health expenditure</i>	50,000 (≈USD 30)	25,000	100,000

Values presented as median and interquartile range [25th–75th percentile]. All monetary values are self-reported monthly amounts in Nigerian Naira (NGN). USD equivalents calculated using an exchange rate of NGN 1,650 per USD as at time of study.

Per capita income calculated as household income divided by household size.

OOPE = out-of-pocket expenditure; NGN = Nigerian Naira; USD = United States Dollar; PPP = purchasing power parity.

Table 3 shows that participants were economically vulnerable before healthcare spending was considered. Median monthly household income fell from NGN 250,000 before illness to NGN 200,000 after illness, and 47.1% reported income decline following diagnosis. Per-capita household income declined from a median of NGN 44,000 before out-of-pocket expenditure to NGN 32,000 after payment, well below the applied monthly poverty threshold. Median total household expenditure was NGN 200,000, of which food accounted for NGN 100,000, indicating limited non-subsistence spending capacity. Median health expenditure was NGN 50,000 per month, equivalent to 25.0% of total household expenditure at the median. Overall, the data indicate a population with constrained and illness-eroded household resources, leaving little financial capacity to absorb chronic care costs.

Table 4. Direct and indirect healthcare costs incurred by chronic disease patients by level of public healthcare facility

Kruskal–Wallis H-test for continuous variables; chi-square test for categorical variables. Statistical significance set at $p < 0.05$.

Variable	Total (N=480)	Primary (n=160)	Secondary (n=240)	Tertiary (n=80)	Test statistic (H)	p-value
Section A: Direct costs- Out-of-pocket expenditure (NGN per month), Median [25th–75th percentiles]						
<i>Total OOPE</i>	37,250 (≈USD 23) [15,800–73,000]	21,800 [8,000–43,050]	37,000 [16,350–70,650]	95,500 [64,500–180,250]	120.09	<0.001
<i>Medicines and drugs</i>	18,000 [8,000–40,000]	10,000 [5,000–23,000]	19,200 [10,000–40,000]	45,000 [25,000–80,000]	76.61	<0.001
<i>Investigations and diagnostics</i>	9,250 [0–21,400]	5,000 [0–15,000]	6,000 [0–20,250]	40,000 [15,000–87,200]	71.45	<0.001
<i>Registration/consultation fees</i>	0 [0–1,200]	0 [0–500]	1,000 [0–2,000]	0 [0–0]	35.91	<0.001
<i>Transport costs</i>	2,000 [600–4,000]	1,000 [300–2,000]	2,200 [1,000–4,000]	4,000 [1,000–5,500]	36.18	<0.001
Section B: Indirect costs- Productivity loss						
<i>Participants missing any workdays, n (%)</i>	199 (41.5%)	64 (40.0%)	101 (42.1%)	34 (42.5%)	$\chi^2 = 5.13^\dagger$	0.077
<i>Missed workdays among affected participants, Median [25th–75th percentiles], days</i>	7 [3–20]	7 [3–26]	8 [2–26]	5.5 [2–10]	2.57	0.277

[†] Chi-square (χ^2) test used for the categorical indirect cost variable (participants missing any workdays).

The median total OOPE of NGN 37,250/month corresponds to approximately USD 23/month at exchange rate of NGN 1,650/USD as at time of study.

Table 4 shows that the Median monthly out-of-pocket expenditure was NGN 37,250 (IQR NGN 15,800–73,000) and increased significantly by facility tier ($p < 0.001$), from NGN 21,800 at primary care to NGN 37,000 at secondary care and NGN 95,500 at tertiary care. Medicines were the largest direct cost component overall and rose steeply across tiers, from NGN 10,000 at primary to NGN 45,000 at tertiary care ($p < 0.001$). Investigations were the second major cost driver and were markedly higher at tertiary facilities (NGN 40,000 vs NGN 5,000–6,000 at primary and secondary; $p < 0.001$). Transport costs also increased significantly with facility level, although absolute amounts were smaller. In contrast, indirect costs showed no clear facility gradient: 41.5% of participants reported at least one missed workday, and among those affected the median was 7 days (IQR 3–20), with no significant difference across tiers. The cost pattern therefore indicates that financial burden across facility levels is driven primarily by direct rather than indirect costs.

Table 5. Catastrophic health expenditure and impoverishment among chronic disease patients by healthcare facility level, Lagos, Nigeria: sensitivity analysis across alternative thresholds

Chi-square (χ^2) test used to compare proportions across facility levels. χ^2 statistic and p-value reported on the Yes row for each threshold.

Variable	Primary (n=160)	Secondary (n=240)	Tertiary (n=80)	Total (N=480)	χ^2	p-value
CHE1 (OOPE as proportion of household income)						
5% threshold						
Yes	114 (71.3%)	197 (82.1%)	77 (96.3%)	388 (80.8%)	21.999	<0.001
No	46 (28.8%)	43 (17.9%)	3 (3.8%)	92 (19.2%)		
10% - World Bank threshold*						
Yes	87 (54.4%)	165 (68.8%)	75 (93.8%)	327 (68.1%)	38.165	<0.001
No	73 (45.6%)	75 (31.3%)	5 (6.3%)	153 (31.9%)		
15% threshold						
Yes	67 (41.9%)	140 (58.3%)	67 (83.8%)	274 (57.1%)	38.481	<0.001
No	93 (58.1%)	100 (41.7%)	13 (16.3%)	206 (42.9%)		
30% threshold						
Yes	37 (23.1%)	87 (36.3%)	46 (57.5%)	170 (35.4%)	27.698	<0.001
No	123 (76.9%)	153 (63.8%)	34 (42.5%)	310 (64.6%)		
CHE2 (OOPE as proportion of non-food household expenditure)						
40% - WHO threshold**						
Yes	90 (56.3%)	158 (65.8%)	69 (86.3%)	317 (66.0%)	21.412	<0.001
No	70 (43.8%)	82 (34.2%)	11 (13.8%)	163 (34.0%)		
50% threshold						
Yes	76 (47.5%)	134 (55.8%)	64 (80.0%)	274 (57.1%)	23.301	<0.001
No	84 (52.5%)	106 (44.2%)	16 (20.0%)	206 (42.9%)		
Impoverishment						
Pre-OOPE poverty						
Yes	130 (81.3%)	190 (79.2%)	62 (77.5%)	382 (79.6%)	0.513	0.774
No	30 (18.8%)	50 (20.8%)	18 (22.5%)	98 (20.4%)		
Post-OOPE impoverishment						
Yes	132 (82.5%)	199 (82.9%)	68 (85.0%)	399 (83.1%)	0.252	0.882
No	28 (17.5%)	41 (17.1%)	12 (15.0%)	81 (16.9%)		
New impoverishment due to OOPE						
Yes	2 (1.3%)	9 (3.8%)	6 (7.5%)	17 (3.5%)	6.159	0.046
No	158 (98.8%)	231 (96.3%)	74 (92.5%)	463 (96.5%)		

* World Bank threshold: CHE1 defined as OOPE $\geq$ 10% of household income.

** WHO threshold: CHE2 defined as OOPE $\geq$ 40% of non-food household expenditure.

Impoverishment defined as per capita post-OOPE income below NGN 107,990/month (equivalent to \$2.15/day at PPP using an exchange rate of NGN 1,650/USD). Pre-OOPE poverty: households already below the poverty line before accounting for healthcare costs. Post-OOPE impoverishment: households below the poverty line after OOPE. New impoverishment: households above the poverty line before OOPE but pushed below it by healthcare costs (Wagstaff & van Doorslaer, 2003).

Table 5 shows that CHE was high under both definitions (CHE1 and CHE2) and rose consistently with facility level. Using the 10% income threshold (CHE1), overall prevalence was 68.1%, increasing from 54.4% at primary care to 68.8% at secondary and 93.8% at tertiary care ($p < 0.001$). This gradient was robust across alternative CHE1 thresholds from 5% to 30%. Using the 40% non-food expenditure threshold (CHE2), overall

prevalence was 66.0%, with rates of 56.3%, 65.8%, and 86.3% across primary, secondary, and tertiary care, respectively ($p<0.001$); a similar pattern persisted at the 50% threshold. By contrast, impoverishment showed a different distribution. Pre-payment poverty affected 79.6% of participants and post-payment poverty 83.1%, with no significant variation across facility tiers. New impoverishment attributable to healthcare spending was limited to 3.5% overall, although it differed modestly by facility level and was highest at tertiary care. These findings indicate that tertiary care is strongly associated with catastrophic spending, whereas measured impoverishment is largely shaped by the high baseline poverty in the sample.

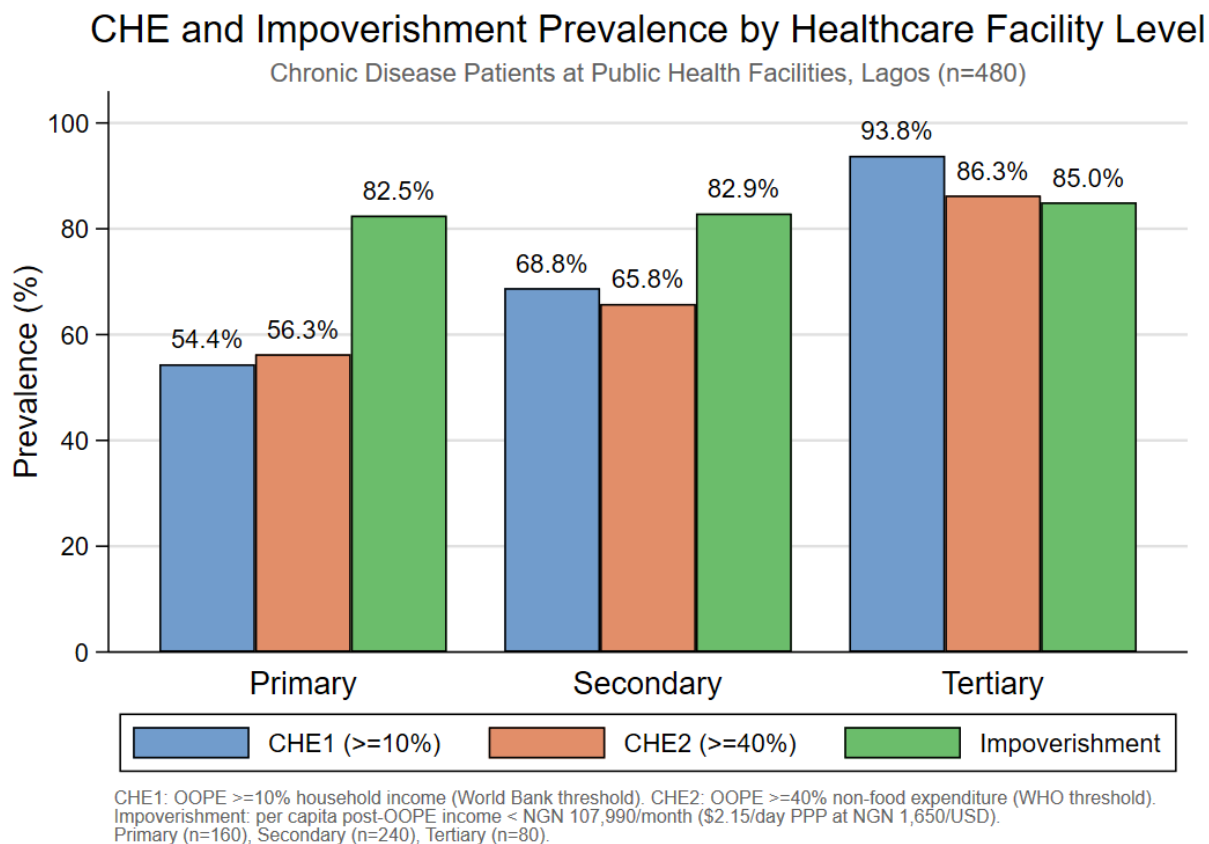


Figure 1: CHE and Improvishment Prevalence by Healthcare Facility Level

Figure 1 shows that CHE rises sharply with facility level from 54% and 56.3 % at primary to 94% and 86.3% respectively at tertiary care level reflecting substantially higher out-of-pocket costs for medicines and diagnostics at advanced facilities. Impoverishment, however, remains consistently high across all tiers but highest at the tertiary care level (~83–85%), indicating most patients were already poor before seeking care. The widening gap between CHE and impoverishment at primary level suggests even modest spending pushes low-income households below the poverty line.

Table 6a. Logistic regression analysis of healthcare facility level as a predictor of catastrophic health expenditure and impoverishment among chronic disease patients at public health facilities

Unadjusted (UOR) and adjusted (AOR) odds ratios with 95% confidence intervals. Reference facility level: primary care.

	CHE1 (OOPE ≥10% household income)		CHE2 (OOPE ≥40% non-food expenditure)		Impoverishment	
	UOR (95% CI)	AOR (95% CI)	UOR (95% CI)	AOR (95% CI)	UOR (95% CI)	AOR (95% CI)
Healthcare facility level (ref: Primary)						
Secondary	1.85** (1.22–2.79)	1.84** (1.19–2.83)	1.47 (0.98–2.22)	1.41 (0.93–2.16)	1.03 (0.61–1.75)	0.95 (0.54–1.67)
Tertiary	12.59*** (4.83–32.78)	13.94*** (5.19–37.42)	4.88*** (2.40–9.91)	5.33*** (2.56–11.09)	1.20 (0.58–2.51)	1.21 (0.55–2.65)
Confounders						
Age (years)	—	1.02* (1.00–1.04)	—	1.01 (1.00–1.03)	—	1.03** (1.01–1.05)
Sex (male=1)	—	0.89 (0.56–1.40)	—	1.20 (0.78–1.86)	—	1.00 (0.58–1.73)
Education (ordinal)	—	0.92 (0.70–1.20)	—	0.76* (0.59–0.99)	—	0.82 (0.57–1.19)
Employed	—	0.81 (0.49–1.35)	—	1.14 (0.71–1.85)	—	1.04 (0.55–1.95)
Married	—	0.77 (0.48–1.24)	—	0.58* (0.36–0.91)	—	0.74 (0.41–1.34)
Household size	—	1.04 (0.92–1.17)	—	1.01 (0.90–1.13)	—	1.38*** (1.18–1.63)
Multimorbidity	—	1.18 (0.70–1.98)	—	0.98 (0.60–1.58)	—	0.70 (0.38–1.29)
Insured	—	0.47* (0.26–0.86)	—	0.74 (0.42–1.31)	—	0.54 (0.28–1.06)
Treatment duration (ref: <1 year)						
1–4 years	—	0.59 (0.31–1.11)	—	0.86 (0.49–1.52)	—	0.70 (0.35–1.41)
5–9 years	—	0.35** (0.18–0.67)	—	0.74 (0.41–1.34)	—	0.63 (0.30–1.31)
10+ years	—	0.45* (0.23–0.88)	—	0.75 (0.40–1.39)	—	1.01 (0.45–2.28)
Model statistics						
Observations	480	480	480	480	480	480
AIC	562.11	552.72	598.88	600.63	441.48	419.15
AUROC	—	0.726	—	0.681	—	0.721
Hosmer–Lemeshow p	—	0.133	—	0.473	—	0.764

* p<0.05 ** p<0.01 *** p<0.001

Adjusted models control for age, sex, education level, employment status, marital status, household size, multimorbidity, treatment duration (4-category: <1 year, 1–4 years, 5–9 years, 10+ years), and insurance status.

Hosmer–Lemeshow p>0.05 indicates adequate model fit (unadjusted model includes facility level only).

Table 6b. Average marginal effects of healthcare facility level on catastrophic health expenditure and impoverishment

Change in predicted probability (percentage points) relative to primary care, adjusted for full confounder set.

	CHE1 (OOPE ≥10% household income)		CHE2 (OOPE ≥40% non-food expenditure)		Impoverishment	
	AME	95% CI	AME	95% CI	AME	95% CI
Healthcare facility level (ref: Primary care)						
Secondary vs Primary	+0.132**	(0.038, 0.225)	+0.079	(-0.018, 0.175)	-0.007	(-0.079, 0.066)
Tertiary vs Primary	+0.385***	(0.293, 0.477)	+0.301***	(0.195, 0.406)	+0.023	(-0.071, 0.116)

AME = average marginal effect reported as change in predicted probability (dy/dx) with 95% confidence interval in parentheses.

* p<0.05 ** p<0.01 *** p<0.001

All models adjusted for age, sex, education level, employment status, marital status, household size, multimorbidity, treatment duration, and insurance status.

Table 6c. Adjusted predicted probabilities of catastrophic health expenditure and impoverishment by healthcare facility level

Predicted probability of each outcome at each facility level, adjusted for full confounder set (average predictive margins).

Facility level	CHE1 Pr(=1)	95% CI	CHE2 Pr(=1)	95% CI	Impov. Pr(=1)	95% CI
Primary (n=160)	0.552***	(0.478, 0.626)	0.568***	(0.492, 0.643)	0.831***	(0.775, 0.886)
Secondary (n=240)	0.684***	(0.626, 0.741)	0.646***	(0.587, 0.706)	0.824***	(0.777, 0.870)
Tertiary (n=80)	0.937***	(0.884, 0.990)	0.868***	(0.796, 0.941)	0.853***	(0.779, 0.927)

Pr = adjusted predicted probability. Values represent the predicted probability of each outcome at each facility level, averaged across all observed covariate values.

* p<0.05 ** p<0.01 *** p<0.001. All values are statistically significant at p<0.001.

All models adjusted for age, sex, education level, employment status, marital status, household size, multimorbidity, treatment duration, and insurance status.

The near-uniform impoverishment probabilities across facility levels (83.1%-85.3%) reflect that 79.6% of participants were already below the poverty line before OOPE, limiting scope for facility tier to drive additional impoverishment.

Tables 6a, b and c show that after adjustment, facility level remained a strong predictor of CHE. Compared with primary care, tertiary care was associated with substantially higher odds of CHE1 (AOR 13.94, 95% CI 5.19–37.42) and CHE2 (AOR 5.33, 95% CI 2.56–11.09), while secondary care was associated with higher odds of CHE1 only (AOR 1.84, 95% CI 1.19–2.83). Higher education and being married were protective against CHE2, while insurance reduced the odds of CHE1 (AOR 0.47, 95% CI 0.26–0.86). Longer treatment duration was also associated with lower CHE1 odds. For impoverishment, facility level was not significant after adjustment; instead, older age and larger household size were the main predictors. Marginal effects and adjusted predicted probabilities showed the same pattern: tertiary care increased the probability of CHE1 by 38.5 percentage points and CHE2 by 30.1 percentage points relative to primary care, whereas predicted impoverishment remained uniformly high across all tiers. These results confirm that facility tier is a strong determinant of catastrophic spending but not of poverty status in this sample.

Table 7a. Stratified logistic regression: predictors of catastrophic health expenditure and impoverishment by healthcare facility level

Adjusted odds ratios (aOR) with 95% confidence intervals. Reference facility level: primary care. Binary treatment duration (<5 years vs ≥5 years) used in all stratified models.

Variable	Panel A: CHE1 (OOPE ≥10% household income)		Panel B: CHE2 (OOPE ≥40% non-food expenditure)			Panel C: Impoverishment			
	Primary (n=160)	Secondary (n=240)	Primary (n=160)	Secondary (n=240)	Tertiary (n=80)	Primary (n=160)	Secondary (n=240)	Tertiary (n=80)	CHE1 Tertiary†
Direct cost components									
Medicines and drugs	1.28 (0.93–1.75)	2.71*** (1.87–3.91)	1.28* (1.00–1.62)	1.34* (1.02–1.77)	1.74* (1.05–2.89)	0.70* (0.50–0.98)	1.07 (0.83–1.38)	0.81 (0.52–1.25)	not run†
Investigations and diagnostics	1.29*** (1.15–1.43)	1.14** (1.05–1.23)	1.12* (1.02–1.23)	1.05 (0.97–1.12)	1.38 (0.99–1.92)	1.10 (0.98–1.24)	0.97 (0.89–1.07)	0.82 (0.55–1.20)	not run†
Hospital fees	0.95 (0.83–1.07)	0.90* (0.82–1.00)	0.99 (0.88–1.11)	0.94 (0.87–1.02)	0.58* (0.37–0.92)	1.13 (0.96–1.33)	1.00 (0.90–1.11)	0.93 (0.76–1.13)	not run†
Transport costs	0.98 (0.86–1.12)	1.11 (0.98–1.25)	0.98 (0.87–1.11)	1.08 (0.98–1.20)	0.69 (0.47–1.01)	1.01 (0.87–1.18)	1.09 (0.96–1.24)	1.10 (0.93–1.33)	not run†
Indirect cost									
Missed workdays (log)	1.70** (1.18–2.47)	1.18 (0.87–1.60)	1.19 (0.85–1.66)	1.19 (0.91–1.55)	3.21 (0.64–16.1)	2.24* (1.18–4.24)	1.20 (0.84–1.71)	1.14 (0.55–2.31)	not run†
Confounders									
Age (years)	1.04 (0.99–1.08)	1.03* (1.00–1.06)	1.03 (0.99–1.07)	1.01 (0.98–1.03)	1.05 (0.98–1.12)	1.05* (1.01–1.10)	1.03 (1.00–1.06)	1.06* (1.00–1.12)	not run†
Sex (male=1)	1.16 (0.49–2.74)	1.37 (0.61–3.07)	1.10 (0.50–2.44)	1.39 (0.70–2.75)	4.00 (0.55–28.9)	0.61 (0.22–1.65)	1.59 (0.64–3.91)	0.59 (0.12–2.96)	not run†
Education (ordinal)	1.96* (1.13–3.39)	0.43** (0.26–0.72)	1.58 (0.95–2.63)	0.45*** (0.29–0.68)	0.16 (0.02–1.30)	1.44 (0.74–2.78)	0.58 (0.33–1.03)	1.00 (0.28–3.50)	not run†
Employed	0.41 (0.16–1.10)	1.41 (0.61–3.25)	1.06 (0.42–2.69)	1.22 (0.59–2.48)	9.06 (0.46–180)	0.75 (0.21–2.63)	1.01 (0.40–2.54)	3.75 (0.38–36.0)	not run†
Married	0.89 (0.35–2.25)	0.57 (0.27–1.27)	0.17*** (0.07–0.44)	0.92 (0.46–1.75)	0.37 (0.03–4.39)	0.42 (0.13–1.42)	0.97 (0.41–2.28)	1.04 (0.16–6.85)	not run†
Household size	0.91 (0.70–1.18)	0.91 (0.74–1.11)	1.03 (0.80–1.33)	1.01 (0.85–1.18)	0.57 (0.30–1.07)	1.44* (1.03–2.03)	1.50*** (1.18–1.91)	1.31 (0.79–2.16)	not run†
Multimorbidity	0.60 (0.22–1.64)	1.21 (0.52–2.85)	0.38 (0.14–1.03)	1.39 (0.68–2.84)	0.04 (0.001–1.29)	0.56 (0.17–1.91)	0.98 (0.39–2.45)	0.26 (0.02–1.71)	not run†
Insured	0.96 (0.28–3.35)	0.69 (0.25–1.94)	1.29 (0.40–4.17)	0.87 (0.36–2.12)	0.30 (0.02–5.45)	0.48 (0.12–1.87)	0.32* (0.12–0.87)	1.86 (0.24–14.3)	not run†
Treatment duration (ref: short-term <5 years)									
Long-term (5+ years)	1.47 (0.63–3.46)	0.50 (0.24–1.05)	1.12 (0.51–2.45)	0.76 (0.41–1.43)	2.02 (0.17–24.1)	2.11 (0.77–5.71)	0.71 (0.32–1.55)	0.78 (0.12–4.92)	not run†
Model diagnostics									
AUROC	0.850	0.861	0.778	0.745	0.925	0.824	0.775	0.789	—
Hosmer–Lemeshow p	0.256	0.902	0.415	0.293	0.539	0.870	0.451	0.075	—

* p<0.05 ** p<0.01 *** p<0.001

† CHE1 tertiary model was not estimated due to near-complete separation: only 5 failures (patients without CHE1) among 80 tertiary observations are insufficient to support reliable logistic regression estimation. All cost variables log-transformed using log(x+1).

Treatment duration was collapsed to binary in stratified models to address sparse cells at smaller within-tier sample sizes.

Table 7b. Average marginal effects of direct and indirect healthcare costs on catastrophic health expenditure and impoverishment, stratified by public healthcare facility level

Values represent average change in predicted probability (dy/dx) per unit increase in log-transformed cost variable, with 95% confidence intervals in parentheses.

Cost component	Panel A: CHE1 (OOPE ≥10% household income)		Panel B: CHE2 (OOPE ≥40% non-food expenditure)			Panel C: Impoverishment			
	Primary (n=160)	Secondary (n=240)	Primary (n=160)	Secondary (n=240)	Tertiary (n=80)	Primary (n=160)	Secondary (n=240)	Tertiary (n=80)	CHE1 Tertiary†
Direct cost components									
Medicines and drugs	0.040 (-0.011, 0.091)	0.133*** (0.095, 0.170)	0.046* (0.002, 0.089)	0.056* (0.005, 0.106)	0.042* (0.009, 0.076)	-0.040* (-0.077, -0.004)	0.008 (-0.022, 0.037)	-0.023 (-0.071, 0.024)	not run†
Investigations and diagnostics	0.041*** (0.028, 0.054)	0.017** (0.007, 0.027)	0.021* (0.004, 0.037)	0.008 (-0.005, 0.022)	0.025* (0.001, 0.048)	0.011 (-0.002, 0.024)	-0.003 (-0.014, 0.007)	-0.020 (-0.064, 0.020)	not run†
Hospital fees	-0.009 (-0.029, 0.011)	-0.013* (-0.026, -0.001)	-0.002 (-0.024, 0.020)	-0.011 (-0.026, 0.004)	-0.042** (-0.072, -0.011)	0.014 (-0.004, 0.032)	0.000 (-0.012, 0.012)	-0.008 (-0.028, 0.013)	not run†
Transport costs	-0.003 (-0.023, 0.018)	0.014 (-0.003, 0.030)	-0.003 (-0.024, 0.023)	0.015 (-0.004, 0.033)	-0.028 (-0.054, 0.001)	0.002 (-0.015, 0.019)	0.010 (-0.005, 0.025)	0.010 (-0.009, 0.033)	not run†
Indirect cost									
Missed workdays (log)	0.087** (0.032, 0.143)	0.022 (-0.018, 0.062)	0.032 (-0.030, 0.094)	0.033 (-0.016, 0.082)	0.090 (-0.021, 0.208)	0.092** (0.023, 0.161)	0.021 (-0.021, 0.063)	0.013 (-0.062, 0.092)	not run†

AME = average marginal effect. All cost variables log-transformed using log(x+1).

* p<0.05 ** p<0.01 *** p<0.001

† CHE1 tertiary model was not estimated due to near-complete separation (see Table 7a footnote).

All models adjusted for age, sex, education level, employment status, marital status, household size, multimorbidity, treatment duration (binary), and insurance status.

Table 7a and b shows that the cost pathways to CHE varied across the three levels of care. At the primary and secondary facilities level, investigation costs were the most consistent predictors of CHE1. At secondary care, medicines were the dominant predictor of both CHE1 and CHE2 and produced the largest marginal increase in CHE1 probability. At tertiary care level, the CHE2 model identified medicines as a significant positive predictor, while hospital fees showed an inverse association. For impoverishment, the pattern differed: at primary care level, missed workdays were the strongest positive predictor, whereas medicines showed an inverse association, likely reflecting underlying household purchasing capacity. At secondary care level, household size and lack of insurance were more influential than individual cost items. No individual cost predictor was significant for impoverishment at tertiary care, consistent with the limited variation produced by very high pre-existing poverty and near-universal CHE. Overall, the stratified models indicate that direct costs, especially medicines and investigations, are the principal drivers of CHE, while impoverishment is more strongly linked to underlying household vulnerability.

DISCUSSION

This study demonstrates that financial hardship among patients with chronic illnesses in Lagos is structurally ingrained in the way care is financed and delivered throughout the public health system tiers, rather than being an incidental aspect of care. There are three particularly noteworthy findings from this study. First, there was a significant increase in direct out-of-pocket expenses across all institution tiers, with tertiary care patients bearing the highest brunt of this cost. Secondly, catastrophic health expenditure (CHE) was pervasive under both the budget-share and capacity-to-pay approaches, and the tertiary effect persisted even after adjustment, indicating that the gradient was not simply a function of patient case-mix. Thirdly, impoverishment followed a different pattern- with very elevated post-payment poverty, but because most respondents were already impoverished prior to healthcare related payments being deducted, facility level was not an independent predictor. When all are considered collectively, these findings suggest that for chronic disease patients in Lagos, the main financial protection issue is not only that healthcare can drive households into poverty but also that care is being financed on top of entrenched poverty in ways that make catastrophic spending nearly inevitable.

The level of CHE observed in this study exceeds pooled global and sub-Saharan African estimates, but this is consistent with the fact that the sample comprised chronic disease patients actively using outpatient services rather than the general population estimates [19,20]. It is however consistent with earlier Nigerian research evidence showing that chronic illness generates sustained financial strain through repeated spending on medicines, investigations, clinic attendance, and transport over prolonged periods [16,24-26]. Most directly, it agrees with Ipinimo and Durowade, a facility-based comparison of public and private NCD care in Ekiti State, which documented high levels of both catastrophic expenditure and impoverishment, with CHE associated with occupation, disease complications, and frequency of clinic visits, and impoverishment shaped primarily by socioeconomic status of respondents [25]. Our findings are consistent with the broader general trend but add greater specificity on the mechanisms of financial harm within public facilities- medicines and diagnostic investigations were the dominant direct cost drivers of CHE, whereas impoverishment reflected deeper household vulnerability, particularly among older patients and those in larger households. More recent national evidence further strengthens this interpretation. Using the Nigeria Living Standard Survey 2018-2019, Odunyemi et al. discovered that households affected by non-communicable diseases in Nigeria incur substantial out-of-pocket spending, with medications accounting for a major share of the burden and with measurable CHE and impoverishment effects nationwide [51]. Similarly, Aregbeshola and Khan demonstrated from national household data that household characteristics and socioeconomic vulnerability greatly predict catastrophic expenditure in Nigeria, highlighting the structural rather than episodic nature of the issue [52]. Although missed workdays did not differ significantly across facility tiers, the fact that a substantial proportion of participants reported work loss indicates that indirect productivity costs remain an important component of the household burden, particularly for families with limited and unstable earnings. Evidence on indirect costs is also consistent with Okediji et al. [16], who reported measurable productivity losses among households managing chronic illness in Nigerian health facilities; however, as in the present study, the economic burden was driven more strongly by direct treatment costs, especially medicines. These converging findings suggest that results herein this study do not represent an isolated facility-level anomaly, but rather an intensified expression of a broader national pattern in which chronic illness remains heavily financed through household out of pocket resources. This study shows that chronic sickness erodes household economic capability before healthcare costs are

completely taken into account, in addition to catastrophic spending itself. The burden of chronic illnesses in this study extends beyond out-of-pocket payments to a wider process of income loss and financial depletion, as seen by the fall in median household income following illness onset and the continued decline in per-capita household income following out-of-pocket expenditure. This notion is significant since it expands the definition of economic hardship beyond CHE. Prior to facing the direct costs of medications, diagnostics, transportation, and clinic attendance, households seem to be financially weakened by illness-related income erosion. The fact that a sizable percentage of participants reported work loss suggests that indirect productivity costs continue to be a significant part of the household burden, especially for families with low and inconsistent incomes, even though missed workdays did not differ significantly across facility tiers. Okediji et al. [16] reported quantifiable productivity losses among households managing chronic illness in Nigerian health facilities; however, as in the current study, the economic burden was primarily driven by direct treatment costs, particularly medications. The evidence on indirect costs is also consistent with their findings.

Beyond catastrophic spending itself, this study also demonstrates that chronic illness erodes household economic capacity even before healthcare related payments are taken into account. The burden of chronic illnesses in this study extends beyond out-of-pocket payments to a wider process of income loss and financial depletion, as seen by the fall in median household income following illness onset and the continued decline in per-capita household income following out-of-pocket expenditure. This notion is significant since it expands the definition of economic hardship beyond CHE. Prior to facing the direct costs of medications, diagnostics, transportation, and clinic attendance, households seem to be financially weakened by illness-related income erosion. This is in accordance with evidence from Odunyemi, et al. whose national study in Nigeria explicitly confirms this fact and further notes that NCDs can cause substantial income losses through chronic disability and hospitalization even before considering the debilitating cost of care. [51]

The close convergence of CHE1 and CHE2 in this study, 68.1% and 66.0% respectively, further indicates that the burden is severe regardless of threshold definition. This interpretation is strengthened by recent evidence from Lagos state where Wright et al. reported that catastrophic healthcare expenditure remains a significant household problem in Lagos communities, confirming that financial risk in this megacity extends beyond health facility-based samples like ours and reflects broader urban vulnerability [53]. Against that backdrop, the present study contributes an important systems-level insight: tertiary attendance independently predicts both CHE1 and CHE2, and among chronic disease patients already enrolled in the public sector, the burden is not uniformly distributed but rises sharply with care level. Thus, advancement through the referral system seems to function as both a clinical and a financial escalation pathway.

The proximate determinants of this pattern are made clear by the cost decomposition. The primary direct cost components were medications and diagnostic investigations while missed workdays, though important, did not vary significantly by facility tier. This is consistent with earlier Nigerian facility-based research and with national NCD evidence from Odunyemi et al., all of which identify medicines as a major source of household financial burden [24-26,50]. Similar financial vulnerability has also been documented in other Nigerian clinical populations. Amarachukwu et al. reported high catastrophic cost among people living with sickle cell disease receiving tertiary care in south-east Nigeria, while Alali et al. found high levels of both CHE and post-treatment poverty among patients with chronic hepatitis B in Port Harcourt [54,55]. When considered collectively, these findings indicate that the recurring costs of necessary treatment inputs, particularly medications and diagnostics,

are more responsible for the financial toxicity of chronic disease care in Nigeria than consultation fees alone. This finding is further supported by the stratified models in our analysis, which demonstrate that while medicines predominated at the secondary level and continued to be substantial at the tertiary level, investigations were particularly essential driver at the primary and secondary levels- these are standard components of managing chronic illnesses, not ancillary costs.

The chronic disease profile of the study further strengthens the plausibility of the findings. Hypertension was the most prevalent condition, which is epidemiologically consistent with national survey data showing a high burden of hypertension in Nigeria, especially among middle-aged and older adults, alongside substantial gaps in treatment and control [56]. The predominance of hypertension in this sample therefore reflects the broader non-communicable disease landscape within which recurrent outpatient spending occurs. At the same time, the tertiary care level concentration of diabetes, cancer, kidney disease, and thyroid disease is consistent with the more complex and specialist-intensive case mix expected at that level, which contributes to the explanation of the considerable cost escalation seen there.

The impoverishment findings in this study require a more nuanced interpretation. The absence of an independent facility-level effect does not suggest that healthcare payments are harmless. Rather, it reflects a floor effect created by severe pre-existing poverty- nearly four in five participants were already below the poverty line before being exposed to out-of-pocket payments. Under such conditions, healthcare payments may deepen deprivation without substantially changing the binary classification of who is poor. This helps explain why older age and larger household size remained significant predictors of impoverishment, while facility tier did not. These findings are also directionally consistent with national evidence that CHE and financial hardship in Nigeria are patterned by social vulnerability and household composition [52]. In practical terms, catastrophic spending and impoverishment are related but analytically distinct: in this population, the dominant problem is not simply transition into poverty, but the compression of already-poor households by recurrent healthcare costs.

One of the most policy-relevant findings in this study is the protective effect of insurance against CHE1, despite the very low level of insurance coverage in the sample. This agrees with longitudinal evidence from Kwara State, Nigeria showing that health insurance reduces the risk of catastrophic health expenditure over both shorter and longer time horizons, including among poorer households [57] and is consistent with evidence from Ghana indicating that national health insurance can improve financial protection against catastrophic payments [58]. However, the low prevalence of insurance in the present study indicates that this protective effect remains too shallow to meaningfully alter population-level risk. Financial protection for chronic diseases in this population and other closely related populations in low- and middle-income countries will therefore require more than nominal insurance expansion. It will require deeper pooling of prepaid funds, stronger coverage of medicines and diagnostics, and explicit attention to the cost consequences of referral and specialist care. Since medicines were the largest direct cost component in this study, pooled procurement and centralized purchasing deserve serious consideration; evidence from low- and middle-income countries suggests that such arrangements can reduce medicine prices and improve affordability [59]. This is particularly relevant in Lagos, where sub-national health financing data already point to the importance of more efficient and equitable purchasing arrangements across levels of care [60]. Overall, the policy message is clear: unless chronic disease care is financed more effectively and collectively with essential treatment inputs made more affordable, efforts to expand access

within the public healthcare system will remain undermined by the persistent risk of severe household financial hardship.

This study has several limitations, first of which is its cross-sectional design which limits causal inference and does not permit assessment of how financial hardship evolves over time. Furthermore, it was conducted only in public healthcare facilities in Lagos State and may therefore have limited external validity beyond similar urban public-sector settings, particularly for patients receiving care in private or informal health settings. Cost and income measures were self-reported and are therefore vulnerable to recall bias, although this was mitigated through ensuring short recall periods and cross-checking with available payment records where possible. Besides, because catastrophic health expenditure is constructed from out-of-pocket spending, analyses relating individual cost components to CHE are subject to mechanical dependence and are best interpreted as descriptive of the cost structure of financial hardship rather than as evidence of independent causal effects.

There is a high prevalence of CHE and impoverishment among patients with chronic diseases attending public healthcare facilities, although CHE increased significantly with facility tier while impoverishment showed only modest variation across levels. The identified predictors were tertiary care level and insurance status for CHE, and older age and larger household size for impoverishment. Therefore, it is important to expand the scope and coverage of health insurance among chronic disease patients to provide full protection against CHE and impoverishment. Also, to reduce the burden of out-of-pocket expenditure from chronic diseases, patients should be encouraged to utilize primary care where appropriate to minimize cost escalation. Lastly, other identified predictors should be taken into account by the government, public health facility managers, and other stakeholders when designing policies that would provide financial risk protection against out-of-pocket expenditure among patients with chronic diseases.

Ethics Approval

Ethical approval/clearance was sought and obtained from the Health Research Ethics Committee of the University of Geneva (CUREG-MM-2024-05-91), Lagos State University Teaching Hospital, Ikeja (LREC/06/10/2651). The research was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki [50]. Verbal and written consent was duly acquired from all participants, while ensuring confidentiality, voluntary participation, and the possibility of enforcing their right to withdraw from the study at any point in time.

Consent to Participate

All participants were provided with detailed information regarding the purpose, procedures, potential risks, and benefits of the study prior to participation. Informed consent was obtained from all individuals involved in the research, and participation was entirely voluntary. Participants were assured of their right to withdraw from the study at any point without any consequences. Confidentiality and anonymity of responses were strictly maintained throughout the study.

Consent to Publish

Not applicable

Funding Declaration

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Clinical Trial Number

Not applicable

Data Availability Statement

The data supporting the findings of this study are available upon reasonable request. Due to ethical considerations and to protect participant confidentiality, the datasets are not publicly available. Interested researchers may request access by contacting the corresponding author via email at adilgeorgefabian@gmail.com

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