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Determinants and Socioeconomic Inequalities of Delayed Healthcare-Seeking among Buruli Ulcer Patients in the Democratic Republic of Congo: A Mixed-Methods Study Using Wagstaff Decomposition

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Approved: 23 June 2026
Posted: 25 June 2026

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Cite As:
Kapaya Makinu, H., Nappa, K., Makumbu, I.H., Mensah, G., Bonfoh, B., Kimaro, E., & Saila-Ngita, D. (2026). *Determinants and Socioeconomic Inequalities of Delayed Healthcare-Seeking among Buruli Ulcer Patients in the Democratic Republic of Congo: A Mixed-Methods Study Using Wagstaff Decomposition.* ESI Preprints.
https://doi.org/10.19044/esipreprint.6.2026.p853

Abstract

This study aimed to identify the determinants of delayed biomedical healthcare-seeking and to analyze the associated socioeconomic inequalities among Buruli ulcer patients in the Kimputu Health Zone, Democratic Republic of the Congo.

A convergent mixed-methods study was conducted among 412 Buruli ulcer patients. Quantitative data were collected using a structured questionnaire covering sociodemographic characteristics, socioeconomic conditions, disease knowledge, traditional beliefs, therapeutic pathways, and healthcare expenditures. Semi-structured interviews were conducted with patients, caregivers, community health workers, and healthcare providers to explore disease perceptions and healthcare-seeking rationales. Determinants of delayed healthcare-seeking and catastrophic health expenditures were assessed using multivariable logistic regression models. Socioeconomic inequalities were evaluated through concentration curves, concentration indices, and Wagstaff decomposition analyses.

The findings showed that 52% of patients experienced delayed biomedical healthcare-seeking. Delayed healthcare-seeking was significantly associated with poor disease knowledge (p=0.000 ;AOR = 0.586), traditional beliefs (p=0.002 ;AOR = 0.538), low trust in biomedical healthcare services (p=0.000 ;AOR = 1.781), perceived disease severity (p=0.000 ;AOR = 2.765), and clinical stage of the disease (p=0.000 ;AOR = 2.146). The prevalence of catastrophic health expenditures reached 85.9%, indicating substantial financial vulnerability among affected households. Catastrophic health expenditures were primarily associated with household size (p=0.005 ;AOR = 1.242), **Wealth_quintilla**(p=0.028 ;AOR = 0.796), and delayed healthcare-seeking (p=0.020 ;AOR = 0.460).

Concentration analyses revealed significant socioeconomic inequalities in both healthcare-seeking behavior and catastrophic health expenditures. Regarding delayed healthcare-seeking, inequalities were mainly associated with poor disease knowledge (Concentration Index = 0.13) and traditional beliefs (Concentration Index = 0.038), suggesting a greater concentration of these determinants among poorer households. For catastrophic health expenditures, inequalities were primarily related to the lack of health insurance mechanisms (Concentration Index = 0.104) and limited social support (Concentration Index = 0.179). This reveals socioeconomic inequalities to the detriment of the poorest households.

Wagstaff decomposition showed that delayed healthcare-seeking (48.2%), household wealth (25.2%), and social support (16.7%) were the main contributors to inequalities in catastrophic health expenditures. Concerning delayed healthcare-seeking, disease knowledge (61.7%),

traditional beliefs (11.5%), and disease stage (8.3%) were the major contributors to observed inequalities. Qualitative findings further revealed complex therapeutic pathways characterized by self-medication, consultation of traditional healers, prayer centers, and biomedical health facilities.

This study demonstrates that delayed healthcare-seeking among Buruli ulcer patients results from complex interactions between cognitive, sociocultural, economic, and structural factors. The findings highlight the need to strengthen community health literacy, improve trust in healthcare services, expand financial protection mechanisms, and promote integrated interventions aimed at reducing inequalities in healthcare access and Buruli ulcer management.

Keywords: Buruli ulcer; healthcare-seeking behavior; delayed healthcare-seeking; catastrophic health expenditure; socioeconomic inequalities; Wagstaff decomposition; therapeutic pathways; Democratic Republic of the Congo

1. Introduction

Buruli ulcer (BU), caused by *Mycobacterium ulcerans*, is one of the most disabling neglected tropical diseases (NTDs) affecting populations in several regions of sub-Saharan Africa. The disease remains a significant public health concern in endemic countries, including the Democratic Republic of the Congo (DRC), where cases continue to be reported despite ongoing control efforts (World Health Organization [WHO], 2017; Programme National de Lutte contre les Maladies Tropicales Négligées [PNLMTN], 2016; Ministry of Public Health, Hygiene and Social Welfare, 2024). Buruli ulcer is characterized by progressive skin and soft tissue lesions that may evolve into extensive ulcerative forms, leading to functional disabilities, permanent sequelae, social stigmatization, and substantial deterioration in quality of life (Johnson & Pluschke, 2019; Yotsu et al., 2018). The disease therefore generates not only clinical consequences but also important social and economic burdens for affected households and communities.

Early diagnosis and prompt access to biomedical healthcare are essential components of Buruli ulcer control. Early treatment can prevent progression toward severe lesions, reduce complications, limit disabilities, and improve functional outcomes. Conversely, delayed healthcare-seeking often results in advanced disease stages requiring longer, more complex, and more costly treatment (Capela et al., 2015; Yotsu et al., 2018). In rural settings characterized by poverty, limited healthcare infrastructure, and geographical barriers, delays in accessing appropriate care may further

increase the burden of disease and expose households to substantial financial hardship.

Previous studies conducted in endemic countries have consistently shown that healthcare-seeking behaviors among Buruli ulcer patients are influenced by a complex combination of sociocultural, economic, and health-system factors (Grietens et al., 2008, 2012; Mulder et al., 2008; Onwuka & Oparaocha, 2025; Yotsu et al., 2018). Frequently reported determinants include limited knowledge of the disease, traditional beliefs regarding its causes, economic constraints, perceptions of healthcare quality, and barriers related to geographical accessibility (Baba et al., 2025; Grietens et al., 2012; Koka et al., 2016). In many endemic communities, patients often follow complex therapeutic itineraries involving self-medication, traditional healers, spiritual practices, and delayed attendance at biomedical health facilities (Grietens et al., 2008, 2012; Hausmann-Muela et al., 2003; MacKian, 2003; Mulder et al., 2008). Such therapeutic pathways frequently contribute to delays in diagnosis and treatment, thereby increasing the risk of disease progression and adverse health outcomes.

Cultural beliefs play a particularly important role in shaping therapeutic decisions. In several African settings, Buruli ulcer is commonly associated with mystical, supernatural, or spiritual causes, which may encourage patients to seek help from traditional healers, prayer centers, or other non-biomedical providers before consulting formal healthcare services (Grietens et al., 2008, 2012; Koka et al., 2016; Mulder et al., 2008; Yotsu et al., 2018). These beliefs may reinforce delays in biomedical healthcare-seeking and contribute to the persistence of advanced disease forms (Capela et al., 2015; Onwuka & Oparaocha, 2025). Similar patterns have been documented in community reports from Kongo Central Province and other endemic areas of the DRC, where therapeutic pathways are often fragmented and involve multiple care providers (AC PHYLO, 2024).

Beyond sociocultural determinants, economic constraints constitute a major barrier to timely healthcare utilization. Direct and indirect costs associated with transportation, consultations, medications, hospitalization, and productivity losses represent a substantial burden for households living in poverty. In the absence of adequate financial protection mechanisms, these costs may expose affected families to catastrophic health expenditures and long-term economic vulnerability (Bashir et al., 2024; Mulaga et al., 2022; Njagi et al., 2020; Sriram et al., 2024; Xu et al., 2003). Consequently, delayed healthcare-seeking is not only a behavioral issue but also a manifestation of broader socioeconomic inequalities influencing access to healthcare services.

In the context of ongoing efforts toward Universal Health Coverage (UHC), catastrophic health expenditure has become an important indicator of

inequitable access to healthcare. Evidence from low- and middle-income countries suggests that poorer households are disproportionately affected by out-of-pocket health payments and are therefore more vulnerable to financial hardship associated with illness (Bashir et al., 2024; Mulaga et al., 2022; World Health Organization & World Bank, 2023). Understanding how socioeconomic inequalities influence healthcare-seeking behavior is therefore essential for designing effective interventions aimed at improving equitable access to care.

The complexity of healthcare-seeking behaviors among Buruli ulcer patients requires an integrative theoretical perspective capable of capturing interactions between individual, social, economic, and environmental determinants. The present study is primarily informed by the socio-ecological model, Andersen's Behavioral Model of healthcare utilization, the social health inequalities framework, and the One Health approach. The socio-ecological model emphasizes the influence of multiple interacting levels of determinants, including individual, interpersonal, community, and structural factors (McLeroy et al., 1988). Andersen's Behavioral Model proposes that healthcare utilization is shaped by predisposing, enabling, and need-related factors (Andersen, 1995). The social health inequalities framework provides analytical tools for examining how socioeconomic conditions influence healthcare utilization and health outcomes (O'Donnell et al., 2008; Wagstaff et al., 2003). In addition, the One Health approach recognizes the interdependence between human health, environmental conditions, and socioeconomic contexts, offering a broader perspective for understanding health vulnerabilities in rural endemic settings (One Health High-Level Expert Panel [OHHLEP], 2022).

Despite the growing body of evidence documenting healthcare-seeking behaviors among Buruli ulcer patients, most studies have primarily focused on sociocultural determinants, therapeutic pathways, or clinical outcomes (Grietens et al., 2008, 2012; Mulder et al., 2008; Onwuka & Oparaocha, 2025; Yotsu et al., 2018). Comparatively little attention has been paid to the interactions between delayed healthcare-seeking, financial vulnerability, and socioeconomic inequalities among affected households. Furthermore, few studies have attempted to quantify the relative contribution of behavioral, social, and economic determinants to observed inequalities in healthcare utilization. This limitation is particularly important in rural endemic settings where poverty, geographical isolation, and limited healthcare accessibility interact to influence both therapeutic trajectories and the economic consequences of illness.

In the Democratic Republic of the Congo, evidence regarding the determinants of delayed healthcare-seeking and the socioeconomic distribution of Buruli ulcer-related healthcare burdens remains scarce. The

Kimputu Health Zone provides a particularly relevant context for addressing these knowledge gaps because of the persistence of Buruli ulcer cases, fragmented therapeutic pathways, and the substantial financial burden experienced by affected households.

The objective of this study was therefore to identify the determinants of delayed biomedical healthcare-seeking and to analyze the associated socioeconomic inequalities among Buruli ulcer patients in the Kimputu Health Zone, Democratic Republic of the Congo. Using a mixed-methods design, the study combined quantitative and qualitative approaches to explore the behavioral, social, cultural, and economic dimensions of therapeutic pathways. Multivariable logistic regression was used to identify factors associated with delayed healthcare-seeking, while Wagstaff decomposition was applied to quantify the relative contribution of behavioral, socioeconomic, and contextual determinants to observed inequalities. By integrating behavioral theories, social inequality frameworks, and a One Health perspective, this study seeks to provide a more comprehensive understanding of the mechanisms driving delayed healthcare-seeking and socioeconomic vulnerability among Buruli ulcer patients in rural endemic settings.

2. Materials and Methods

2.1. Study Design and Setting

This study adopted a mixed-methods approach combining quantitative and qualitative methods to explore the determinants of delayed biomedical healthcare-seeking and the associated socioeconomic inequalities among Buruli ulcer patients in the Kimputu Health Zone, Democratic Republic of the Congo (DRC). The mixed-methods approach enabled the integration of quantitative assessment of determinants and inequalities with qualitative understanding of perceptions, beliefs, and therapeutic logics underlying healthcare-seeking behaviors (McLeroy et al., 1988; One Health High-Level Expert Panel [OHHLEP], 2022).

The quantitative component consisted of an analytical cross-sectional study, whereas the qualitative component used a descriptive and interpretative approach based on in-depth individual interviews. The study was conducted in the Kimputu Health Zone, located in Kwilu Province, an endemic area for Buruli ulcer characterized by major geographical accessibility constraints, poverty, and frequent reliance on traditional healthcare practices (AC PHYLO, 2024; Ministry of Public Health, Hygiene and Social Welfare, 2024; Programme National de Lutte contre les Maladies Tropicales Négligées [PNLMTN], 2016).

2.2. Conceptual and Analytical Framework

The analytical framework of the study was based on an integrated approach combining the socio-ecological model, Andersen's Behavioral Model of healthcare utilization, and the social health inequalities framework. This theoretical combination aimed to explore the interactions between individual, community, and structural factors influencing healthcare-seeking behaviors (Andersen, 1995; McLeroy et al., 1988; O'Donnell et al., 2008; Wagstaff et al., 2003).

Andersen's Behavioral Model guided the selection of explanatory variables according to three major dimensions: predisposing factors (knowledge, traditional beliefs, biomedical trust), enabling factors (household wealth, social support, distance to health facilities, health insurance), and perceived or actual healthcare needs (clinical stage and duration of illness) (Andersen, 1995).

The socio-ecological model enabled the simultaneous integration of individual, interpersonal, community, and structural dimensions of healthcare-seeking behaviors (McLeroy et al., 1988). The One Health approach guided the integrated interpretation of interactions between socioeconomic vulnerability, living environment, healthcare accessibility, and therapeutic behaviors (OHHLEP, 2022; World Health Organization, 2017).

Finally, the social health inequalities framework and Wagstaff's work on concentration indices provided the theoretical basis for the econometric analyses of socioeconomic inequalities (O'Donnell et al., 2008; Wagstaff et al., 2003).

2.3. Study Population and Sampling

The quantitative component included 412 Buruli ulcer patients identified in health facilities and within communities in the Kimputu Health Zone. A community-based approach combining active case identification and snowball sampling techniques was used to recruit eligible participants, consistent with approaches commonly used to investigate healthcare-seeking behaviors and hard-to-reach populations in community health research (Hausmann-Muela et al., 2003; MacKian, 2003).

Patients presenting lesions compatible with Buruli ulcer and residing in the study area during the data collection period were included. Inclusion criteria were:

- being a suspected and Ziehl-confirmed case or a previously treated Buruli ulcer patient;
- residing in the study area;
- agreeing to participate in the study.

Patients unable to provide reliable responses or refusing participation were excluded. The sample size was determined using Schwartz's formula:

$$n = Z^2 \times p(1 - p) / d^2$$

where:

- n represents the minimum sample size;
- Z corresponds to the 95% confidence interval value;
- p represents the estimated prevalence;
- d indicates the desired precision.

2.4. Data Collection Procedures

Quantitative data were collected using a structured questionnaire administered face-to-face by trained interviewers.
Information collected included:

- socio-demographic characteristics;
- household economic conditions;
- therapeutic pathways;
- direct and indirect healthcare expenditures;
- clinical characteristics of the disease;
- social support mechanisms;
- knowledge and perceptions related to Buruli ulcer.

The qualitative component relied on purposive sampling involving patients, caregivers, community health workers, and healthcare providers. Qualitative data collection continued until thematic saturation was achieved, following established principles of qualitative inquiry in health systems and healthcare-seeking behavior research (Hausmann-Muela et al., 2003; MacKian, 2003).

Qualitative data were collected through semi-structured interviews focusing on disease perceptions, therapeutic choices, cultural beliefs, barriers to healthcare access, and experiences related to healthcare expenditures.

2.5. Study Variables

2.5.1. Main Outcome Variables

The primary outcome variable of the quantitative component was delayed biomedical healthcare-seeking, defined as any initial resort to traditional care, spiritual care, or self-medication before attendance at a formal biomedical health facility. This operational definition is consistent with previous studies examining therapeutic pathways and healthcare-seeking behaviors among Buruli ulcer patients (Grietens et al., 2008; Grietens et al., 2012; Mulder et al., 2008; Onwuka & Oparaocha, 2025).

A second dependent variable concerned catastrophic health expenditures (CHE), defined according to the World Health Organization

threshold as direct out-of-pocket healthcare expenditures equal to or exceeding 40% of the household's capacity to pay (O'Donnell et al., 2008; World Health Organization & World Bank, 2023; Xu et al., 2003).

$$CHE = OOP / CTP \geq 0.40$$

where:

- CHE represents catastrophic health expenditures;
- OOP refers to out-of-pocket healthcare expenditures;
- CTP represents household capacity to pay.

2.5.2. Explanatory Variables

Explanatory variables were selected according to the integrated theoretical framework of the study (Andersen, 1995; McLeroy et al., 1988). These included:

- predisposing factors: knowledge of Buruli ulcer, traditional beliefs, biomedical trust;
- enabling factors: household wealth, health insurance, social support, distance to health facilities;
- healthcare needs: clinical stage and duration of illness;
- socio-demographic characteristics: age, sex, educational level, and household size.

Composite scores were developed for selected cognitive and sociocultural dimensions. Internal consistency of these scores was assessed using Cronbach's alpha coefficient.

2.6. Analysis of Socioeconomic Inequalities

Socioeconomic inequalities were assessed using concentration indices and concentration curves (O'Donnell et al., 2008; Wagstaff et al., 2003). The concentration index was calculated as:

$$C = (2/\mu) \times Cov(h,r)$$

where:

- C represents the concentration index;
- μ represents the mean of the health variable;
- h corresponds to the variable under study;
- r represents the socioeconomic rank of the household.

The concentration index is widely used to quantify socioeconomic inequalities in health outcomes and healthcare utilization (O'Donnell et al., 2008; Wagstaff et al., 2003).

A curve located above the equality line indicated a concentration of the variable among poorer households, whereas a curve located below indicated a concentration among wealthier households.

The Wagstaff decomposition method was then used to estimate the relative contribution of the different determinants to the observed inequalities (O'Donnell et al., 2008; Wagstaff et al., 2003).

$$C = \Sigma k\ (\beta k\ \bar{x}k / \mu)\ Ck + GC\varepsilon / \mu$$

where:

- βk represents the regression coefficient of the determinant;
- $\bar{x}k$ corresponds to the mean of the explanatory variable;
- Ck represents the concentration index of the explanatory variable;
- $GC\varepsilon$ denotes the generalized concentration index of the residual term;
- μ represents the mean of the dependent variable.

This approach has been widely applied to examine the contribution of individual determinants to socioeconomic inequalities in health and healthcare expenditures (Bashir et al., 2024; Mulaga et al., 2022; Njagi et al., 2020; Sriram et al., 2024).

2.7. Statistical Analysis

Quantitative analyses were performed using SPSS version 27,Eviews 12 and Microsoft Excel 2019. Descriptive statistics were first generated to summarize the characteristics of the study population.

Associations between variables were explored using bivariate analyses, followed by multivariate logistic regression models to identify independent determinants of delayed healthcare-seeking and catastrophic health expenditures, consistent with previous studies investigating healthcare-seeking behavior and health inequalities (Grietens et al., 2012; Onwuka & Oparaocha, 2025).

Results were expressed as adjusted odds ratios (AORs) with their 95% confidence intervals. Statistical significance was established at $p < 0.05$.

2.8. Qualitative Analysis

Qualitative data were transcribed, coded, and analyzed using a thematic approach commonly applied in studies exploring healthcare-seeking behaviors, therapeutic pathways, and health system interactions (Hausmann-Muela et al., 2003; MacKian, 2003). Coding was performed independently before analytical categories were harmonized. The qualitative analysis aimed to deepen understanding of the beliefs, community perceptions, and therapeutic rationales influencing healthcare-seeking behaviors.

2.9. Bias Control and Quality Assurance

Standardized training for interviewers, regular supervision of data collection, and data verification procedures were implemented to limit selection, information, and recall biases.

Triangulation of quantitative and qualitative methods strengthened the credibility, validity, and comprehensiveness of the findings (McLeroy et al., 1988; OHHLEP, 2022).

2.10. Ethical Considerations

The study was approved by the relevant ethics committee. Administrative authorization was obtained from local health authorities prior to data collection under Approval No. ESP/CE/132/2025.

Free and informed consent was obtained from all participants before data collection. Anonymity, confidentiality, and secure management of study data were guaranteed throughout the research process.

3. Results

3.1. Sociodemographic characteristics

Tableau I: Sociodemographic characteristics

Variables	Frequency (n = 412)	%
Age (years)		
< 15 years	5	1.2
15–24 years	69	16.7
25–49 years	254	61.7
≥ 50 years	84	20.4
Sex		
Male	249	60.4
Female	163	39.6
Educational level		
Completed primary education	110	26.7
Incomplete primary education	50	12.1
Completed secondary education	236	57.0
Completed higher/university education	16	3.9
Religious affiliation		
Christian	320	77.9
No religion	38	9.2
Muslim	16	3.9
Traditional religion	5	1.2
Household size		
1–6 persons	265	64.5
≥ 7 persons	147	35.6
Occupational status of household head		
Unemployed	106	25.8
Farmer	233	56.7
Public sector employee	49	11.9
Private sector employee	9	2.2
Small-scale entrepreneur	6	1.5
Livestock breeder	9	2.0

Tableau II. Care pathway

Variables	Frequency (n = 412)	%
Complexity of therapeutic pathway		
Low complexity	86	22.3
Moderate complexity	183	47.4
High complexity	117	30.3
Promptness of biomedical healthcare-seeking		
≤ 7 days	161	39.1
> 7 days	251	60.9
Diversity of healthcare providers consulted		
Low diversity	290	70.4
Moderate diversity	77	18.7
High diversity	45	10.9
Initial contact with a biomedical health facility		
No contact	243	59.0
At least one contact	163	41.0
Initial contact with a traditional healer		
No contact	46	11.8
At least one or more contacts	345	88.3
Delay before first consultation at a biomedical health facility		
< 1 week	19	4.6
Between > 1 week and 2 months	161	39.1
Three months or more	232	56.3

Figure 1: Trajectory representation in graph form

3.3. Determinants of late recourse and Catastrophic health expenditure (CHE)

Table III: Associations after odds ratio adjustment

Variable	P-value	Adjusted Odds Ratio (AOR)
Delayed healthcare-seeking (Traditional healer vs Biomedical health facility)		
Knowledge of Buruli ulcer	<0.001	0.586
Traditional beliefs	0.002	0.538
Biomedical trust	<0.001	1.781
Perceived severity of disease	<0.001	2.765
Clinical stage of Buruli ulcer at consultation	<0.001	2.146
Distance to health center	0.013	1.320
Catastrophic health expenditure (CHE ≥40% WHO threshold)		
Household size	0.005	1.242
Clinical stage of Buruli ulcer at consultation	0.191	0.785
Household wealth quintile	0.028	0.796
Healthcare-seeking promptness	0.020	0.465
Health insurance	0.233	0.938
Social support	0.524	0.893

3.4. Décomposition Wagstaff

Table IV shows the contributions of the explanatory variables to their dependent variable : Delay in seeking care

Variable	Delay in seeking care(TRADIP vs ESS)	Coefficient (β)	Average ($\bar{X}$)	Concentration index (Ck)	Contribution
knowledge of Buruli ulcer	0,52	-0,535	3,03	0,128	-0,396
traditional_belief	0,52	-0,619	1,66	0,038	-0,074
biomedical trust	0,52	0,577	1,73	-0,033	-0,062
perception of gravity	0,52	1,017	1,51	0,002	0,005
Stage of disease	0,52	0,764	1,71	0,021	0,053
Distance_health_center	0,52	0,278	2,67	0,036	0,052

Table V shows the contributions of the explanatory variables to their dependent variable : Catastrophic Health Expensure(CHE)

Variable	CHE	Coefficient (β)	Average ($\bar{X}$)	Concentration index (Ck)	Contribution
Household pruning	0,86	0,216	5,75	-0,001	-0,0018
Stage of disease	0,86	-0,242	1,71	0,018	-0,0090
Wealth_quintilla	0,86	-0,229	2,99	0,039	-0,0312
Access to care (promptness)	0,86	-0,765	1,49	0,045	-0,0597
insurance	0,86	-0,064	0,15	0,104	-0,0012
Social Support	0,86	-0,113	0,88	0,179	-0,0208
Distance_health_center	0,86	-0,024	0,02	0,016	-0,000007
duration of illness	0,86	-0,005	4,141	0,002	-0,00004

Figure 2: Concentration curve for catastrophic health expenditures (CHE)

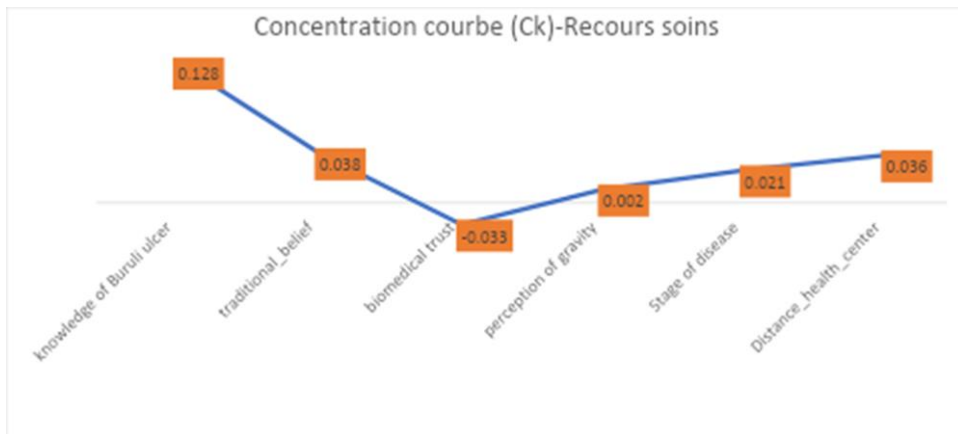

Figure 3: Concentration curve for delayed healthcare-seeking

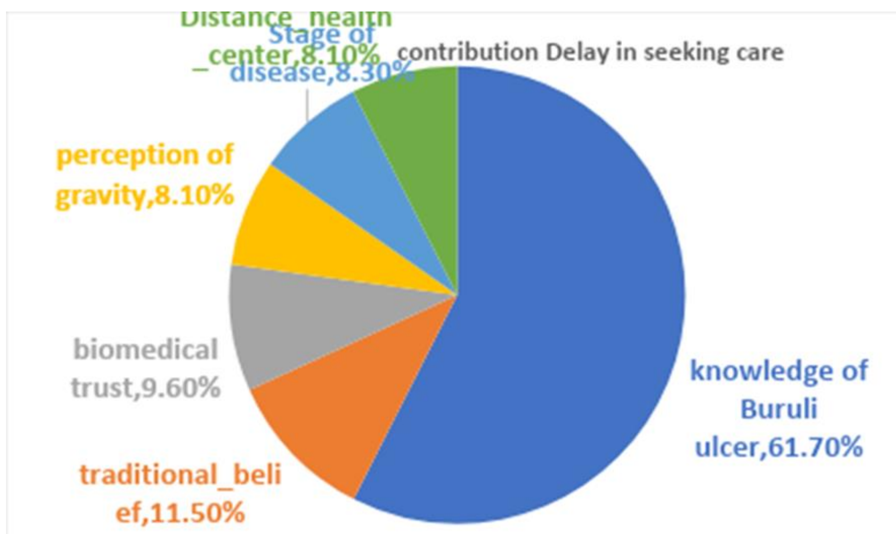

Figure 4 : Graphical representation

Sector related to healthcare access

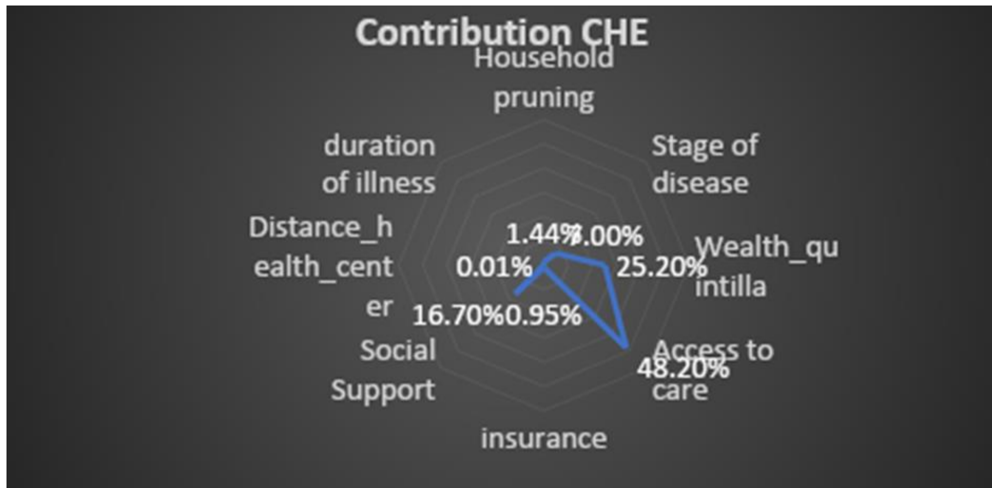

Figure 5: Graphical Representation of Wagstaff Decomposition Contributions to Catastrophic Health Expenditures

3.5. Qualitative results

Dependent Variable: Delay in healthcare-seeking (Traditional healers vs Essential Health Services)

Table V. Findings from the Qualitative Analysis

Explanatory Variables	Qualitative Findings
Knowledge of Buruli ulcer signs	Limited knowledge contributes to delayed healthcare-seeking. Patients and families often fail to recognize early symptoms and interpret the disease through indigenous beliefs. *"The cause is indigenous."* (Family member)
Traditional beliefs	FGDs involving community leaders, families, and traditional healers revealed a predominantly mystical perception of Buruli ulcer. The appearance of ulcers is frequently interpreted as evidence that the underlying cause has already been addressed through traditional healing.
Trust in biomedicine	Low confidence in biomedical services reinforces reliance on traditional healers. Perceived lack of medication and limited effectiveness of health facilities reduce trust. *"The health center does not have medication for Buruli ulcer."* (Healthcare worker)
Perceived severity	Buruli ulcer is mainly perceived as severe only at advanced stages when disability occurs. *"It renders people incapacitated."* (Community leader)
Stage of consultation	Traditional treatment is commonly prioritized before ulceration appears. The ulcer stage often represents the turning point for seeking biomedical care. *"Before the appearance of the wound, it is a matter of traditional healing."* (Traditional healer)
Therapeutic pathways	Patients frequently follow fragmented and sequential therapeutic pathways involving traditional healers, self-medication, and delayed biomedical consultation.
Economic	Financial hardship, transportation costs, and household vulnerability

barriers	contribute to delays in accessing biomedical services.
Social influence	Healthcare-seeking decisions are strongly influenced by family members, community perceptions, and social norms favoring traditional care during early disease stages.

3.6. Integration of Quantitative and Qualitative Findings (Mixed-Methods Triangulation)"

Table X. Integration of Quantitative and Qualitative Findings on Determinants of Delayed Healthcare-Seeking and Catastrophic Health Expenditures among Buruli Ulcer Patients in Kimputu Health Zone

Quantitative Findings	Qualitative Findings	Integrated Interpretation (Triangulation)
Disease knowledge (AOR = 0.586; Wagstaff contribution = 61.7%)	Participants reported limited recognition of early symptoms and frequent confusion between Buruli ulcer and other skin conditions.	Quantitative and qualitative findings converge in showing that inadequate disease knowledge is the strongest determinant of delayed healthcare-seeking and a major driver of socioeconomic inequalities.
Traditional beliefs (AOR = 0.538; Wagstaff contribution = 11.5%)	Several participants associated Buruli ulcer with witchcraft, spiritual forces, or mystical causes and initially sought care from traditional healers.	Traditional beliefs strongly influence initial therapeutic choices and contribute to prolonged and fragmented healthcare pathways.
Trust in biomedical healthcare (AOR = 1.781; Wagstaff contribution = 9.6%)	Some patients reported negative experiences related to poor reception, perceived treatment costs, and fear of biomedical interventions.	Limited trust in healthcare facilities discourages early biomedical consultation and promotes the use of alternative community-based care options.
Advanced clinical stage of disease (AOR = 2.71; $p < 0.001$; Wagstaff contribution = 8.1%)	Patients frequently reported seeking care only when lesions became painful, disabling, or difficult to conceal.	Qualitative findings help explain why many patients present at advanced disease stages, reinforcing the relationship between delayed care-seeking and disease severity.
Low household wealth (AOR = 0.796)	Households described difficulties covering transportation costs, treatment expenses, and food-related expenditures during illness episodes.	Financial constraints limit timely healthcare utilization and contribute to socioeconomic inequalities in access to care.
Household size (AOR = 1.242)	Large households reported having to balance healthcare expenses against other essential household needs.	Economic pressures associated with larger household sizes influence healthcare decisions and increase vulnerability to catastrophic health expenditures.
Fragmented therapeutic pathways	Participants described sequential care-seeking trajectories involving traditional healers, self-medication, prayer centers, and biomedical facilities.	Qualitative evidence reinforces quantitative findings by illustrating the complexity and fragmentation of therapeutic pathways that contribute to delayed healthcare-seeking.

4. Discussion

4.1. Cognitive, Sociocultural, and Behavioral Determinants of Delayed Healthcare-Seeking

This study highlights the central role of cognitive, sociocultural, and behavioral factors in delayed biomedical healthcare-seeking among Buruli ulcer patients in the Kimputu Health Zone. The findings demonstrate that poor disease knowledge, traditional beliefs, and low trust in biomedical healthcare were significantly associated with delayed healthcare utilization. These observations are consistent with evidence from several Buruli ulcer-endemic settings across Africa, where healthcare-seeking decisions are strongly influenced by cultural perceptions of disease causation, therapeutic preferences, and confidence in available healthcare services (Grietens et al., 2008, 2012; Koka et al., 2016; Mulder et al., 2008; Onwuka & Oparaocha, 2025; Yotsu et al., 2018).

Poor knowledge of Buruli ulcer emerged as one of the strongest determinants of delayed healthcare-seeking. Furthermore, concentration analyses revealed that disease knowledge exhibited the highest level of socioeconomic inequality among the determinants examined. This finding suggests that observed inequalities are not solely economic but also cognitive in nature. Households occupying disadvantaged socioeconomic positions appear to have more limited access to reliable information regarding disease recognition, treatment availability, and the benefits of early biomedical care. Similar findings have been reported in studies conducted in several African settings, where insufficient health education and limited disease awareness constitute major barriers to timely healthcare utilization (Baba et al., 2025; Hausmann-Muela et al., 2003; MacKian, 2003; Yotsu et al., 2018).

Traditional beliefs also played a major role in shaping therapeutic decisions. Qualitative findings indicate that mystical or spiritual interpretations of Buruli ulcer frequently encourage patients to seek assistance from traditional healers, prayer centers, or other non-biomedical providers before attending formal healthcare facilities. Similar observations have been reported in Benin, Ghana, and Nigeria, where sociocultural interpretations of Buruli ulcer substantially influence therapeutic itineraries and delay access to biomedical treatment (Grietens et al., 2008, 2012; Koka et al., 2016; Onwuka & Oparaocha, 2025). However, the present study suggests that traditional beliefs do not necessarily imply rejection of biomedical care. Rather, they influence the timing and sequencing of healthcare utilization, with biomedical services often being sought only after traditional approaches have failed. This process contributes to prolonged therapeutic delays and increases the likelihood of progression toward advanced disease forms.

Trust in biomedical healthcare also emerged as a key determinant of healthcare-seeking behavior. Patients expressing lower levels of confidence in biomedical services experienced more fragmented and prolonged therapeutic pathways. This finding may reflect previous negative healthcare experiences, perceived treatment costs, concerns regarding service quality, or structural barriers affecting access to care. Similar patterns have been observed in studies of Buruli ulcer and other neglected tropical diseases, where perceptions of healthcare quality and trust in providers significantly influence therapeutic choices (Johnson & Pluschke, 2019; Yotsu et al., 2018).

Collectively, these findings suggest that interventions aimed at improving early healthcare utilization should not focus exclusively on service availability but should also address the cognitive and sociocultural dimensions influencing therapeutic decision-making.

4.2. Economic Vulnerability and Catastrophic Health Expenditures

The study revealed an exceptionally high prevalence of catastrophic health expenditures (85.9%) among households affected by Buruli ulcer. This proportion exceeds estimates reported in several studies conducted in low- and middle-income countries and highlights the severe financial vulnerability experienced by affected households (Bashir et al., 2024; Mulaga et al., 2022; Njagi et al., 2020; Sriram et al., 2024). The magnitude of this burden likely reflects the combined effects of chronic disease management, geographical barriers to care, poverty, fragmented therapeutic pathways, and prolonged treatment duration.

Multivariable analyses demonstrated that household wealth was one of the strongest predictors of catastrophic health expenditures. Poorer households were disproportionately exposed to both direct healthcare payments and indirect costs associated with transportation, accommodation, productivity losses, and long-term treatment requirements. These findings are consistent with evidence from health equity research showing that inadequate financial protection mechanisms disproportionately affect socioeconomically disadvantaged populations (O'Donnell et al., 2008; World Health Organization & World Bank, 2023; Xu et al., 2003).

The concentration analyses further indicated that social protection mechanisms, including health insurance coverage and social support networks, were more concentrated among wealthier households. This suggests that socioeconomic inequalities extend beyond income differentials and encompass unequal access to financial resilience mechanisms. Consequently, poorer households experience a double disadvantage: increased exposure to healthcare costs and reduced access to mechanisms capable of mitigating financial risk.

Social support emerged as a particularly important protective factor. Households benefiting from stronger family and community networks appeared better able to mobilize financial assistance and material support during illness episodes. Conversely, households with weaker social support structures were more vulnerable to debt accumulation and worsening poverty. These findings reinforce growing evidence that social capital constitutes an important determinant of resilience in contexts characterized by limited formal financial protection.

4.3. Therapeutic Pathways, Complexity of Healthcare-Seeking, and Graph Theory

The graph theory-inspired approach provided valuable insights into the complexity of therapeutic pathways followed by Buruli ulcer patients. The observed trajectories frequently involved multiple transitions between self-medication, traditional healers, prayer centers, and biomedical healthcare facilities. These findings demonstrate that healthcare-seeking should not be viewed as a single decision point but rather as a dynamic process characterized by sequential interactions among multiple healthcare providers.

The analysis revealed that traditional healers occupied a central position within several therapeutic networks. This finding is consistent with studies conducted in Benin and other endemic settings, which have documented the important role of traditional healthcare providers in shaping therapeutic pathways and influencing healthcare-seeking decisions (Grietens et al., 2008, 2012; Mulder et al., 2008). The persistence of traditional healthcare utilization appears closely linked to cultural beliefs, financial constraints, and the accessibility of community-based providers.

Importantly, the qualitative findings suggest that patients do not necessarily perceive traditional medicine and biomedical care as mutually exclusive alternatives. Instead, healthcare-seeking behaviors appear to follow a logic of therapeutic complementarity, whereby individuals navigate between different healthcare systems according to symptom progression, financial resources, social influences, and cultural interpretations of illness. Similar patterns have been described in previous studies examining healthcare-seeking behaviors in neglected tropical diseases (Hausmann-Muela et al., 2003; MacKian, 2003).

From a methodological perspective, the graph theory-inspired approach constitutes an innovative contribution by allowing visualization of therapeutic trajectories and identification of critical points at which delays are generated. Such approaches may provide useful tools for designing interventions aimed at reducing fragmentation within healthcare pathways and improving timely referral to biomedical services.

4.4. Socioeconomic Inequalities and Wagstaff Decomposition

The Wagstaff decomposition analyses demonstrated that observed inequalities in catastrophic health expenditures resulted from complex interactions among economic, behavioral, social, and clinical determinants. Delayed healthcare-seeking emerged as the largest contributor to observed inequalities, followed by household wealth, social support, and disease severity.

These findings suggest that healthcare-seeking behaviors act as important mediating mechanisms through which social vulnerability is transformed into financial vulnerability. Delayed healthcare utilization increases the likelihood of disease progression, resulting in more intensive treatment requirements, prolonged hospitalization, and higher healthcare costs. This process reinforces existing socioeconomic disparities and contributes to the persistence of health inequalities (O'Donnell et al., 2008; Wagstaff et al., 2003; World Health Organization, 2008).

Interestingly, some variables traditionally associated with healthcare inequalities, such as educational level and geographical distance to health facilities, contributed less strongly than expected to the observed disparities. One possible explanation is that widespread poverty within the study area reduces socioeconomic variation between households, thereby limiting the relative influence of education. Additionally, local solidarity networks may partially compensate for geographical barriers. However, these interpretations should be approached cautiously given the cross-sectional nature of the study.

The concentration analyses further revealed that inequalities were not exclusively economic but also cognitive and social. Disease knowledge was strongly concentrated among more advantaged households, suggesting that unequal access to health information contributes substantially to observed disparities in healthcare utilization. These findings highlight the importance of considering informational inequalities as an integral component of broader health inequalities.

4.5. Implications for Public Health, Universal Health Coverage, and the One Health Approach

The findings have important implications for public health policies targeting Buruli ulcer and other neglected tropical diseases in rural endemic settings. First, they suggest that interventions should move beyond a purely biomedical perspective and address the cognitive, social, and economic determinants shaping healthcare-seeking behavior.

Strengthening community health education programs may help reduce cognitive inequalities and improve recognition of early disease symptoms. Community-based awareness initiatives should be adapted to

local cultural contexts and designed to address misconceptions regarding disease causation and treatment. Given the important role of traditional healers within therapeutic pathways, integrating these actors into referral systems may also facilitate earlier access to biomedical care.

The findings further emphasize the importance of strengthening financial protection mechanisms within the framework of Universal Health Coverage. Expanding health insurance coverage, supporting community solidarity mechanisms, and reducing indirect healthcare costs may help decrease household exposure to catastrophic expenditures and improve equity in healthcare access.

Finally, the results strongly support the relevance of the One Health approach for understanding healthcare-seeking behavior in Buruli ulcer-endemic settings. The observed therapeutic trajectories appear to result from multidimensional interactions involving poverty, environmental conditions, geographical isolation, healthcare accessibility, cultural beliefs, and social vulnerability. Such complexity cannot be adequately addressed through biomedical interventions alone. Instead, integrated strategies combining public health actions, social protection policies, community engagement, and environmental considerations are required to address the interconnected determinants of health and healthcare utilization (One Health High-Level Expert Panel [OHHLEP], 2022).

4.6. Strengths and Limitations of the Study

This study presents several methodological strengths. The mixed-methods design enabled integration of quantitative and qualitative evidence, thereby providing a multidimensional understanding of healthcare-seeking behaviors and catastrophic health expenditures. The combined use of multivariable logistic regression, concentration indices, concentration curves, and Wagstaff decomposition allowed not only the measurement of inequalities but also the estimation of the relative contribution of individual determinants. Furthermore, the application of a graph theory-inspired framework represents an innovative methodological contribution to the study of therapeutic pathways in neglected tropical diseases.

Nevertheless, several limitations should be acknowledged. First, the cross-sectional design precludes causal inference regarding relationships between explanatory variables and outcomes. Second, information related to healthcare expenditures and healthcare-seeking behaviors relied partly on self-reported data and may therefore be subject to recall bias. Third, some complex sociocultural dimensions may not have been fully captured through standardized quantitative instruments. Despite these limitations, the triangulation of quantitative and qualitative findings enhanced the credibility, validity, and overall robustness of the study conclusions.

Conclusion

This study provides new evidence on the determinants of delayed biomedical healthcare-seeking and the socioeconomic inequalities associated with Buruli ulcer in the Kimputu Health Zone, Democratic Republic of the Congo. By combining quantitative and qualitative approaches, the findings demonstrate that delayed healthcare-seeking is shaped by a complex interplay of cognitive, sociocultural, economic, and structural factors. Poor knowledge of the disease, traditional beliefs, limited trust in biomedical healthcare, poverty, and weak social support emerged as key determinants influencing therapeutic trajectories and access to care.

The study further reveals a high burden of catastrophic health expenditures among affected households, highlighting the substantial financial vulnerability associated with Buruli ulcer. The decomposition analyses indicate that delayed healthcare-seeking constitutes a major pathway through which social and economic disadvantages translate into financial hardship. Beyond economic inequalities, the findings also demonstrate the existence of cognitive and social inequalities, particularly regarding access to health information and protective social resources.

The graph theory-inspired analysis of therapeutic pathways contributes to a more comprehensive understanding of healthcare-seeking behavior by illustrating the dynamic interactions between self-medication, traditional healers, spiritual care, and biomedical services. Rather than reflecting a simple opposition between traditional and biomedical healthcare systems, therapeutic trajectories appear to follow a logic of complementarity shaped by cultural beliefs, resource availability, and healthcare accessibility.

From a public health perspective, the findings suggest that efforts to improve Buruli ulcer control should extend beyond the strengthening of biomedical services alone. Interventions aimed at improving community health literacy, strengthening trust in healthcare systems, integrating traditional actors into referral mechanisms, and expanding financial protection for vulnerable households are likely to contribute to earlier healthcare utilization and reduced socioeconomic inequalities.

The study also highlights the relevance of combining socio-ecological, behavioral, social inequality, and One Health perspectives to better understand healthcare-seeking behavior in neglected tropical diseases. The observed patterns reflect multidimensional interactions linking poverty, social vulnerability, environmental conditions, healthcare accessibility, and disease outcomes. Consequently, effective responses require integrated and multisectoral strategies that address both the medical and social determinants of health.

Although the cross-sectional design limits causal inference, the mixed-methods approach, the use of concentration indices and Wagstaff

decomposition, and the innovative application of graph theory concepts provide a robust analytical framework for examining healthcare-seeking behavior and health inequalities. Future research should further explore the longitudinal dynamics of therapeutic pathways and evaluate interventions aimed at reducing delays in healthcare utilization and the financial burden associated with Buruli ulcer.Ultimately, reducing the burden of Buruli ulcer requires not only improving access to diagnosis and treatment but also addressing the underlying social, cognitive, and economic inequalities that shape healthcare-seeking behavior. Strengthening equitable access to information, healthcare services, and financial protection mechanisms will be essential for achieving more effective and inclusive control of Buruli ulcer in endemic rural settings.

Conflict of Interest: The authors reported no conflict of interest.

Data Availability: All data are included in the content of the paper.

Funding Statement: The study was funded by Science for Africa Foundation [Afrique One-ASPIRE, Del-15-008 and Afrique One-REACH, Del-22-011] with support from Wellcome Trust and the UK Foreign, Commonwealth & Development Office, and is part of the EDCTP2 programme supported by the European Union.

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