Open Access Library Journal
2026, Volume 13, e15296
ISSN Online: 2333-9721
ISSN Print: 2333-9705

Explaining Factors of the Financial Hospital Care Cost for Children Aged 0 to 59 Months. Case Study of the Kalonda Ouest Health Zone, Kasai (DR Congo, 2024)

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How to cite this paper: Mekanda-me-Bibolo, U., Kekemb, T.B., Ankoy, A.M.T., Mukendi, S.B., Mjumbe, C.K., Kayembe, D.M., Bushabu, E.M., Osakanu, G.L., Kandolo, S.I., Numbi, O.L. and Ngongo, G.M. (2026) Explaining Factors of the Financial Hospital Care Cost for Children Aged 0 to 59 Months. Case Study of the Kalonda Ouest Health Zone, Kasai (DR Congo, 2024). *Open Access Library Journal*, **13**: e15296.
https://doi.org/10.4236/oalib.1115296

Received: April 3, 2026
Accepted: June 2, 2026
Published: June 5, 2026

Abstract

Introduction: Severe acute malnutrition (SAM) imposes significant costs on families, particularly in rural areas. This study aims to identify the factors influencing the financial cost of care for children hospitalized in Kalonda West in 2024. **Methods:** A multiple linear regression analysis was conducted on all hospitalized children, after logarithmic transformation of the cost to normalize its distribution. Variables including nutritional status, length of hospital stay, parental education level, distance between home and hospital, and parental age were considered. Adjusted β coefficients and 95% confidence intervals were used to quantify associations. **Results**: Maternal education level was positively associated with cost, with children whose mothers were educated having approximately 14% higher hospital costs than those whose mothers were not educated ($\beta = 0.135$; 95% CI: 0.066 - 0.205; $p < 0.001$). Each additional kilometer between home and hospital was associated with an increase in cost of approximately 1.6% ($\beta = 0.016$; 95% CI: 0.007 - 0.025; $p < 0.001$). Length of hospital stay was strongly associated with expenditure, with each additional day resulting in a 6.8% increase in cost ($\beta = 0.067$; 95% CI: 0.025 - 0.109; $p = 0.002$).

Malnourished children incurred costs 19% higher than those with normal nutritional needs ($\beta = 0.170$; 95% CI: 0.029 - 0.310; p = 0.018). Parental age was also associated with a median increase of 2.8% in cost per additional year ($\beta = 0.028$; 95% CI: 0.020 - 0.036; p < 0.001). **Conclusion**: Improving affordability requires targeted subsidy policies, strengthened parenting education, innovative financing, and encouraging high-impact interventions during the first 1000 days of a child's life.

Subject Areas

Public Health, Sociology

Keywords

Financial Cost, Severe Acute Malnutrition, Care, Child Nutrition, Kalonda West, Democratic Republic of Congo

1. Introduction

In many low- and middle-income countries, particularly in sub-Saharan Africa, severe acute malnutrition (SAM) is a major public health issue. In the Democratic Republic of Congo (DRC), nearly 2 million children under five are affected by SAM annually [1]-[3]. The Kasai region, particularly affected, has recently experienced armed conflict, mass population migration, and a persistent food crisis [4].

In the Kalonda West health zone, especially in its rural areas, access to medical care remains difficult. Local populations face a health system weakened by a lack of infrastructure, qualified personnel, and essential medicines. This situation is exacerbated by insecurity and insufficient public funding, making healthcare inaccessible to a large portion of the population [5].

Faced with inadequate public assistance and a shortage of nutritious food, families frequently find themselves bearing the costs of hospital care. The DRC's National Multisectoral Strategic Nutrition Plan highlights that chronic and acute malnutrition affects a significant proportion of the population, particularly children and women, and that households bear a large share of nutrition-related costs [6]-[8].

Geographical constraints on access and inadequate health infrastructure further increase the economic vulnerability of households. In several eastern provinces, patients must travel long distances to access care, often without any guarantee of finding staff or available medication upon arrival [9].

In this situation, malnutrition not only becomes a public health issue but also generates a considerable financial burden. Healthcare costs are borne primarily by households, contributing to their impoverishment and limiting their ability to meet other essential needs [10].

Furthermore, while numerous studies have examined the prevalence of malnutrition and its medical or dietary origins, few have focused on the factors determining the cost associated with its management. Understanding these factors is crucial for improving equitable access to care, targeting financial assistance to the most vulnerable households, and better planning local health policies.

2. Methods

2.1. Study Design

A retrospective hospital-based case-control study was conducted.

2.2. Study Framework

Our study was conducted in the pediatric department of the Kalonda West General Referral Hospital and the DITEKEMENA Secondary Hospital, in the Kalonda West health zone. The health zone has a total population of 524,086 inhabitants, an area of 3300 km^2, a population density of 158.8 inhabitants/km^2, and 31 health areas. These two hospitals provide referral care for cases.

2.3. Study Population

Our study population consists of normal-nourished and malnourished children aged 0 to 59 months hospitalized at the Kalonda West General Referral Hospital and the Ditekemena Secondary Hospital in the city of Tshikapa. The statistical unit is therefore the child suffering from other pathologies and the hospitalized malnourished child, while the reporting unit (study respondent) is the child's caregiver.

Inclusion Criteria

Any child aged 0 - 59 months meeting the case definition for severe acute malnutrition (SAM) and who was hospitalized and registered in the consultation register at the Kalonda West and Ditekemena Intensive Care Units (ICUs) from January to March 2024.

Any child aged 0 - 59 months meeting the control definition and who was hospitalized for a reason other than malnutrition at the same health facility during the same period.

Excluded from this study were the financial costs of nutritional care for children with moderate acute, chronic, and global malnutrition, as well as those for children with normal nutritional needs over 59 months of age.

Costs related to capital expenditure, transportation of supplies, and coordination and supervision activities within the Intensive Therapeutic Nutrition Units (INTUs) were not included. Any child meeting the case definition but presenting with another condition during hospitalization that could influence the cost was also excluded.

Exclusion criteria

Variables

- Dependent Variables

The dependent variable represents household out-of-pocket spending, total hospital cost.

Total financial cost of hospital care, expressed in US dollars (USD), including direct medical expenses (consultations, medications, examinations), transportation costs, therapeutic nutrition costs, other expenses related to hospitalization.

- Independent variables
    - Socio-demographic characteristics: Sex and age of the child household size, education level of the father and mother
    - Characteristics of hospitalization: Length of hospitalization
    - Economic conditions: Household income, cost of transportation to the hospital

The father or mother level of education was "no level" (No) depending on whether the mother had not completed elementary school, which would have prevented her from reading or writing, and for a mother (or father) who could read and write, it was the opposite (Yes).

2.4. Sampling and Sample Size

Calculation of the number of cases (Kelsey)

- $$n \geq \frac{\left(1+\frac{1}{C}\right)\left(Z_{\alpha}+Z_{1-\beta}\right)^{2} \times p(1-p)}{\left(p_{0}-p_{1}\right)^{2}}; \quad p=\frac{p_{1}+C p_{0}}{1+C}$$
- n = Sample size
- c = number of witnesses per case (2)
- Z_{α} = Z-value for type I error (at the confidence level of 95% = 1, 65)
- $Z_{1-\beta}$ = Z value for a power $1-\beta$; (1, 28)
- p_0 = proportion of witnesses exposed (50)
- p_1 = Proportion of exposed cases (66, 67)

By applying the formula above and adding 10% of possible non-response cases to avoid falling below the minimum sample size during data collection, the number of cases was at least 123.

Number of controls:

Two controls were matched with one case of SAM. Therefore, the number of controls was 246.

Total sample size. A total of 360 children were included in the study using Kelsey's formula:

123 cases (malnourished children). 246 controls (normally nourished children).

A case-control ratio of 1:2 was chosen to increase the statistical power of the analysis, which was 80%.

Cases and control were chosen based on medical diagnosis.

Data were collected using: Standardized survey forms, medical record reviews.

Structured interviews with parents/legal guardians.

Interviews with healthcare staff and caregivers were used to collect data on financial costs at the level of the Intensive Therapeutic Nutrition Units and partners (UNICEF/ACF/World Bank), suppliers of nutritional and pharmaceutical supplies for the nutritional care of malnourished and normal-nutrited children. Indeed, the price lists for pharmaceutical and food products from UNICEF, the World Bank, and WFP allowed us to calculate the direct and indirect financial costs. For this calculation, we used the exchange rate of 2600 FC to 1 US dollar.

Among the tools used were:

Consultation records, hospitalization and laboratory registers, prices and invoices for medications and nutritional supplies, the tariff schedule, and the RUMER (Reference Intake of Medical and Social Services).

Data were entered and analyzed using Microsoft Excel 2024 and SPSS version 25. Qualitative variables were described using frequencies and percentages. For quantitative variables, normality was tested using the Kolmogorov-Smirnov test to perform comparisons, as was the case for the direct cost of care, for which the distribution was either free or skewed.

Qualitative variables were presented as counts and percentages, while quantitative variables were described by the median and interquartile range (IQR), with non-normal distributions (Shapiro-Wilk test).

The association between total cost and qualitative variables was assessed using the Wilcoxon-Mann-Whitney U test (for bimodal variables) and the Kruskal-Wallis test (for multimodal variables). The threshold for statistical significance was set at $p < 0.05$.

All significant variables were included in a multivariate analysis. Multiple linear regression was used to identify the determinants of total cost. Indeed, due to the asymmetry of the distribution (judged using the Shapiro-Wilk test at 5%), a logarithmic transformation was applied before modeling, improving the normality of the residuals and the validity of the estimates. The variables included in the final model were selected based on their epidemiological relevance and the associations observed in the bivariate analysis. The assumptions of the linear regression model were systematically verified, including the normality of the residuals, homoscedasticity, independence of errors, and the absence of multicollinearity between the explanatory variables. The results are presented as adjusted regression coefficients (β), along with their 95% confidence intervals and p-values. The statistical significance level was set at 5%.

2.5. Ethical Considerations

The study was approved by the Ethics Committee of the University of Lubumbashi (number UNILU/CEM/054/2025). Authorization was obtained from the local health authorities, and informed consent was obtained from the parents or guardians of the included children. The confidentiality and anonymity of the participants were strictly maintained.

3. Results

The study participants were predominantly sick but not malnourished children (66.7%), with a slight female predominance (54.4%). Most fathers and mothers had a secondary education or higher, representing 49.7% and 63.8%, respectively. The median monthly household income was low (US$75). The median age of the children was 24 months, with relatively large households (median = 7 people). The median distance between the home and the healthcare facility was 3 km. The median length of stay was 6 days, while the median age of the child's caregiver was 33 years (See Table 1).

Table 1. Participant characteristics.

Variables	Terms and conditions	Frequencies	%
Patient status	Malnourished	130	33.3
	Non-malnourished	260	66.7
Sex of the child	Female	212	54.4
	Male	178	45.6
Father's level of education	None	69	17.7
	Primary	127	32.6
	Secondary	148	37.9
	Higher/University	46	11.8
Mother's level of education	None	37	9.5
	Primary	104	26.7
	Secondary	181	46.4
	Higher/University	68	17.4
	[Min - Max]	**Median**	**IQR**
Monthly income	[28.6 - 1153.8]	75	14.4
Age (months)	[1 - 59]	24	28
Household size	[3 - 14]	7	2
Distance from the facility (km)	[0 - 56]	3	4
Duration of care	[0 -14]	6	2
Age of the Guardian costs (months)	[22 - 73]	33	10

Bivariate analysis showed that the cost of hospital care was significantly higher for malnourished children compared to non-malnourished children ($p < 0.001$). No significant difference in cost was observed according to the child's sex ($p > 0.05$). In contrast, the father's and mother's education levels were significantly associated with the cost of care, with a progressive increase in the median cost as the education level increased ($p < 0.01$ and $p < 0.001$, respectively). Monthly income was not significantly correlated with the cost ($p > 0.05$). In correlation analysis, the age of the caregiver, household size, and duration of care were positively and significantly correlated with the cost, while the distance between the home and the healthcare facility was negatively associated with the cost ($p < 0.001$) (See Table 2).

Table 2. Bivariate analysis of factors associated with the cost of hospital care.

Independent variables	Modalities/Statistics	Median (IQR)	p (test)
Patient status	Malnourished	14.9 (7.7 - 17.3)	0.000 (Mann-Whitney Wilcoxon)
	Non-malnourished	10.5 (6.5 - 12.6)	
Sex of the child	Female	7.8 (5.8 - 11.0)	>0.05 (Mann-Whitney Wilcoxon)
	Male	7.8 (5.8 - 10.8)	
Father' s level of education	None	10.7 (7.7 - 14.1)	<0.01 (Kruskal-Wallis)
	Primary	10.5 (7.9 - 21.1)	
	Secondary	12.9 (10.8 - 25.6)	
	Higher/University	20.0 (8.4 - 45.7)	
Mother' s level of education	None	8.2 (6.5 - 13.5)	<0.001 (Kruskal-Wallis)
	Primary	10.6 (7.7 - 19.3)	
	Secondary	11.2 (7.9 - 26.6)	
	Higher/University	17.3 (14.8 - 38.8)	
Monthly income	r = 0.093	-	>0.05 (Spearman)
Age of the person in charge	r = 0.42	-	<0.001 (Spearman)
Household size	r = 0.20	-	<0.001 (Spearman)
Distance (km)	r = -0.37	-	<0.001 (Spearman)
Duration of care	r = 0.31	-	<0.001 (Spearman)

3.1. Econometric Model

3.1.1. Rational Model

The financial cost of hospital care was a continuous and positive variable with a skewed distribution. To stabilize the variance and allow for a proportional interpretation of the effects, we used the logarithm of the cost as the dependent variable. Multiple linear regression was chosen to estimate the independent effect of each factor on the cost, while simultaneously controlling for the other relevant variables.

3.1.2. Model Specification

The econometric model is formulated as follows:

$$\text{Log}(\text{Cost}) = \beta_0 + \sum \beta_i x_i + \varepsilon_i$$

3.1.3. Model Quality

Adjusted $R^2 = 0.235$: approximately 23.5% of the variation in the total cost is explained by the variables included in the model.

Fisher's Test (Overall): significant, $p < 0.001$, indicating that the overall model is robust.

Multicollinearity: no problems detected, VIF < 2 for all variables.

3.1.4. Final Interpretation

- Maternal education: children whose mothers are educated have a 14% higher hospital cost compared to children whose mothers are not educated.
- Distance from home to hospital: each additional kilometer is associated with an increase in the median cost of approximately 1.6%.
- Duration of treatment: each additional day results in a 6.9% increase in cost.
- Child status: malnourished children have a 19% higher cost compared to well-nourished children.
- Parental age: each additional year of parental age is associated with a 2.8% increase in cost.

4. Discussion

In this study, several sociodemographic and clinical factors were independently associated with the cost of hospital care after multivariate adjustment, highlighting the multifactorial nature of hospital expenditures in paediatric care settings.

The mother's level of education appeared to be a significant determinant of the cost of hospital care (**Table 3**). Children whose mothers were educated had approximately 14% higher hospital costs compared to those whose mothers were not educated. This result is consistent with the literature and demonstrates that more educated parents have a greater ability to recognize signs of severity, request more additional tests, and adhere to more intensive care pathways, which may indirectly increase the use of hospital resources. Previous studies have also reported a positive association between parental education level and direct hospital costs, thus demonstrating an interaction between educational capital, healthcare-seeking behaviors, and treatment intensity [11] [12].

Table 3. Factors associated with the cost of hospital care by multiple linear regression.

Independent variables	β	IC 95 %	p-value
Constant	0.544	0.174 - 0.914	0.004
Mother's instruction (Yes vs. No)	0.135	0.066 - 0.205	<0.001
Distance from home (km)	0.016	0.007- 0.025	<0.001
Duration of treatment (days)	0.067	0.025 - 0.109	0.002
Status (Malnutrited vs. Normally nutrited)	0.17	0.029 - 0.310	0.018
Parental age (years)	0.028	0.020 - 0.036	<0.001

The distance between home and hospital was also positively associated with cost, with a median increase of 1.6% per additional kilometer (**Table 3**). This finding suggests that geographical distance contributes to increased hospital expenditures, likely through delayed admissions or more severe clinical presentations requiring more intensive care. These observations are consistent with those of Moukoumbi Lipenguet *et al.* (2023) [13], who reported that distance increases the consumption of hospital resources. However, some urban settings or those with good healthcare coverage show little or no effect of distance on hospital costs, likely due to better access to primary care and organized transportation [14]. These discrepancies highlight that the impact of distance is highly dependent on the local organization of the healthcare system and the density of healthcare services.

Length of hospital stay was one of the most significant determinants of cost, with each additional day associated with a median increase of 6.8% (**Table 3**) in expenses. This result is expected and well-documented, as length of stay is a direct proxy for the consumption of hospital resources, including nursing care, treatments, additional tests, and accommodation costs. Previous studies have confirmed that length of hospital stay is one of the main drivers of hospital costs, regardless of the initial pathology [15] [16].

The child's nutritional status was also an independent factor in the cost of care. Malnourished children incurred approximately 19% higher costs compared to normally nourished children. This observation is explained by the greater clinical vulnerability of malnourished children, their increased risk of complications, associated infections, and prolonged hospital stays, requiring more intensive care. The literature consistently highlights that pediatric malnutrition is associated with a substantial increase in hospital costs, both in low- and middle-income countries [17] [18].

Finally, parental age was positively associated with hospital costs, with each additional year of parental age associated with a median cost increase of 2.8%. This could reflect older parents' greater ability to understand the healthcare system and request more comprehensive care, or a greater propensity to adhere to additional treatments and tests. [11] [12] also observed that caregivers' sociodemographic characteristics influence hospital consumption and costs. However, some studies have shown that parental age does not always affect costs, especially when decisions are highly standardized by hospital protocols or when the parent has a less decisive role in care [5]. Thus, the influence of parental age can vary depending on the degree of decision-making autonomy and the cultural context.

5. Conclusions

This research identified the key factors explaining the financial cost of hospital care for children aged 0 to 59 months in the Kalonda West health zone, Kasai province (DRC). The findings were:

- The mother's level of education was significantly associated with the cost of care, with a progressive increase in the median cost of approximately 14% as the level of education increased ($\beta = 0.135$; 95% CI 0.066 - 0.205; $p < 0.001$).
- Distance from home: Each additional kilometer between home and hospital was associated with an increase in cost of approximately 1.6% ($\beta = 0.016$; 95% CI 0.007 - 0.025; $p < 0.001$).
- Parental age: Each additional year of parental age was associated with a median cost increase of 2.8% ($\beta = 0.028$; 95% CI 0.020 - 0.036; $p < 0.001$).
- The econometric model robustly explains the cost variations (adjusted R^2 =

0.235).

In a context of poverty, insecurity, and underfunding of the health system, these expenditures represent a significant barrier to accessing care, especially for children suffering from severe acute malnutrition.

6. Study limitations

The sample is limited to hospitalized children, which risks selection bias due to the lack of community data. Furthermore, this study does not distinguish between costs covered by technical and financial partners and those paid by households. Finally, the specific context of the Kalonda West Health District limits the generalizability of these results to other provinces in the country and in Africa.

Conflicts of Interest

The authors declare no conflicts of interest.

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