

Cost Analysis of Malaria Prevention and Treatment Among Pregnant Women with Under-Five Children Attending Antenatal Clinics in Public and Private Health Care Facilities in Amac, Abuja, Nigeria

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Abstract- Malaria remains a major public health and health-financing challenge in Nigeria, with pregnant women experiencing increased vulnerability to infection and its associated maternal and neonatal complications. Evidence on the magnitude of these differences in the Abuja Municipal Area Council (AMAC) remains limited. This study assessed the perceived cost, accessibility and affordability of malaria prevention and treatment services among pregnant women attending selected public and private antenatal clinics in AMAC, Abuja, Nigeria.

Methods - A comparative cross-sectional analytical study was conducted among 300 pregnant women attending antenatal care in selected public and private health facilities across five wards of AMAC: Gwarinpa, Jikwoyi, Nyanya, Karu and Kabusa. The final analytical sample comprised 150 women attending public facilities and 150 attending private facilities. Participants were selected using a multistage sampling approach. Data were collected using a structured interviewer-administered questionnaire covering sociodemographic characteristics, malaria prevention and treatment costs, perceived accessibility and perceived affordability. Descriptive statistics were used to summarize participant characteristics and outcomes. Chi-square tests assessed associations between sociodemographic characteristics and perceived cost/accessibility, while independent-samples t-tests compared mean costs and perception scores between public and private facilities. Statistical significance was set at $p < 0.05$.

Results - The majority of respondents were aged 25–34 years (58.3%), married (85.0%), and had at least secondary education (83.3%). Women attending private facilities were more likely to have tertiary education and higher household income, whereas lower-income respondents were disproportionately represented in public facilities. The mean reported cost of malaria prevention was ₦2,450 (SD ₦850) in public facilities compared with ₦4,600 (SD ₦1,100) in private facilities, representing an absolute

difference of ₦2,150 ($t = -18.72$, $p < 0.001$). Similarly, mean malaria treatment cost was ₦4,850 (SD ₦1,450) in public facilities and ₦8,100 (SD ₦1,750) in private facilities, a difference of ₦3,250 ($t = -17.35$, $p < 0.001$). Perceived accessibility was significantly higher among public-facility attendees (mean 3.28, SD 0.72) than private-facility attendees (mean 2.82, SD 0.64; $t = 5.87$, $p < 0.001$). Perceived affordability was also significantly higher in public facilities (mean 3.76, SD 0.81) than private facilities (mean 2.88, SD 0.84; $t = 9.24$, $p < 0.001$). Educational attainment, occupation, household income and ward of residence were significantly associated with perceived prevention and treatment costs and accessibility.

Conclusion - Malaria prevention and treatment among pregnant women in AMAC impose substantially higher reported financial costs in private healthcare facilities than in public facilities. Socioeconomic position and geographical location were important determinants of perceived cost and accessibility. Strengthening public-sector malaria financing, expanding financial-risk protection, improving commodity availability and establishing effective public-private malaria service arrangements could reduce financial barriers and promote more equitable access to malaria services during pregnancy.

Keywords - Malaria; pregnancy; cost analysis; health economics; antenatal care; affordability; accessibility; out-of-pocket expenditure; public health facilities; private health facilities; Nigeria; Abuja.

I. INTRODUCTION

Malaria continues to impose a substantial health and economic burden on populations living in endemic regions, particularly in sub-Saharan Africa. The burden is especially important among pregnant women because physiological and immunological

changes associated with pregnancy increase susceptibility to *Plasmodium falciparum* infection and can increase the risk of maternal anaemia, severe disease and adverse pregnancy outcomes. Maternal malaria is also associated with fetal growth restriction, low birth weight, preterm delivery, stillbirth and other adverse neonatal outcomes. The World Health Organization (WHO) therefore recommends a comprehensive package of malaria interventions during pregnancy, including insecticide-treated nets (ITNs), effective diagnosis and treatment of malaria illness, and intermittent preventive treatment in pregnancy with sulfadoxine-pyrimethamine (IPTp-SP) in areas of moderate-to-high transmission.

The continuing importance of malaria control in Nigeria is underscored by the country's position among the highest-burden malaria settings globally. The WHO's most recent malaria reporting continues to identify Nigeria as a major contributor to the global malaria burden. The 2025 WHO malaria reporting also highlights persistent challenges in prevention, case management, programme financing and the emerging threat of antimalarial drug resistance.

The burden of malaria is not restricted to its clinical consequences. Malaria creates direct and indirect economic costs for households and health systems. Direct costs include expenditure on consultation, laboratory investigations, medicines, hospitalization and transportation. Indirect costs may include income losses, time spent seeking treatment, productivity losses and costs incurred by caregivers. These costs can be particularly consequential for households relying predominantly on out-of-pocket payment for healthcare.

Evidence from Nigeria demonstrates the economic importance of malaria beyond the cost of medicines alone. Uzochukwu and colleagues found substantial household and health-system costs associated with malaria, with indirect household costs constituting an important component of the overall burden. In their study, household expenditure on malaria treatment included direct medical expenditure, transportation and productivity losses, while provider costs included medicines, medical supplies, diagnostic services, personnel and infrastructure.

Earlier Nigerian evidence has similarly demonstrated that malaria-related expenditure disproportionately affects poorer households because healthcare payments consume a larger proportion of their available resources. Studies examining socioeconomic inequalities in malaria expenditure have shown that malaria constitutes a burden across socioeconomic groups but can be especially consequential among poorer households.

The economic burden is particularly important during pregnancy because pregnant women may require repeated contact with the health system for antenatal care, preventive treatment, malaria diagnosis and treatment of febrile illness. A woman who experiences malaria during pregnancy may incur several categories of expenditure, including transportation to a facility, consultation, laboratory investigations, medicines, additional visits and, in severe cases, hospitalization. These costs may be compounded by household responsibilities and lost productivity.

1.1 STUDY RATIONALE

Although malaria cost studies have been conducted in different parts of Nigeria, relatively limited evidence directly compares the financial experience of pregnant women receiving malaria-related services through public and private antenatal facilities within the same urban administrative setting. Existing studies also frequently focus on malaria treatment rather than the combined prevention-and-treatment pathway.

This study addresses this gap by comparing reported malaria prevention and treatment costs across public and private facilities while simultaneously examining accessibility and affordability. The findings have relevance for health financing, maternal health programming, malaria control and universal health coverage.

1.2 RESEARCH QUESTIONS

The study addressed five principal questions:

1. What is the reported cost of malaria prevention among pregnant women attending public and private antenatal clinics in AMAC?

2. What is the reported cost of malaria treatment among pregnant women attending public and private antenatal clinics?
3. Does perceived accessibility differ between public and private facilities?
4. Does perceived affordability differ between public and private facilities?
5. Which sociodemographic characteristics are associated with perceived malaria prevention and treatment costs and accessibility?

1.3 STUDY OBJECTIVES

The study aimed to:

1. Determine the reported cost of malaria prevention among pregnant women attending selected public and private health facilities in AMAC.
2. Determine the reported cost of malaria treatment among pregnant women attending selected public and private health facilities.
3. Compare perceived accessibility of malaria prevention and treatment services between public and private facilities.
4. Compare perceived affordability of malaria prevention and treatment services between public and private facilities.
5. Determine the association between selected sociodemographic characteristics and perceived malaria-related costs and accessibility.

II. MATERIALS AND METHODS

2.1 STUDY AREA

The study was conducted in Abuja Municipal Area Council (AMAC), one of the six Area Councils of the Federal Capital Territory (FCT), Nigeria. AMAC encompasses heterogeneous urban, peri-urban and semi-urban communities and contains a mixture of government-owned and privately operated health facilities. Five wards were represented in the study: Gwarinpa, Jikwoyi, Nyanya, Karu and Kabusa. These locations were selected to capture variation in population density, socioeconomic conditions, geographic accessibility and availability of both public and private antenatal services.

The healthcare environment in AMAC provides an appropriate context for economic comparison because pregnant women can obtain antenatal and malaria-related services through different provider arrangements. Public primary healthcare facilities provide government-supported maternal and malaria services, while private clinics and hospitals provide services largely financed through direct payment, insurance and other private financing arrangements.

2.2 STUDY DESIGN

A comparative cross-sectional analytical design was used. The design enabled comparison of malaria prevention and treatment costs, accessibility and affordability among pregnant women attending public and private health facilities.

The study was primarily quantitative. Data were collected during a defined study period, and each participant was assessed once. The design permitted examination of associations between socioeconomic characteristics and perceived cost/accessibility but did not establish temporal or causal relationships.

2.3 STUDY POPULATION

The study population consisted of pregnant women aged 15–49 years attending antenatal clinics in selected public and private health facilities in AMAC. The intended study population included pregnant women receiving malaria prevention and/or treatment services during the current pregnancy. The dissertation title additionally identifies women with under-five children; however, the supplied Results tables do not contain a reported variable establishing the presence or number of under-five children. Consequently, this characteristic was not incorporated as an analytical variable in this manuscript.

2.3.1 INCLUSION CRITERIA

Participants were eligible if they:

- were pregnant and aged 15–49 years;
- were registered for antenatal care at a selected facility;
- had attended at least one ANC visit during the current pregnancy;
- had received or sought malaria prevention or treatment services; and
- provided informed consent.

2.3.2 EXCLUSION CRITERIA

Women were excluded if they:

- were critically ill at the time of interview;
- were unable to communicate adequately with the research team;
- declined consent; or
- were temporary visitors who were not receiving routine ANC services at the selected facility.

2.4 SAMPLE SIZE DETERMINATION

The initial minimum sample size was estimated using Cochran's formula for a single population proportion:

$$n = \frac{Z^2 p(1-p)}{d^2}$$

where:

- n = minimum required sample size;
- Z = standard normal deviate corresponding to 95% confidence level = 1.96;
- p = estimated malaria prevalence of 22% = 0.22;
- $(1-p)$ = 0.78; and
- d = desired precision = 0.05.

The sample was increased to 300 to improve statistical precision, accommodate potential non-response and facilitate balanced comparison between facility types. The final analytical sample consisted of 300 respondents, with 150 attending public facilities and 150 attending private facilities.

2.5 SAMPLING TECHNIQUE

A multistage sampling procedure was used.

First, five wards—Gwarinpa, Jikwoyi, Nyanya, Karu and Kabusa—were purposively selected to reflect geographical and socioeconomic diversity.

Second, eligible public and private healthcare facilities providing antenatal services were selected within the wards.

Third, eligible pregnant women attending ANC during the data-collection period were approached and recruited systematically until the required facility allocation was achieved.

The final analysis compared two equally sized groups: 150 women attending public facilities and 150 women attending private facilities.

2.6 DATA COLLECTION INSTRUMENT

Data were collected using a structured interviewer-administered questionnaire developed from the study objectives, relevant malaria literature and malaria prevention and treatment principles.

The questionnaire contained sections covering:

1. sociodemographic characteristics;
2. malaria prevention costs;
3. malaria treatment costs;
4. perceived accessibility;
5. perceived affordability; and
6. satisfaction with malaria-related services.

Cost questions covered expenditure associated with medicines, diagnostic testing, consultation, transportation, follow-up and other malaria-related services.

Accessibility was assessed using a four-point response scale ranging from very difficult to very easy. Affordability was assessed using a five-point scale ranging from very unaffordable to very affordable.

2.7 DATA COLLECTION PROCEDURES

Trained research assistants administered questionnaires to eligible participants during ANC sessions. Interviews were conducted in settings that permitted reasonable privacy and confidentiality. Before commencement of the main survey, the questionnaire was pretested outside the selected study facilities. Data collectors were trained on questionnaire administration, ethical conduct, respondent communication and quality-control procedures. Completed questionnaires were reviewed for completeness, consistency and legibility. Data were subsequently coded and entered into a statistical database for analysis.

2.8 VARIABLES

PRIMARY OUTCOME VARIABLES

The principal outcomes were:

- perceived/reporting cost of malaria prevention;
- perceived/reporting cost of malaria treatment;
- perceived accessibility of malaria prevention and treatment;
- perceived affordability of malaria prevention and treatment.

EXPLANATORY VARIABLES

These included:

- age;
- gestational age;
- educational attainment;
- marital status;
- occupation;
- monthly household income;
- parity;
- ward of residence; and
- facility type.

2.9 DATA ANALYSIS

Data were analysed using descriptive and inferential statistical techniques.

Categorical variables were summarized using frequencies and percentages. Continuous variables were summarized using means and standard deviations. Chi-square tests were used to examine associations between sociodemographic

characteristics and categorical measures of perceived cost or accessibility.

Independent-samples *t*-tests were used to compare mean prevention costs, treatment costs, accessibility scores and affordability scores between public and private facilities.

The statistical significance threshold was set at $p < 0.05$.

Where appropriate, the mean differences and approximate 95% confidence intervals were calculated from the reported group means, standard deviations and sample sizes.

2.10 ETHICAL CONSIDERATIONS

Ethical approval was obtained from the appropriate health research ethics authority before commencement of the study. Administrative permission was obtained from participating health facilities. Participation was voluntary. Participants received information about the study and provided informed consent before interview. Confidentiality and anonymity were maintained, and information collected was used for research purposes.

III. RESULTS

1.1. Table 1: Socio-Demographic Characteristics of Pregnant Women by Facility Type in AMAC, FCT, Nigeria (N = 300)

Variable	Category	Public Facilities (n=150)	%	Private Facilities (n=150)	%	Total (N=300)	%
Age (Years)	15–24	35	23.3	20	13.3	55	18.3
	25–34	85	56.7	90	60.0	175	58.3
	35–44	25	16.7	35	23.3	60	20.0
	45+	5	3.3	5	3.3	10	3.3
	Total	150	100.0	150	100.0	300	100.0
Gestational Age	1–12 Weeks	15	10.0	10	6.7	25	8.3
	13–24 Weeks	60	40.0	55	36.7	115	38.3
	25–36 Weeks	55	36.7	60	40.0	115	38.3
	37–42 Weeks	20	13.3	25	16.6	45	15.0
	Total	150	100.0	150	100.0	300	100.0
Educational Level	No Formal Education	10	6.7	5	3.3	15	5.0
	Primary	25	16.7	10	6.7	35	11.7
	Secondary	70	46.7	50	33.3	120	40.0

Variable	Category	Public Facilities (n=150)	%	Private Facilities (n=150)	%	Total (N=300)	%
Marital Status	Tertiary	45	30.0	85	56.7	130	43.3
	Total	150	100.0	150	100.0	300	100.0
	Single	15	10.0	10	6.7	25	8.3
	Married	125	83.3	130	86.7	255	85.0
	Divorced/Separated	7	4.7	6	4.0	13	4.3
	Widowed	3	2.0	4	2.6	7	2.3
Occupation	Total	150	100.0	150	100.0	300	100.0
	Unemployed	35	23.3	15	10.0	50	16.7
	Self-Employed	50	33.3	45	30.0	95	31.7
	Government Employee	25	16.7	40	26.7	65	21.7
	Private Employee	20	13.3	35	23.3	55	18.3
	Student	20	13.3	15	10.0	35	11.6
Monthly Household Income (₦)	Total	150	100.0	150	100.0	300	100.0
	<50,000	55	36.7	20	13.3	75	25.0
	50,000–100,000	50	33.3	35	23.3	85	28.3
	101,000–200,000	30	20.0	50	33.3	80	26.7
	>200,000	15	10.0	45	30.0	60	20.0
	Total	150	100.0	150	100.0	300	100.0
Parity	Primigravida (0)	30	20.0	25	16.7	55	18.3
	1–2 Children	60	40.0	55	36.7	115	38.3
	3–4 Children	40	26.7	45	30.0	85	28.3
	5+ Children	20	13.3	25	16.6	45	15.0
	Total	150	100.0	150	100.0	300	100.0
Ward of Residence	Gwarinpa	30	20.0	30	20.0	60	20.0
	Jikwoyi	32	21.3	28	18.7	60	20.0
	Nyanya	35	23.3	35	23.3	70	23.3
	Karu	28	18.7	30	20.0	58	19.3
	Kabusa	25	16.7	27	18.0	52	17.4
	Total	150	100.0	150	100.0	300	

4.2. Table Showing Chi-Square Analysis of Socio-Demographic Variables on Cost of Malaria Prevention Among Pregnant Women in AMAC, FCT, Nigeria (N = 300)

Socio-Demographic Variable	Category	Low-Cost n (%)	High-Cost n (%)	χ^2	df	p-value
Age Group	15–24 years	38 (69.1)	17 (30.9)	6.24	3	0.101
	25–34 years	102 (58.3)	73 (41.7)			

Socio-Demographic Variable	Category	Low-Cost n (%)	High-Cost n (%)	χ^2	df	p-value
Gestational Age	35–44 years	28 (46.7)	32 (53.3)	4.18	3	0.243
	45+ years	4 (40.0)	6 (60.0)			
	1–12 weeks	16 (64.0)	9 (36.0)			
	13–24 weeks	70 (60.9)	45 (39.1)			
	25–36 weeks	63 (54.8)	52 (45.2)			
Educational Level	37–42 weeks	23 (51.1)	22 (48.9)	18.67	3	<0.001*
	No Formal Education	4 (26.7)	11 (73.3)			
	Primary Education	13 (37.1)	22 (62.9)			
	Secondary Education	72 (60.0)	48 (40.0)			
	Tertiary Education	83 (63.8)	47 (36.2)			
Marital Status	Single	13 (52.0)	12 (48.0)	3.11	3	0.375
	Married	150 (58.8)	105 (41.2)			
	Divorced/Separated	6 (46.2)	7 (53.8)			
	Widowed	3 (42.9)	4 (57.1)			
	Unemployed	20 (40.0)	30 (60.0)	15.82	4	0.003*
Occupation	Self-Employed	55 (57.9)	40 (42.1)			
	Government Employee	45 (69.2)	20 (30.8)			
	Private Employee	32 (58.2)	23 (41.8)			
	Student	20 (57.1)	15 (42.9)			
Household Income (₦)	<50,000	20 (26.7)	55 (73.3)	31.46	3	<0.001*
	50,000–100,000	42 (49.4)	43 (50.6)			
	101,000–200,000	55 (68.8)	25 (31.2)			
	>200,000	55 (91.7)	5 (8.3)			
	Primigravida (0)	35 (63.6)	20 (36.4)	5.37	3	0.146
Parity	1–2 Children	68 (59.1)	47 (40.9)			
	3–4 Children	46 (54.1)	39 (45.9)			
	5+ Children	23 (51.1)	22 (48.9)			
	Gwarinpa	42 (70.0)	18 (30.0)	10.94	4	0.027*
Ward of Residence	Jikwoyi	35 (58.3)	25 (41.7)			
	Nyanya	38 (54.3)	32 (45.7)			
	Karu	30 (51.7)	28 (48.3)			
	Kabusa	27 (51.9)	25 (48.1)			

Level of significance = 0.05

*Significant at $p < 0.05$

Summary of Significant Findings

- Educational Level ($\chi^2 = 18.67$, $p < 0.001$): Women with tertiary and secondary education were more likely to perceive malaria prevention services as affordable than women with no formal or primary education.

- Occupation ($\chi^2 = 15.82$, $p = 0.003$): Government employees and self-employed women reported lower malaria prevention costs compared to unemployed women.
- Household Income ($\chi^2 = 31.46$, $p < 0.001$): Higher-income households perceived malaria prevention services as more affordable than lower-income households.
- Ward of Residence ($\chi^2 = 10.94$, $p = 0.027$): Significant geographical differences existed in the perception of malaria prevention costs across wards.

4.3. Table Showing Chi-Square Analysis of Socio-Demographic Variables and Perceived Cost of Malaria Treatment Among Pregnant Women in AMAC, FCT, Nigeria (N = 300)

Socio-Demographic Variable	Category	Low-Cost n (%)	High-Cost n (%)	χ^2	df	p-value
Age Group	15–24 years	32 (58.2)	23 (41.8)	5.82	3	0.121
	25–34 years	98 (56.0)	77 (44.0)			
	35–44 years	26 (43.3)	34 (56.7)			
	45+ years	4 (40.0)	6 (60.0)			
Gestational Age	1–12 weeks	14 (56.0)	11 (44.0)	3.05	3	0.383
	13–24 weeks	65 (56.5)	50 (43.5)			
	25–36 weeks	61 (53.0)	54 (47.0)			
	37–42 weeks	20 (44.4)	25 (55.6)			
Educational Level	No Formal Education	3 (20.0)	12 (80.0)	22.46	3	<0.001*
	Primary Education	10 (28.6)	25 (71.4)			
	Secondary Education	65 (54.2)	55 (45.8)			
	Tertiary Education	82 (63.1)	48 (36.9)			
Marital Status	Single	12 (48.0)	13 (52.0)	2.92	3	0.404
	Married	138 (54.1)	117 (45.9)			
	Divorced/Separated	6 (46.2)	7 (53.8)			
	Widowed	4 (57.1)	3 (42.9)			
Occupation	Unemployed	15 (30.0)	35 (70.0)	17.12	4	0.002*
	Self-Employed	50 (52.6)	45 (47.4)			
	Government Employee	48 (73.8)	17 (26.2)			
	Private Employee	30 (54.5)	25 (45.5)			
	Student	17 (48.6)	18 (51.4)			
Household Income (₦)	<50,000	15 (20.0)	60 (80.0)	28.34	3	<0.001*
	₦50,000–₦100,000	35 (41.2)	50 (58.8)			
	₦101,000–₦200,000	55 (68.8)	25 (31.2)			
	>₦200,000	55 (91.7)	5 (8.3)			
Parity	Primigravida (0)	34 (61.8)	21 (38.2)	3.81	3	0.282
	1–2 Children	63 (54.8)	52 (45.2)			
	3–4 Children	42 (49.4)	43 (50.6)			
	5+ Children	21 (46.7)	24 (53.3)			
Ward of Residence	Gwarinpa	40 (66.7)	20 (33.3)	11.58	4	0.021*
	Jikwoyi	32 (53.3)	28 (46.7)			

Socio-Demographic Variable Category	Low-Cost n (%)	High-Cost n (%)	χ^2	df	p-value
Nyanya	35 (50.0)	35 (50.0)			
Karu	28 (48.3)	30 (51.7)			
Kabusa	25 (48.1)	27 (51.9)			

Level of Significance = 0.05

*Significant at $p < 0.05$

compared with women with lower education, unemployment, and lower income levels.

Interpretation of Findings

The Chi-square analysis showed that educational level ($\chi^2 = 22.46$, $p < 0.001$), occupation ($\chi^2 = 17.12$, $p = 0.002$), household income ($\chi^2 = 28.34$, $p < 0.001$), and ward of residence ($\chi^2 = 11.58$, $p = 0.021$) were significantly associated with the perceived cost of malaria treatment among pregnant women.

Women with tertiary education, formal employment, and higher household incomes were more likely to perceive malaria treatment costs as affordable

However, age group ($\chi^2 = 5.82$, $p = 0.121$), gestational age ($\chi^2 = 3.05$, $p = 0.383$), marital status ($\chi^2 = 2.92$, $p = 0.404$), and parity ($\chi^2 = 3.81$, $p = 0.282$) were not significantly associated with the perceived cost of malaria treatment. This suggests that socioeconomic status and geographical location are stronger determinants of cost perception than reproductive or demographic characteristics among pregnant women attending antenatal clinics in AMAC.

4.4. Table Chi-Square Analysis of Socio-Demographic Variables and Respondents' Perceived Accessibility (High vs. Low) to Malaria Prevention and Treatment Services Among Pregnant Women in AMAC, FCT, Nigeria (N = 300)

Socio-Demographic Variable	Category	High Accessibility n (%)	Low Accessibility n (%)	χ^2	df	p-value
Age Group (Years)	15–24	38 (69.1)	17 (30.9)	6.18	3	0.103
	25–34	112 (64.0)	63 (36.0)			
	35–44	32 (53.3)	28 (46.7)			
	≥45	5 (50.0)	5 (50.0)			
Gestational Age	1–12 weeks	16 (64.0)	9 (36.0)	3.67	3	0.299
	13–24 weeks	72 (62.6)	43 (37.4)			
	25–36 weeks	68 (59.1)	47 (40.9)			
	37–42 weeks	31 (68.9)	14 (31.1)			
Educational Level	No Formal Education	5 (33.3)	10 (66.7)	24.71	3	<0.001*
	Primary	15 (42.9)	20 (57.1)			
	Secondary	74 (61.7)	46 (38.3)			
	Tertiary	93 (71.5)	37 (28.5)			
Marital Status	Single	14 (56.0)	11 (44.0)	3.14	3	0.371
	Married	162 (63.5)	93 (36.5)			
	Divorced/Separated	7 (53.8)	6 (46.2)			
	Widowed	4 (57.1)	3 (42.9)			
Occupation	Unemployed	24 (48.0)	26 (52.0)	18.93	4	0.001*
	Self-employed	60 (63.2)	35 (36.8)			

Socio-Demographic Variable	Category	High Accessibility (%)	n	Low Accessibility (%)	n	χ^2	df	p-value
	Government Employee	50 (76.9)		15 (23.1)				
	Private Employee	35 (63.6)		20 (36.4)				
	Student	18 (51.4)		17 (48.6)				
Monthly Income	Household < ₦50,000	28 (37.3)		47 (62.7)		34.85	3	<0.001*
	₦50,000–₦100,000	48 (56.5)		37 (43.5)				
	₦101,000–₦200,000	61 (76.3)		19 (23.7)				
	> ₦200,000	50 (83.3)		10 (16.7)				
Parity	Primigravida	38 (69.1)		17 (30.9)		4.82	3	0.185
	1–2 Children	70 (60.9)		45 (39.1)				
	3–4 Children	49 (57.6)		36 (42.4)				
	≥5 Children	30 (66.7)		15 (33.3)				
Ward of Residence	Gwarinpa	45 (75.0)		15 (25.0)		11.42	4	0.022*
	Jikwoyi	36 (60.0)		24 (40.0)				
	Nyanya	41 (58.6)		29 (41.4)				
	Karu	34 (58.6)		24 (41.4)				
	Kabusa	31 (59.6)		21 (40.4)				

Level of significance: $\alpha = 0.05$

* Statistically significant ($p < 0.05$)

Summary of Findings

- Educational Level: $\chi^2 = 24.71$, $p < 0.001$ — significant association with perceived accessibility.
- Occupation: $\chi^2 = 18.93$, $p = 0.001$ — significant association with perceived accessibility.

- Monthly Household Income: $\chi^2 = 34.85$, $p < 0.001$ — significant association with perceived accessibility.

- Ward of Residence: $\chi^2 = 11.42$, $p = 0.022$ — significant association with perceived accessibility.

4.5. Table showing Independent Samples T-Test Comparing Cost of Malaria Prevention Between Public and Private Health Facilities Among Pregnant Women in AMAC, FCT, Nigeria

Variable	Facility Type	N	Mean (₦)	SD	Mean Difference	t-value	p-value
Cost of Malaria Prevention	Public	150	2,450	850	-2,150	-18.72	<0.001*
	Private	150	4,600	1,100			

Interpretation: There was a statistically significant difference in the mean cost of malaria prevention between public and private facilities ($t = -18.72$, $p < 0.001$). Pregnant women attending private facilities

reported significantly higher malaria prevention costs than those attending public facilities.

4.6. Table showing Independent Samples T-Test Comparing Cost of Malaria Treatment Between Public and Private Health Facilities Among Pregnant Women in AMAC Area Council, FCT, Nigeria

Variable	Facility Type	N	Mean (₦)	SD	Mean Difference	t-value	p-value
Cost of Malaria Treatment	Public	150	4,850	1,450	-3,250	-17.35	<0.001*
	Private	150	8,100	1,750			

Interpretation: A statistically significant difference was observed in the mean cost of malaria treatment between public and private facilities ($t = -17.35$, $p < 0.001$). The average treatment cost was considerably higher among women attending private facilities.

4.7 Table showing Independent Samples T-Test Comparing Perceived Accessibility of Malaria Prevention and Treatment Services Between Public and Private Health Facilities

(Accessibility score based on a 4-point scale: 1 = Very Difficult, 2 = Difficult, 3 = Easy, 4 = Very Easy)

Variable	Facility Type	N	Mean Score	SD	Mean Difference	t-value	p-value
Perceived Accessibility	Public	150	3.28	0.72	0.46	5.87	<0.001*
	Private	150	2.82	0.64			

Interpretation: Pregnant women attending public facilities reported significantly higher accessibility to malaria prevention and treatment services than those attending private facilities ($t = 5.87$, $p < 0.001$).

4.8 Table showing Independent Samples T-Test Comparing Perceived Affordability of Malaria Prevention and Treatment Services Between Public and Private Health Facilities

(Affordability score based on a 5-point Likert scale: 1 = Very Unaffordable to 5 = Very Affordable)

Variable	Facility Type	N	Mean Score	SD	Mean Difference	t-value	p-value
Perceived Affordability	Public	150	3.76	0.81	0.88	9.24	<0.001*
	Private	150	2.88	0.84			

Interpretation: The mean affordability score was significantly higher among women attending public facilities than those attending private facilities ($t = 9.24$, $p < 0.001$). This suggests that malaria prevention and treatment services were perceived to be more affordable in public facilities.

Summary of Independent T-Test Results

Outcome Variable	Public Mean	Private Mean	t-value	p-value	Significance
Cost of Malaria Prevention (₦)	2,450	4,600	-18.72	<0.001	Significant
Cost of Malaria Treatment (₦)	4,850	8,100	-17.35	<0.001	Significant
Perceived Accessibility Score	3.28	2.82	5.87	<0.001	Significant
Perceived Affordability Score	3.76	2.88	9.24	<0.001	Significant

Overall Interpretation

The independent samples t-test demonstrated statistically significant differences between pregnant women attending public and private health facilities across all four domains examined. Women attending

private facilities incurred significantly higher costs for both malaria prevention and treatment services, while women attending public facilities reported significantly better accessibility and affordability of malaria-related healthcare services. These findings

suggest that public facilities may provide a more economically accessible

IV. DISCUSSION

This study provides evidence that malaria prevention and treatment services are associated with substantially different financial experiences depending on whether pregnant women receive care in public or private facilities in AMAC. The most important finding was that women attending private facilities reported substantially higher costs for both prevention and treatment. At the same time, public-facility attendees reported better affordability and accessibility.

The finding that malaria prevention was more expensive in private facilities is consistent with the broader structure of Nigeria's mixed health system. Public facilities may receive government and development-partner support for malaria commodities, maternal services and primary healthcare activities. Private facilities, by contrast, commonly rely more heavily on user charges to finance medicines, laboratory services, personnel and operational expenses.

The magnitude of the difference observed in this study is important from a health-equity perspective. A mean prevention expenditure of ₦4,600 in private facilities compared with ₦2,450 in public facilities represents a difference of ₦2,150 per respondent. For households with limited income, repeated antenatal contacts can transform apparently modest individual payments into substantial cumulative expenditure.

The treatment difference was even larger. Women attending private facilities reported an average malaria treatment cost of ₦8,100 compared with ₦4,850 in public facilities. The ₦3,250 difference is economically meaningful, particularly in a setting where out-of-pocket payment remains important in healthcare financing.

Earlier Nigerian research has demonstrated that malaria expenditure includes much more than medicine purchases. Household economic burden studies have identified medicines, diagnostics,

administrative charges, transport and productivity losses as components of the total cost of malaria.

The present study therefore probably represents only part of the true economic burden because the available dataset focused principally on reported service-related expenditure and perceptions. Transportation, waiting time, productivity losses, childcare responsibilities and costs of care sought elsewhere were not comprehensively incorporated into the final cost estimates.

This limitation is particularly important for pregnant women with young children. Women who have children below five years may face additional opportunity costs because healthcare attendance requires arranging childcare, transportation and household responsibilities. However, because the supplied dataset does not report a specific under-five-child variable, the present analysis cannot quantify this additional burden.

The observed association between household income and perceived malaria costs was particularly strong. Women from households earning less than ₦50,000 were substantially more likely to classify prevention and treatment as high cost than women from higher-income households. This finding reinforces the principle that affordability is relative to household economic capacity rather than simply the nominal price of a service.

A malaria service costing ₦5,000 may represent a modest expenditure for a high-income household but a substantial financial shock for a household with limited income. Consequently, policies focused solely on reducing absolute prices may not fully address inequity. Financial protection mechanisms must also account for socioeconomic differences.

The association between education and perceived cost is similarly important. Women with tertiary education were more likely to perceive malaria services as affordable and accessible than women with lower levels of education. Education may influence health literacy, knowledge of available services, ability to navigate health financing arrangements and employment opportunities.

The relationship between occupation and perceived cost reinforces this interpretation. Unemployed women were more likely to report high costs and poorer accessibility, whereas government employees reported more favourable experiences. Stable employment may increase household purchasing power and reduce the financial consequences of healthcare expenditure.

The geographical association observed across wards also indicates that cost and accessibility are not solely individual-level phenomena. Health facility distribution, transport networks, local socioeconomic conditions, service availability and commodity supply may vary across communities.

5.1 Public versus private sector financing

The public-private difference deserves careful interpretation. The lower cost reported in public facilities should not automatically be interpreted as evidence that public facilities provide universally superior care. Private facilities may provide services that users value, including shorter waiting times, longer opening hours, improved amenities, greater privacy or perceived responsiveness.

The economic question is therefore not simply which sector is cheaper but whether differences in cost are proportionate to differences in quality, convenience and health outcomes.

Nevertheless, the affordability findings indicate that higher private-sector prices can create financial barriers. If private providers are disproportionately used by women who can afford higher payments, while poorer women are concentrated in public facilities, differences in service quality may potentially reinforce socioeconomic inequalities.

5.2 Accessibility paradox

An important finding was that public facilities were perceived as more accessible than private facilities despite the common perception that private providers can offer greater convenience.

This finding may reflect the integration of public facilities into government-supported antenatal and malaria programmes. Public facilities may provide

IPTp, malaria education, diagnostic services and preventive commodities through routine ANC platforms.

WHO emphasizes the integration of malaria prevention into antenatal services and recognizes ANC as an important platform for delivering IPTp-SP. The result should nevertheless be interpreted cautiously because accessibility in this study was based on respondents' perceptions rather than objective measurements such as distance, travel time, waiting time, commodity availability or facility density.

5.3 Affordability and financial protection

The difference in affordability scores was one of the strongest findings in the study. Public-facility attendees recorded a mean affordability score of 3.76 compared with 2.88 among private-facility attendees. This finding has direct implications for universal health coverage. WHO and international health-financing frameworks emphasize that access to essential health services should not result in financial hardship. Malaria prevention during pregnancy is particularly suitable for financial protection because preventive interventions can avert later treatment costs and adverse maternal and neonatal outcomes.

The finding is also consistent with evidence showing that households may rely on savings or reduction of other expenditures to finance malaria treatment. A Nigerian study of coping mechanisms found that malaria treatment was predominantly financed through out-of-pocket payments and that households commonly used savings and reduced expenditure on other needs to cope with treatment costs.

5.4 Implications for malaria prevention

WHO identifies IPTp-SP as a highly cost-effective intervention in malaria-endemic pregnancy settings.

The implication for AMAC is that financial barriers to preventive interventions should be minimized because prevention may reduce the need for more expensive treatment later.

The delivery of IPTp through ANC should therefore be strengthened, while alternative delivery channels

can complement ANC where women have inadequate contact with formal services. WHO's community-delivery guidance specifically identifies community health workers as a possible complementary mechanism.

Similarly, ITN availability should be protected through reliable procurement and distribution systems. Stock-outs can shift costs from the health system to households and undermine the apparent affordability of public-sector services.

5.5 Implications for malaria treatment

The higher treatment expenditure observed in private facilities suggests the need for greater financial protection for women who use private providers. This is important because private facilities may remain an important source of care in urban settings.

Policy should therefore avoid assuming that strengthening public facilities alone will eliminate financial barriers. Instead, public-private approaches could include standardized treatment protocols, quality assurance, commodity access arrangements and transparent pricing mechanisms.

The 2025 WHO malaria report also emphasizes the continuing importance of quality-assured malaria treatment and the emerging threat of antimalarial resistance.

5.6 Economic burden beyond direct expenditure

One of the central contributions of this study is to demonstrate the importance of examining malaria through a health-economic rather than purely clinical lens.

A woman who spends ₦8,100 on malaria treatment does not necessarily experience only an ₦8,100 burden. She may also spend money on transportation, lose income during clinic attendance, pay for childcare, purchase medicines unavailable at the facility, or make additional visits.

Previous Nigerian cost-of-illness evidence demonstrated that indirect costs can exceed direct medical expenditure. In Enugu, for example, indirect

household costs associated with malaria were a major contributor to total household expenditure.

A recent systematic review of malaria cost-of-illness evidence in Africa similarly emphasizes that malaria generates economic costs at household, health-system and societal levels and that cost estimates vary substantially according to perspective and methodology.

Future studies in AMAC should therefore adopt a comprehensive societal perspective incorporating direct medical, direct non-medical and indirect costs.

V. HEALTH-ECONOMIC INTERPRETATION

The findings can be interpreted using the concept of opportunity cost. Every naira spent on malaria prevention or treatment represents resources that cannot simultaneously be spent on food, education, transportation, housing or other healthcare needs.

This is especially relevant among low-income households. The observed association between income and perceived affordability suggests that malaria-related expenditures may impose a disproportionately greater welfare burden on poorer households.

The public sector therefore performs an important redistributive function when it provides subsidized malaria services. Government financing can shift part of the cost away from households and toward collective financing mechanisms.

However, subsidies are only effective if commodities and services are actually available. A nominally free IPTp dose that is unavailable at a public facility may result in private purchase and therefore transfer the financial burden back to the household.

This suggests that malaria financing should be assessed using both:

1. financial protection, and
2. effective availability of services and commodities.

A comprehensive financing strategy should therefore address procurement, supply chains, provider financing, insurance coverage, user charges and monitoring of household expenditure.

VI. POLICY AND PROGRAMME IMPLICATIONS

7.1 Strengthen public financing of malaria in pregnancy

Government and development partners should sustain financing for malaria interventions integrated into antenatal care, particularly IPTp, ITNs, diagnostic commodities and quality-assured treatment.

7.2 Expand financial-risk protection

Malaria services for pregnant women should be incorporated comprehensively into maternal health financing and health-insurance arrangements. Financial protection should prioritize low-income women.

7.3 Reduce stock-outs

Stock-outs can convert nominally subsidized services into out-of-pocket expenditure. Commodity availability should therefore become a core performance indicator for malaria and ANC programmes.

7.4 Strengthen public-private collaboration

Private providers should be incorporated into malaria financing and programme structures through appropriate accreditation, reporting, quality assurance and commodity-access mechanisms.

7.5 Develop transparent private-sector pricing

Appropriate regulatory mechanisms should encourage transparent pricing for malaria diagnostics, consultations and medicines in private facilities.

7.6 Target socioeconomic vulnerability

Women with low education, unemployment and low household income should receive targeted health education and financial support.

7.7 Address geographical inequities

Differences across wards indicate a need for geographically targeted malaria and maternal-health planning.

7.8 Integrate cost monitoring into routine programmes
Routine malaria monitoring should include household expenditure, affordability and service accessibility indicators rather than focusing exclusively on clinical coverage.

VII. STRENGTHS OF THE STUDY

The study has several strengths.

First, it directly compares public and private healthcare facilities within the same geographic setting, reducing some of the contextual differences that can complicate comparisons across different regions.

Second, the sample included 300 respondents, providing a substantial facility-based sample for comparative analysis.

Third, the study examined both prevention and treatment rather than focusing exclusively on malaria illness.

Fourth, it incorporated affordability and accessibility alongside monetary costs, providing a broader health-economic perspective.

Finally, analysis of socioeconomic characteristics demonstrated that the burden of malaria expenditure is socially patterned rather than evenly distributed across the population.

VIII. LIMITATIONS

Several limitations should be considered.

First, the cross-sectional design prevents causal inference. The associations between income, education, occupation and perceived cost cannot establish that these characteristics caused differences in perceptions.

Second, cost information was self-reported and may therefore be affected by recall or reporting bias.

Third, the study primarily captured direct reported expenditure and did not comprehensively quantify indirect costs such as productivity losses, waiting time, childcare and household opportunity costs.

Fourth, the analysis did not include objective measures of facility quality, distance, waiting time, drug availability or treatment outcomes.

Fifth, because the study was facility-based, women who did not attend ANC or who sought malaria care outside formal facilities were not represented.

Sixth, socioeconomic differences between public- and private-facility attendees may confound the crude comparison of costs. For example, private-facility users had higher educational attainment and household income. Future studies should use multivariable regression or propensity-score methods to adjust for such differences.

Finally, the supplied dissertation materials do not report the number or proportion of respondents with under-five children. Since this characteristic appears in the study title but not in the reported analytical tables, it should be verified against the original dataset before journal submission.

IX. CONCLUSION

This study demonstrates substantial differences in the reported cost and perceived affordability of malaria prevention and treatment among pregnant women attending public and private healthcare facilities in AMAC, Abuja.

The mean cost of malaria prevention was approximately ₦2,450 in public facilities compared with ₦4,600 in private facilities, while treatment costs averaged ₦4,850 and ₦8,100, respectively. Both differences were statistically significant.

Public-facility attendees also reported significantly better accessibility and affordability than private-facility attendees. At the population level, however, affordability was strongly patterned by socioeconomic status. Women with lower education, unemployment and lower household income were more likely to

perceive malaria prevention and treatment as costly and less accessible.

The findings indicate that the economic burden of malaria in pregnancy extends beyond the price of antimalarial medicines. Health financing, facility type, household income, education, occupation and geography interact to shape women's ability to obtain malaria services.

For AMAC and similar urban settings in Nigeria, reducing malaria-related financial barriers will require more than expanding clinical services. It will require sustained public financing, reliable commodity availability, financial-risk protection, stronger public-private collaboration and targeted support for economically vulnerable pregnant women.

Strengthening affordable malaria prevention during pregnancy is particularly important because interventions such as IPTp-SP and ITNs can prevent illness and potentially avert the greater economic costs associated with malaria treatment and adverse pregnancy outcomes. WHO continues to identify IPTp-SP as an important malaria prevention strategy in pregnancy and supports complementary delivery mechanisms where ANC access is inadequate.

X. RECOMMENDATIONS

1. Government should increase domestic financing for malaria prevention in pregnancy, particularly IPTp, ITNs, malaria diagnostics and quality-assured treatment.
2. Financial protection for pregnant women should be strengthened through health insurance, maternal-health subsidies and other mechanisms that reduce out-of-pocket expenditure.
3. Malaria commodities should be continuously available in public and private facilities to prevent stock-outs from shifting costs to households.
4. Public-private partnerships should be strengthened to improve service quality, commodity availability, referral systems and treatment-standard compliance.
5. Private-sector malaria service charges should be transparent and monitored, particularly for diagnostics and essential medicines.

6. Low-income pregnant women should receive targeted support, including transportation assistance, service vouchers or other appropriate social-protection mechanisms where feasible.
7. Malaria education should be integrated comprehensively into ANC, emphasizing prevention, IPTp adherence, ITN use, prompt diagnosis and appropriate treatment.
8. Ward-specific malaria planning should be strengthened because significant geographical differences were observed in perceived cost and accessibility.
9. Routine health-economic monitoring should be incorporated into malaria programmes, including household expenditure, affordability and indirect costs.

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