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Malaria Ideation and Prevention Practices among Childbearing Women in Nigeria

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Abstract

Background

Although some progress has been made in the recent years, malaria remains a significant challenge to population health in Nigeria, especially affecting the most vulnerable group of young children and pregnant women. To further sustain malaria elimination efforts, prevention practices need to be continuously appraised. Meanwhile, preventive behaviour is contingent on the malaria ideation among childbearing women, the primary caregivers for under-five children. Ideational factors are the cognitive, emotional and social aspects that influences health-related behaviours. Therefore this study assessed the relationship between ideational factors and malaria prevention practices among childbearing women in Nigeria.

Methods

Data was extracted from a nationally representative data source, the Nigeria Malaria Indicator Survey for year 2021. The study sample included women aged 15-49 years who had under-five children. Prevention practices included use of insecticide treated nets (ITNs) and intermittent preventive treatment in pregnancy ($IPTp^{3+}$). Guided by the theory of planned behaviour and social cognitive theory, data were analysed using generalized structural equation modelling.

Results

The mean age of respondents was 28.4 years, 39.3% used ITNs and 52.5% used $IPTp^{3+}$. The results of the ideational factors showed that media exposure to malaria messages (AOR=1.10 C.I= [1.01,

1.40]), perceived self-efficacy (AOR= 1.31, C.I= [1.17, 1.46]), community malaria norms (AOR=1.06, C.I= [1.00, 1.13]) were associated with use of mosquito net. After adjusting for socio-demographic characteristics, the relationship of ideational factors to use of IPTp^{3+} was as follows: knowledge about malaria (AOR=1.17 C.I= [0.95, 1.46]), perceived self-efficacy (AOR= 1.09, C.I= [0.96, 1.24]), perceived severity of malaria (AOR=1.11, C.I= [0.98, 1.26]), community norms (AOR=0.95, C.I= [0.86, 1.04]).

Conclusion

Malaria ideational factors influence use of treated net but there was no significant association with use of intermittent preventive treatment in pregnancy by childbearing women. Malaria prevention programmes should prioritize knowledge dissemination and promoting self-efficacy in malaria prevention.

Keywords

Malaria, Behaviour, Malaria ideational factors, Childbearing, Generalized structural equation modelling, Nigeria, Malaria Prevention Practices

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BACKGROUND

Although some progress has been made in the recent years, malaria remains a significant challenge to population health in Nigeria (1). Malaria is transmitted to humans through the bites of infected female Anopheles mosquitoes. Among the five Plasmodium parasite species responsible for malaria, *Plasmodium falciparum* is the most prevalent (2).

According to the World Health Organization, in 2021, there were 247 million reported malaria cases globally, resulting in 619,000 deaths. The African region accounted for 94% of the 247 million malaria cases worldwide with Nigeria contributing 27% to the global malaria cases. Malaria affects the most vulnerable group of young children and pregnant women. Childbearing women faces unique vulnerability to malaria due to pregnancy induced changes in immunity placing both maternal and neonatal health at risk (3). In 2019, 35% of pregnant women in the WHO African region were exposed to malaria, leading to complications such as low birth weight in approximately 822,000 infants (1). In 2022, 76% of the 608,000 global malaria deaths occurred among children under five years old (4).

Use of insecticide treated net(ITN) and Intermittent preventive treatment in pregnancy(IPTp) are core vector control measures and have led to reduction in malaria burden in sub-Saharan Africa (5). When high coverage of ITNs is achieved, it helps to lower malaria risk at the individual level as well as at the community level by reducing the vector population. Studies have shown that ITNs can reduce malaria incidence by approximately 45% to 50% and decrease mortality rates among children under five by approximately 20% when used consistently (6,7).

The World Health Organization (WHO) recommends intermittent preventive treatment in pregnancy with sulfadoxine-pyrimethamine (IPTp-SP) and folic acid supplementation to prevent malaria and anemia during pregnancy (5). Nigeria's Federal Ministry of Health has implemented IPTp for over 15 years, providing at least two doses of SP/Fansidar during antenatal care visits. The Malaria Indicator Survey tracks the coverage of this intervention, measuring the percentage of women who received three or more doses of $IPTp^{3+}$ during their most recent pregnancy (8). Research shows that IPTp significantly reduces the incidence of malaria infections during pregnancy, which has led to improvement maternal health outcomes and reducing adverse birth outcomes such as low birth weight (9).

Malaria transmission and control include complex interaction between human, mosquito, parasites, their environment, health care system and policy measures at any given time (10). The human aspect of this interaction can be influenced by ideational or psychosocial factors, which shape behaviours, decision making, and responses to malaria prevention and control efforts. Ideational factors are the cognitive, emotional and social aspects that influences health-related behaviours through knowledge, attitudes, norms, beliefs, and interpersonal communication (11). Cognitive aspects includes attitudes, knowledge, perceived risk, subjective norms and self-image. Emotional domain includes self-efficacy and social domain includes social support, social influence, interpersonal communication and personal advocacy (12).

Knowledge about malaria significantly influences health-seeking behaviours among women (13,14). Despite good knowledge levels, the reported usage of insecticide-treated nets (ITNs) and intermittent preventive treatment (IPTp) remains low (15,16). Emotional factors like self-efficacy are crucial in women's decisions to use ITNs (12). Women with higher self-efficacy are more likely to engage in preventive behaviours (17,18). Perceiving malaria as a significant threat also predicts preventive behaviour (19). Enhanced self-efficacy can be cultivated through targeted health education campaigns (20).Community norms, perceived susceptibility, and malaria attitudes also significantly influence malaria prevention practices. Women who perceive ITN use as a community norm are more likely to adopt this behaviour (11,19). Perceived susceptibility to malaria and attitudes toward prevention methods can either motivate or hinder the adoption of preventive measures (21). Cultural beliefs and perceptions of malaria severity also shape preventive practices (22,23).

Despite extensive research on malaria prevention, gaps remain in understanding the factors that shape these practices. Most studies examine individual and community factors separately, neglecting their hierarchical relationships. This study aims to fill this gap by using Generalized Structural Equation Modelling (GSEM) to interrogate multi-level factors and provide a more comprehensive understanding of how they interact to shape malaria prevention practices.

METHODS

Study design and population

This study involved secondary data analysis of data collected among childbearing women in the 2021 Nigeria Malaria Indicator Survey (NMIS, 2021).

The National Malaria Elimination Programme (NMEP) of the Federal Ministry of Health (FMoH) in collaboration with The National Population Commission (NPC) and National Bureau of Statistics (NBS) carried out the 2021 NMIS. The survey data collection took place from 12 October to 4 December 2021. The survey was conducted in the first year of the current National Malaria Strategic Plan and carried out amidst pandemic, COVID-19. The sample for the 2021 NMIS was designed to provide survey indicators for the whole country including urban and rural areas, and the six geographical zones, including 36 states and the Federal Capital Territory (FCT). The 2021 NMIS used the sample frame for the proposed 2023 Population and Housing Census (PHC) of the Federal Republic of Nigeria (8).

A two-stage sampling approach was adopted for the 2021 NMIS. In the first stage, 568 Enumeration Areas (EAs) were selected with probability proportional to the EA size which is the number of households residing in the EA. The sample selection was done in such a way that it is representative of each state. As a result, there was 568 clusters throughout the country, 195 in the urban areas and 373 in the rural areas. In the second stage's selection, a fixed number of 25 households were selected in every cluster via equal probability systematic sampling (8).

Data collection

The 2021 NMIS used computer-assisted personal interviewing (CAPI) for data collection, data entry and editing were carried out using the CSPro software package. The Women's Questionnaire was used to collect information from all eligible women aged 15-49 who were either permanent residents of the households or visitors present in the households in the night preceding the survey. The women were asked about their background characteristics, Reproduction, Pregnancy and Intermittent preventive treatment, Fever in children, Malaria knowledge and belief. Adescription of the outcome and explanatory variables is presented in Table 1.

Table 1: Description of variables

Category	Variables	Description
Outcome variables	ITNs usage	Binary variable (1= used ITN, 0 = Did not use ITN)
	$IPTp^{3+}$ usage	Binary variable (1= 3 doses or more doses of IPTp, 0 = Took <3 doses of IPTp)
Independent variables		
	Ideational factors	Continuous Variable (Derived using Multiple Correspondence Analysis)
		Media Exposure
		Malaria Knowledge
		Perceived Susceptibility
		Perceived Self-efficacy
		Perceived Severity
		Malaria Attitudes
		Malaria Norms
Socio-Demographic Variables		
	Age (years)	15-19; 20-24; 25-29; 30-34; 35-39; 40-44; 45-49
	Religion	1= Muslim; 2= Christian
	Wealth Index	Poorest; poorer; middle; richer; richest
	Place of Residence	Rural; Urban
	Region	North central; North east; North west; South east; South south; South west
	Education Level	None; Primary; Secondary; Higher
Covariates		
	Parity	1= ≤4; 2= >4
	Pregnancy status	0= No; 1= Yes
	Reading newspaper	not at all; < once a week; ≥ once a week
	Listening to radio	not at all; < once a week; ≥ once a week
	Watching television	not at all; < once a week; ≥ once a week
	Use of internet	not at all; < once a week; ≥ once a week
	Smart phone use	not at all; < once a week; ≥ once a week
	Number of ANC visit	0=0; 1= 1-4; 2= >4
	Sex of household head	1= Male; 2=Female
	Source of $IPTp^{3+}$	1= Antenatal Visit; 2= Another facility visit; 3= Community health extension worker; 4= Other source

** ITNs (Insecticide Treated Nets); IPTp (Intermittent Preventive Treatment in Pregnancy); ANC (Antenatal Care)*

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Malaria Ideation Factors

The Ideational Model combines key behavioural theories such as the Diffusion of Innovations, the Theory of Planned Behaviour, and Social Cognitive Theory to explain how health behaviours are formed and changed. In this study, ideational factors such as media exposure, malaria knowledge, perceived susceptibility and severity, self-efficacy, attitudes toward malaria, and community norms were considered central to understanding malaria prevention behaviour.

Table 2: Malaria Ideation Indicators and their respective ID on the Nigeria 2021 MIS dataset

Ideational Factor	ID	Indicator (Level categories)
Media Exposure	ml501a	Heard of malaria messages from: Radio
	ml501b	Heard of malaria messages from: Television
	ml501c	Heard of malaria messages from: Poster/Billboard
	ml501d	Heard of malaria messages from: Newspaper/Magazine
	ml501e	Heard of malaria messages from: Leaflet/Brochure
	ml501f	Heard of malaria messages from: Healthcare Provider
	ml501g	Heard of malaria messages from: Community Worker
	ml501h	Heard of malaria messages from: Social Media
	ml501i	Heard of malaria messages from: Town Announcer
	ml501j	Heard of malaria messages from: Community volunteer
	ml501k	Heard of malaria messages from: Family/Friends
	ml501x	Heard of malaria messages from: Others
	ml501z	Heard of malaria messages from: Don't Remember
Malaria Knowledge	ml502a	Sleep inside a mosquito net
	ml502b	Sleep inside an insecticide-treated net
	ml502c	Use mosquito repellent or coil
	ml502d	Take preventative medications
	ml502e	Spray House with insecticide
	ml502f	Fill in stagnant water (Puddles)
	ml502g	Keep surrounding clean
	ml502h	Put Mosquito Screen on Windows
	ml502x	Others
	ml502z	Don't Know
Malaria Susceptibility	ml505	People in the community only get malaria in rainy season
	ml506	When a child has fever, you always worry it might be malaria
Malaria Severity	ml507	Getting malaria is not a problem because it is easily treated
	ml508	Only weak children die from malaria
Malaria self-efficacy	ml509	You can sleep inside nets for the whole night/ lots of mosquito
	ml510	You can sleep inside nets for the whole nights/few mosquitoes
Malaria Attitudes	ml511	Don't like sleeping in net when the weather is too warm
	ml512	When a child has fever, give any medicine you have at home
Community norms	ml513	People in community take their child to clinic day/day after fever
	ml514	People in community sleep under net every night.

ANALYSIS

The dataset was imported into R Studio, where relevant variables related to ideational factors and socio-demographic characteristics and covariates were selected. A summary of the variables was conducted to check for missing values, and categorical variables were converted to ordered factors. Reliability was also evaluated for each domain of malaria ideational factors using the Cronbach's α coefficient and values of 0.7 or higher were considered acceptable. Multiple Correspondence Analysis (MCA) was applied to generate continuous scores for each malaria ideational factor. These component scores were then merged with the primary dataset as new variables. For multi-level analysis, individuals (level 1) were nested within communities (level 2) with the cluster number was used to represent the second level. This approach captured the hierarchical nature of the data, with level 1 compromising individuals and level 2 representing communities. Generalized Structural Equation Modelling was used in this study to study the relationship between ideational factors and malaria prevention practices among childbearing women in Nigeria. GSEM allows analysis of multiple, interrelated pathways involving different types of variables, while accounting for the nested structure of individuals within communities. The family distribution as binomial and link function as logit were specified. Model I was univariate models (Model 1) to identify factors associated with malaria prevention practices. Model II was a multivariable model for ideational factors. Finally, factors with p-value less than 0.05 in the univariate (unadjusted) model were included in model III in order to examine the relationship between ideational factors and malaria prevention practices while accounting for the hierarchical nature of the data.

The model is in the form:

Level 1 (Individual-Level GSEM)

$$g\big(E(y_{ij})\big) = \Lambda_1\big(\boldsymbol{B}_1\eta_{ij} + \Gamma_1 x_{ij} + \zeta_{ij}\big) + \varepsilon_{ij}$$

Level 2 (Community-Level GSEM)

$$\eta_j = \Lambda_2\,(\boldsymbol{B}_2\eta_j + \Gamma_2 x_j + \zeta_j) + \varepsilon_{ij}$$

where:

y_{ij}: $Observed\ variables\ at\ level\ 1\ (n \times 1)$

η_{ij}: $Vector\ of\ level\ 1\ \ latent\ variables\ (m_1 \times 1)$

x_{ij}: $Vector\ of\ level\ 1\ \ observed\ predictors\ for\ individual\ i\ in\ group\ j\ variables\ (k_1 \times 1)$

Λ_1 : $Factor\ loading\ matrix\ at\ level\ 1\ \ m_1 \times 1$

Λ_2 : $Factor\ loading\ matrix\ at\ level\ 2\ \ m_2 \times 1$

$\boldsymbol{B_1}$: $Coefficient\ matrix\ for\ relationships\ among\ Level\ 1\ latent\ variables\ (m_1 \times m_1)$

Γ_1: $Cofficient\ matrix\ linking\ Level\ 1\ predictors\ to\ latent\ variables\ \ (m_1 \times k_1)$

ζ_{ij} : $Vector\ of\ structural\ errors\ at\ level\ 1\ \ (m_1 \times 1)$

η_j: $Vector\ of\ level\ 2\ latent\ \ variables\ (m_2 \times 1)$

x_j: $Vector\ of\ level\ 2\ \ observed\ predictors\ group\ j\ (k_2 \times 1)$

$\boldsymbol{B_2}$: $Coefficient\ matrix\ for\ relationships\ among\ Level\ 2\ latent\ variables\ (m_2 \times m_2)$

Γ_2: $Cofficient\ matrix\ linking\ Level\ 2\ predictors\ to\ latent\ variables\ \ (m_2 \times k_2)$

ζ_{ij} : $Vector\ of\ structural\ errors\ at\ level\ 2\ \ (m_2 \times 1)$

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RESULTS

Socio-demographic characteristics

The sociodemographic characteristics of childbearing women are presented in Table 3. The mean age of respondents was (28.4 ± 9.0) years. Of the 14,476 respondents 2,663 (18.4%) were aged 15-19 years followed by 20-24 (17.0%), and 25-29 (18.6%). Religious affiliation shows that 51.2% were Muslims, and 48.9% were Christians. The majority (65.9%) lived in rural areas. The highest proportion of respondents were domiciled in the North West (25.1%), followed by North Central (18.5%) and North East (17.4%). In terms of education, 33.1% have no formal education, while 39.2% completed secondary school. The respondents' household wealth quintile were evenly distributed, with the largest group being the richest (24.8%).

Table 3: Socio-Demographic Profile of Respondents (Childbearing women in Nigeria, NMIS, 2021)

Variable (n=14,476)	Categories	Frequency	Percentage (%)
Age group	15-19	2,663	18.4
	20-24	2,466	17.0
	25-29	2,687	18.6
	30-34	2,340	16.2
	35-39	1,998	13.8
	40-44	1,435	9.9
	45-49	887	6.1
Religion	Christian	7,058	48.8
	Islam	7,418	51.2
Type of place of residence	Urban	4,930	34.1
	Rural	9,546	65.9
Education	None	4,792	33.1
	Primary	1,977	13.7
	Secondary	5,669	39.1
	Higher/Tertiary	2,038	14.1
Geopolitical zone	North Central	2,674	18.5
	North East	2,523	17.4
	North West	3,635	25.1
	South East	1,523	10.5
	South South	2,148	14.9
	South West	1,973	13.6
Wealth Index quintiles	Poorest	2,434	16.8
	Second	2,431	16.8
	Middle	2,802	19.4
	Fourth	3,225	22.3
	Richest	3,584	24.7

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Association between Socio-demographic, Ideational Factors and Use of Insecticide Treated Net (ITNs)

Three models examining factors associated with the use of insecticide-treated nets (ITNs) are presented in Table 4. Model I shows unadjusted associations, which showed that some demographic characteristics, such as, age, region, use of smart phone, religion, place of residence,

parity, pregnancy status and head of family have significant association with use of insecticide treated net (ITN). The result also indicated that all ideational factors except malaria knowledge were significantly associated with ITN use. In Model II, which includes only ideational factors, media exposure (AOR = 1.15, CI = 1.01-1.31), self-efficacy (AOR = 1.15, CI = 1.08-1.23), perceived susceptibility (AOR = 1.08, CI = 1.02-1.15), community norms (AOR = 1.07, CI = 1.02-1.14), and perceived severity (A0R = 0.94, CI = 0.89-0.99) remained significant. After adjusting for other variables, the results for the full model revealed that ideational factors such as media exposure (AOR=1.10, C.I= 1.01-1.40), perceived self-efficacy (AOR= 1.31, C.I= 1.17-1.46), community norms (AOR=1.06, C.I= 1.00-1.13), malaria knowledge (AOR= 1.10, C.I= 0.95-1.27), low perceived susceptibility (AOR= 0.99, C.I= 0.86-1.14), perceived severity of malaria (AOR= 1.01, C.I= 0.93-1.10), malaria attitude (AOR= 1.04, C.I= 0.94-1.15) were associated with use of ITNs.

Multilevel Structure and Random Effects

To account for the hierarchical structure of the data, where respondents (childbearing women) are nested within communities, table 4 shows variance of 1.04 (SE = 0.11) and intraclass correlation coefficient (ICC) of 0.24, suggests that community differences play a role in explaining the likelihood of ITN use.

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Table 4: Unadjusted and Adjusted Generalized Structural Models of Ideational Factors and Use of ITN with Adjustment for Socio-demographic Characteristics

Variables	Model I	Model II	Model III
Malaria Ideation Factors			
Media Exposure	1.14(1.01,1.30)*	1.15(1.01,1.31)*	1.10(1.01,1.40)*
Malaria Knowledge	0.99(0.89,1.10)	0.98(0.88,1.10)	1.10(0.95,1.27)
Perceived Susceptibility	1.12(1.06,1.18)*	1.08(1.02,1.15)*	0.99(0.86,1.14)
Perceived Self-efficacy	1.18(1.12,1.24)*	1.15(1.08,1.23)*	1.31(1.17,1.46)*
Perceived Severity	1.05(1.00,1.10)*	0.94(0.89,0.99)*	1.01(0.93,1.10)
Malaria Attitudes	1.13(1.07,1.18)*	1.01(0.95,1.08)	1.04(0.94,1.15)
Malaria Norms	1.11(1.06,1.17)*	1.07(1.02,1.14)*	1.06(1.00,1.13)*
Age			
15-19	1.00		1.00
20-24	1.31(1.15,1.50)*		1.26(1.04,1.52)*
25-29	1.35(1.19,1.54)*		1.29(1.07,1.56)*
30-34	1.57(1.37,1.80)*		1.55(1.27,1.90)*
35-39	1.38(1.19,1.59)*		1.33(1.07,1.64)*
40-44	1.38(1.18,1.62)*		1.33(1.05,1.69)*

45-49	1.32(1.09,1.59)*		1.25(0.96,1.64)
Region			
North central	1.00		1.00
North east	3.50(2.50,4.89) *		2.83(1.96,4.07)*
North west	3.18(2.32,4.36) *		3.20(2.26,4.53)*
South east	0.32(0.22,0.47) *		0.28(0.19,0.41)*
South south	0.52(0.37,0.73) *		0.39(0.27,0.55)*
South west	0.53(0.37,0.75) *		0.46(0.32,0.666)*
Smart phone use			
no	1.00		1.00
yes	0.76(0.67,0.86)*		0.87(0.76,0.99)*
Religion			
Christian	1.00		1.00
Islam	1.32(1.13,1.55)*		0.88(0.73,1.05)
Place of Residence			
urban	1.00		1.00
rural	1.43(1.10,1.87)*		1.12(0.89,1.39)
parity			
≤4	1.00		1.00
>4	1.29(1.18,1.41)*		1.07(0.92,1.24)
Pregnancy status			
no	1.00		
yes	1.23(1.07,1.42)*		1.15(0.95,1.40)
Head of Family			
Male	1.00		
Female	0.81(0.71,0.92)*		
Wealth Index			
poorest	1.00		
poorer	1.29(1.11,1.50)*		
middle	1.32(1.11,1.56)*		
richer	1.06(0.87,1.28)		
richest	0.96(0.77,1.19)		
Reading newspaper			
not at all	1.00		
less than once a week	0.85(0.74,0.98)*		
at least once a week	0.95(0.81,1.12)		
Listening to radio			
not at all	1.00		
less than once a week	1.02(0.91,1.14)		
at least once a week	1.08(0.97,1.21)		
Watching television			

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not at all	1.00		
less than once a week	0.88(0.77,1.01)		
at least once a week	0.83(0.73,0.94)*		
Use of internet			
never	1.00		
yes, last 12 months	0.80(0.71,0.90)*		
yes, before last 12 month	1.15(0.85,1.54)		
Education Level			
none	1.00		
primary	1.05(0.91,1.20)		
secondary	0.82(0.73,0.94)*		
higher	0.75(0.63,0.88)*		
ANC visit			
0	1.00		
≤4	1.45(1.20,1.75)*		
>4	1.21(0.99,1.47)		
Source of IPTp			
Antenatal visit	1.00		
Another facility visit	0.46(0.22,0.98)*		
Community health worker	1.65(0.73,3.71)		
Other source	1.77(0.92,3.44)		
Random effects: individual>community_id			
Variance(S.E)		1.96(0.16)	1.04(0.11)
ICC		0.37 (0.33,0.41)	0.24 (0.20,0.28)
Model Fit Statistics			
Log-Likelihood		-8205.699	-4850.57
Degrees of Freedom		9	17
AIC		16429.40	9735.14
BIC		16497.62	9855.44

*Significant at 5% confidence interval

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Association between Socio-demographic, Ideational Factors and Intermittent Preventive Treatment in Pregnancy ($IPTp^{3+}$)

Three models examining factors associated with the use of intermittent preventive treatment during pregnancy ($IPTp^{3+}$) are presented in Table 5. Model I shows unadjusted associations, which showed that some demographic characteristics, such as, region, listening to radio and watching television have significant association with $IPTp^{3+}$. In Model II, which includes only ideational factors, none of ideational factors was significant. After adjusting for the determinants, the results

for the full model showed the relationship of ideational factors to use of IPTp^{3+} as follows; media exposure (AOR=0.81, C.I= 0.61-1.06), perceived self-efficacy (AOR= 1.09, C.I= 0.96-1.24), malaria knowledge (AOR= 1.17, C.I= 0.95-1.46), low perceived susceptibility (AOR= 1.02, C.I= [0.90-1.16]), perceived severity of malaria (AOR= 1.11, C.I= 0.98-1.26), malaria attitude (AOR= 0.92, C.I= 0.80-1.05), community malaria norms (AOR= 0.95, C.I= 0.86-1.04).

Multilevel Structure and Random Effects

To account for the hierarchical structure of the data, where respondents (childbearing women) are nested within communities, table 5 shows variance of 0.38 (SE = 0.08) and intraclass correlation coefficient (ICC) of 0.10, suggests that community differences play a role in explaining the likelihood of intermittent preventive treatment in pregnancy(IPTp^{3+}) use.

Table 5: Unadjusted and Adjusted Generalized Structural Models of Ideational Factors and Use of Intermittent Preventive Treatment during pregnancy with Adjustment for Socio-demographic Characteristics

Variables	Model I	Model II	Model III
Malaria Ideation Factors			
Media Exposure	0.71(0.56,0.91)*	0.78(0.60,1.02)	0.81(0.61,1.06)
Malaria Knowledge	1.32(1.09,1.61)*	1.22(0.99,1.50)	1.17(0.95,1.46)
Perceived Susceptibility	1.06(0.95,1.19)	1.01(0.89,1.15)	1.02(0.90,1.16)
Perceived Self-efficacy	1.07(0.97,1.18)	1.09(0.96,1.24)	1.09(0.96,1.24)
Perceived Severity	1.13(1.02,1.26)	1.11(0.98,1.25)	1.11(0.98,1.26)
Malaria Attitudes	1.01(0.91,1.12)	0.93(0.81,1.07)	0.92(0.80,1.05)
Malaria Norms	0.97(0.89,1.06)	0.96(0.87,1.05)	0.95(0.86,1.04)
Region			
North central	1.00		1.00
North east	0.60(0.44,0.81) *		0.70(0.50,0.97)*
North west	0.62(0.47,0.82) *		0.69(0.51,0.93)*
South east	0.56(0.41,0.78) *		0.50(0.36,0.71)*
South south	0.58(0.42,0.81) *		0.56(0.40,0.79)*
South west	0.52(0.38,0.73) *		0.49(0.35,0.69)*
Listening to radio			
not at all	1.00		1.00
less than once a week	1.11(0.92,1.35)		1.24(1.00,1.55)*
at least once a week	1.22(1.01,1.47)*		1.25(1.00,1.57)*
Watching television			
not at all	1.00		1.00
less than once a week	0.81(0.65,0.99)*		0.71(0.56,0.91)*
at least once a week	1.09(0.91,1.31)		0.88(0.70,1.11)

Source of IPTp			
Antenatal visit	1.00		1.00
Another facility visit	0.54(0.28,1.03)		0.63(0.32,1.23)
Community health worker	1.05(0.53,2.09)		1.24(0.60,2.56)
Other source	0.56(0.31,0.98)*		0.61(0.33,1.11)
ANC visit			
0	1.00		1.00
≤4	1.23(0.82,1.87)		1.05(0.66,1.67)
>4	1.86(1.23,2.82)*		1.61(1.01,2.55)*
Age			
15-19	1.00		
20-24	0.31(0.59,1.27)		
25-29	0.35(0.50,1.07)		
30-34	0.57(0.51,1.09)		
35-39	0.38(0.55,1.21)		
40-44	0.38(0.50,1.25)		
45-49	0.32(0.39,1.58)		
Place of Residence			
urban	1.00		
rural	0.92(0.76,1.11)		
parity			
≤4	1.00		
>4	0.92(0.78,1.08)		
Head of Family			
Male	1.00		
Female	1.04(0.79,1.37)		
Wealth Index			
poorest	1.00		
poorer	1.28(0.97,1.70)		
middle	1.26(0.96,1.66)		
richer	1.29(0.98,1.70)		
richest	1.25(0.95,1.65)		
Pregnancy status			
no	1.00		
yes	0.83(0.63,1.08)		
Use of internet			
never	1.00		
yes, last 12 months	1.12(0.93,1.36)		
yes, before last 12 month	0.89(0.55,1.44)		
Education Level			
none	1.00		
primary	1.02(0.81,1.29)		
secondary	1.12(0.92,1.36)		
higher	1.02(0.79,1.31)		
Reading newspaper			
not at all	1.00		

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less than once a week	1.05(0.84,1.31)		
at least once a week	1.14(0.86,1.52)		
Smart phone use			
no	1.00		
yes	1.13(0.93,1.37)		
Religion			
Christian	1.00		
Islam	1.00(0.84,1.20)		
Random effects: individual>community_id			
Variance(S.E)		0.40(0.08)	0.38(0.08)
ICC		0.11 (0.07,0.15)	0.10 (0.06,0.14)
Model Fit Statistics			
Log-Likelihood		-2230.46	-2204.14
Degrees of Freedom		9	17
AIC		4478.92	4442.29
BIC		4533.77	4545.90

*Significant at 5% confidence interval

DISCUSSION

Driven by factors such as insecticide resistance, changing climatic conditions, population migration, and sociocultural dynamics malaria remains a challenging health issue in Nigeria and many West African countries (10). Continuous research is important to keep up with these shifting conditions and to ensure that interventions remain relevant, effective, and sustainable. This study is particularly significant as it focused on childbearing women, a highly vulnerable group whose behavioural responses are influenced by psychosocial and cultural factors. Ideational factors (perceived self-efficacy, media exposure, community norms) and sociodemographic factors (education, wealth index, regional disparities), were examined in relation to preventive practices-ITN and IPTp^{3+} uptake.

Findings from the study showed that a woman's perceived self-efficacy was associated with use of insecticide-treated nets (ITNs). Women who possessed confidence in their ability to use insecticide-treated nets (ITNs) consistently were more likely to adopt this behaviour, highlighting the need to empower women with the necessary confidence and skills to effectively implement preventive measures. The study's findings agree with previous research which showed that women with higher self-efficacy were more likely to adopt consistent ITN use (18). This underscores the

importance of targeted education and empowerment initiatives aimed at fostering self-efficacy and promoting effective malaria prevention practices (17,18).

Media exposure was found to positively influence use of insecticide-treated nets (ITNs). Women exposed to malaria-related information via radio, television, and other media channels exhibited better adherence to ITN usage. This suggests that well-designed communication campaigns can effectively change behaviour by increasing awareness and knowledge. Consistent with findings, this study shows that women exposed to malaria-related messages via mass media are more likely to use adopt malaria prevention practices (12). This highlights the potential of mass media campaigns to bridge knowledge gaps and influence community norms (25). Therefore, utilizing accessible media channels, especially in rural areas is important for promoting preventive behaviours and reducing the spread of malaria.

Community malaria preventive norms also significantly impacted malaria prevention practices. Women residing in communities where ITN usage was perceived as a common practice were more likely to adopt the behaviour themselves. This highlights the role of social dynamics and the influence of community expectations on individual decision-making. Leveraging community norms through peer-to-peer advocacy and local health champions could amplify the uptake of malaria prevention measures. This aligns with results from a study which demonstrated that perceptions about ITN use in a community positively influenced individual behaviour (14). This underscores the role of social dynamics and peer influence in driving preventive actions. Community-based interventions that promote positive norms, such as group discussions and advocacy by local leaders, could improve the adoption of ITNs and IPTp^{3+}.

Regional variations in ITN and IPTp^{3+} usage were evident, with women in the North East and North West demonstrating higher adoption rates compared to those in the southern regions. This disparity reflects differences in cultural practices, environmental conditions, concentration of intervention and access to healthcare services (26). For instance, higher malaria transmission rates in the northern regions may create a stronger perceived need for preventive measures, while greater availability of healthcare resources may enhance access. Women in the North East and North West displayed better ITN usage rates compared to those in the South, is consistent with the study of (27), which attributed such differences to variations in cultural practices, healthcare access, and

environmental conditions. The literature further highlights that regions with higher malaria transmission rates often experience stronger behavioural adherence due to heightened perceived risk (28,29).

The study found an association between the number of antenatal care (ANC) visits and use of $IPTp^{3+}$. Women who attended more than four ANC visits were significantly more likely to adopt preventive measures, such as intermittent preventive treatment during pregnancy, compared to those who attended fewer visits. This finding showed the importance of regular antenatal care (ANC) visits in preventing malaria among pregnant women, highlighting the need for targeted interventions to improve ANC attendance and enhance maternal health (27).

Sociodemographic factors also played a crucial role. Education level played a role in malaria prevention behaviours, with women who attained secondary or higher education being more likely to adopt $IPTp^{3+}$. This finding aligns with the studies which demonstrated that higher educational attainment correlates with improved health literacy and greater adoption of preventive measures (13,18). Wealth index also influenced prevention behaviour, with poorest women showing higher ITN usage but lower $IPTp^{3+}$ uptake. This apparent discordance may be attributed to targeted distribution efforts of free ITNs to vulnerable populations, while access barriers such as cost and availability may hinder $IPTp^{3+}$ uptake among the same groups. This aligns with studies which found that poorer women exhibited higher ITN usage, consistent with targeted distribution efforts (17), their lower $IPTp^{3+}$ uptake reflects access barriers, a trend noted in studies by (27,30).

The multilevel analysis reveals considerable variance at the individual and community level, showing the influence of community dynamics on malaria prevention behaviours. This finding shows the role of community-level interventions in shaping individual behaviour and malaria prevention practices.

The regional disparities in malaria prevention practices shows the need for geographically tailored strategies. Interventions in southern regions should address the unique barriers faced by these populations, such as cultural misconceptions and reduced access to health services. Maintaining and strengthening existing efforts in the northern regions can help sustain high levels of ITN and IPTp3+ usage. Regional disparities shows the importance of geographically tailored interventions,

a recurring theme in the literature. For instance, a study emphasized the need to address unique barriers faced by southern regions, including misconceptions and cultural resistance to ITNs and IPTp^{3+} (28). The findings also reveal gaps in preventive behaviours among wealthier and urban populations, suggesting complacency or competing health priorities, as discussed in previous study (31).

This has some limitations that must be considered when interpreting the results. One of the limitations is that, the study is based on secondary data from the 2021 Nigeria Malaria Indicator Survey (NMIS), which may limit the generalizations to other malaria-endemic countries. Its cross-sectional design limits causality between ideational factors and preventive behaviours.

One strength of the study is the multilevel approach which reduces biases in the analysis by accounting for the non-independence of observations within communities. This improves the precision of estimates and provides results on individual-level ideational gaps while controlling for community-level factors.

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The findings of this study are critical for shaping public health policies and interventions aimed at malaria elimination and prevention in Nigeria. The identification of ideational factors such as perceived self-efficacy and community norms provides a foundation for designing behaviour change campaigns. Interventions that build women's confidence in their ability to use ITNs and encourage community-wide adherence to preventive measures can significantly enhance uptake.

CONCLUSION

Ideational factors are important determinants of malaria prevention practices among childbearing women in Nigeria. This study showed that fostering self-efficacy, and improving community norms can significantly enhance ITNs usage. However, the limited influence of these factors on IPTp^{3+} uptake showed the need for a broader approach to address structural barriers and improve access to healthcare services. The study also revealed disparities in malaria prevention practices based on socio-demographic characteristics, including wealth, religion, and place of residence. These findings show the importance of adjusting malaria prevention strategies to address the unique needs and challenges of different population groups. Reducing the malaria burden requires

sustained commitment to culturally sensitive, evidence-based approaches that empower communities to take proactive measures against the disease.

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