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Decomposition of Regional Inequality in the Usage of Mosquito Nets in Nigeria

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ABSTRACT

The usage of mosquito nets is one of the interventions of the government to curb malaria, yet consistent use of insecticide-treated mosquito nets is not universally applied. Despite widespread free distribution efforts, less than half of those with nets use them regularly. The study, therefore, decomposed the causes of regional inequality in the usage of mosquito nets in Nigeria. The data used for this study were from the 2021 Nigeria Malaria Indicator Surveys (NMIS). The study employed Anderson's behavioral theory of health services utilization and used the Blinder-Oaxaca Group Differences to decompose the determinants of regional disparity in mosquito net utilization. The findings indicated that there existed regional inequality in the usage of mosquito nets in Nigeria. The result further showed that the educational gap, perception, north-south dichotomy, sex of the household head, and disparity in wealth quintile in the rural-urban areas contributed positively and significantly to the inequality in the usage of mosquito nets in the rural-urban areas in Nigeria. The findings also showed that the household age divide and perceptual differences between the Northeast and other regions impacted the North-East inequality. Also, household head age divide, and social-media usage differences between the Northwest and other regions contributed to north-west inequality, perception differences between other regions, and the southeastern regions contributed to south-east inequality in mosquito net utilization. Furthermore, household head age divide, sex of household head differences, and social-media usage differences reduced the south-south inequality, perception gap, rural-urban differences, and wealth disparity between the south and western regions, which contribute to increased south-west inequality in mosquito net utilization, and urbanization contributed to north-central inequality. This study, therefore, recommended that the government should implement region-specific education and communication strategies that would address socio-economic, gender, and perceptual disparities.

Keywords: Mosquito net; Regional Inequality; Blinder-Oaxaca; Malaria

INTRODUCTION

The global response to malaria has led to a widespread increase in the use of mosquito nets, as a cornerstone intervention for malaria prevention, according to the World Health Organization (WHO, 2024). Mosquito nets are one of the most effective and widely available methods for preventing malaria, West Nile virus, etc, and there is interest in understanding the complexities of behavioural drivers of non-use among those with access (Ricotta, Oppong, Yukich, & Briët, 2019). Over 3 billion mosquito nets have been distributed globally since 2004, with

approximately 86% directed to sub-Saharan Africa, where the malaria burden is highest (WHO, 2024). Mosquito nets and other malaria control measures helped avert approximately 2.2 billion cases and 12.7 million deaths globally, with the vast majority (80% of cases, 94% of deaths) occurring in the WHO African Region between 2000 and 2023 (Symons et al., 2025). This indicates that mosquito nets, when properly distributed and used, remain one of the most cost-effective public health tools for malaria and west Nile virus prevention globally. Nigeria bears the highest malaria burden globally, accounting for approximately 27% of all global malaria cases and 31% of deaths as of 2023 (WHO, 2024). As part of global and national malaria control strategies, mosquito nets have been promoted as the most cost-effective vector control intervention. The basis for reducing malaria vectors and the transmission of malaria is the mosquito net (Birget & Koella, 2015). Among the several selective vector control schemes, mosquito net is the most important and promising component (Apinjoh et al., 2015).

The severity of malaria varies geographically throughout Nigeria; in the North-Central, North-East, and North-West regions, the prevalence is high among children aged 6 to 59 months, while in the South-East region, it is low (Andrada et al., 2019). A report on the National Malaria Elimination Programme (NMEP) stated that at the national level, December 2023 had the greatest achievement rate of Under-five children receiving Mosquito nets (7%), followed by October (6.6%). Mosquito net uptake among children under five was below 1% in sixteen states (43%) and above 18.6% in Osun and Yobe states, respectively. In Nigeria, there are significant regional differences in the ways that people seek medical attention. For instance, it is thought that women from the Southern regions of South-South, South-East, and South-West are better educated than their counterparts from the northern regions of North Central, North-East, and North-West. As a result, there may be a greater likelihood of these women using health care services, such as mosquito net use (Chukwu et al., 2021).

Substantial regional disparities persist in both the ownership and consistent use of mosquito nets, despite nationwide malaria prevention efforts in Nigeria (Tadesse et al., 2024; Kim et al., 2020). Studies show that 56% of households possess at least one mosquito net, utilization rates vary markedly by geopolitical zone, with significantly higher prevalence of both ownership and nightly use documented in the North East and North West compared to the South and Central regions, despite higher net access rates in the south; lower ownership in the north: 47.9% vs. south: 70.8% (Adejoh et al., 2022; Ovadje & Nriagu, 2016). The North-East and North-West regions show a significant and positive association with mosquito net usage, while the South-East, South-South, and South-West display a significant but negative correlation (Solanke et al., 2023). The highest prevalence of malaria among children aged 6 to 59 months is concentrated in the North-Central, North-East, and North-West zones, whereas the South-East records the lowest (Andrada et al., 2019). These disparities raise critical concerns about regional equity in malaria prevention efforts and whether certain populations remain disproportionately vulnerable despite national-level interventions.

Findings from the work of Merga et al. (2024) revealed that individual factors (such as maternal education, wealth, parity, and household size) and contextual factors (community literacy, urban-versus-rural residence, and geopolitical zone of residence) systematically influence net usage. Moreover, wealth, education level, household composition, and regional socio-economic disadvantage consistently emerge as key predictors of utilization of mosquito nets (Budu et al., 2022). Previous studies have largely focused on aggregate or household-level data without adequately addressing spatial dimensions of ITN usage, leaving a significant gap in understanding the extent to which regional inequalities exist. This study, therefore, seeks to decompose regional inequality in the usage of mosquito nets in Nigeria, with the aim of informing more targeted and equitable public health strategies for malaria control.

LITERATURE REVIEW

Several studies have been conducted on the usage of mosquito nets in regions both locally and internationally. This study hinges on Anderson's behavioral model of health services utilization (BMHSU). It states that the use of wellbeing services depends on three primary elements: need, aiding, and predisposing factors (Andersen, 1968; Jahangir et al., 2012). Solanke et al. (2023) examined ITN use across the northern regions of Nigeria by employing three multilevel mixed-effect regression models to assess both individual and community-level predictors. Their findings indicated that the northwest zone reported a higher rate of ITN usage compared to the northeast, where ongoing armed insurgencies have significantly disrupted access to health interventions. Complementing this regional perspective, Chukwu et al. (2021) analyzed the differences in ITN uptake across Nigeria's geopolitical zones using percentages, Chi-square assessments, and multivariable logit models. Their results revealed that the North-East had the highest ITN utilization, while the South-West recorded the lowest. This contrasts with Solanke et al. (2023), who reported lower use in the North-East. The inconsistency may reflect differences in data periods, analytical frameworks, or population samples. While Chukwu et al. provide useful descriptive comparisons, the study's reliance on cross-sectional data limits causal interpretation. Additionally, the absence of qualitative context weakens its ability to explain why utilization varies across regions beyond statistical correlation.

At the subnational level, Andrada et al. (2019) provided a comprehensive mapping of household ITN ownership and use across Nigeria using the Chi-square Automatic Interaction Detector (CHAID) and multiple logistic regression analysis. Their findings confirmed significant regional variations, with northern households demonstrating higher ownership rates compared to southern ones. Notably, households in the North-West were five times more likely to own mosquito nets than those in the North Central zone. In another Nigerian study, Ujuju et al. (2022) analyzed ITN use among children under five and school-aged children using multilevel logistic regression on data from the 2018 Nigeria Demographic and Health Survey. The study revealed that ITN use was substantially higher among children under five, with only one state recording more than 80% usage among school-aged children compared to seven states for younger children. This finding exposes a critical policy gap, as school-aged children, who remain at risk of malaria, are often excluded from targeted ITN distribution programs. While the study's multilevel approach is statistically robust, its cross-sectional design prevents the establishment of temporal causality and limits understanding of how household decision-making or awareness campaigns affect ITN use over time.

A comparative perspective can be drawn from the work of P. L. Aung et al. (2022), who investigated ITN use among pregnant women in Myanmar using descriptive and logistic regression analyses. The study found higher non-utilization among women in lowland and delta regions compared to coastal areas. Despite being conducted outside Nigeria, the study's findings reinforce the global pattern of geographical disparities in ITN use and highlight how environmental and socioeconomic factors influence health behavior. However, self-reported data may introduce recall or social desirability biases, necessitating the triangulation of survey results with observational or qualitative data. Earlier research by Auta (2012) explored the demographic factors associated with ITN use among Nigerian women and children through chi-square tests for independence. The results indicated that ITN usage was lowest in the South-West, echoing patterns observed in later studies such as Chukwu et al. (2021). While Auta's work provided foundational evidence of regional disparity, its analytical methods were limited in scope, as bivariate analyses do not account for potential confounding factors. Nevertheless, the study remains significant for highlighting early awareness of spatial inequalities in ITN utilization.

Overall, the reviewed studies reveal a consistent trend of regional and demographic disparities in ITN ownership and use, with northern regions, particularly the North-West, showing relatively higher utilization rates compared to the southern areas.

METHODS

This study is grounded in the empirical research conducted by Adewara et al. (2018), which employs the Blinder-Oaxaca decomposition method to analyze the disparities in mosquito net usage between the southern and Northern zones. By utilizing this decomposition technique, the study illustrates how differences in various factors affecting mosquito net utilization in the southern settings may contribute to the observed disparities in Northern areas. Consequently, if the inequalities in mosquito net usage in northern areas stem from variations in the factors influencing southern usage, then addressing these disparities in southern factors could help mitigate the inequality observed in the northern regions.

$$y^{south} - y^{North} = \beta^{South}\, x^{North} - \beta^{south} x^{north} \quad (1)$$

Where x^{south} and x^{North} depicts vectors of the issues that influence the usage of mosquito nets, such as individual socio-demographic characteristics and factors at the household level that are assessed at the means for the southern and Northern regions, respectively.

Assuming that there are just two explanatory variables x_1 and x_2 then,

$$y^{south} - y^{North} = (\beta_0^{south} - \beta_0^{North}) + (\beta_1^{south} x_1^{south} - \beta_1^{North} x_1^{North}) + (\beta_2^{south} x_2^{south} - \beta_2^{North} x_2^{North}) \quad (2)$$

$$= G_0 + G_1 + G_2$$

The difference in y between the southern and Northern areas is said to be caused by (i) differences in the intercepts (G_0), (ii) differences in x_1 and β_1 (G_1) and (iii) differences in x_2 and β_2(G_2): For example, G_1 may quantify the difference in mean results resulting from variations in mosquito net usage (x_1) and the impacts of using mosquito nets (β_1).

Oaxaca decomposition contributes to the explanation of the overall or particular gap in the explanatory variable caused by (i) variations in x's (the explained component) and (ii) variations in β's (the unexplained component). The discrepancy in mosquito net usage between southern and Northern regions was further explained in two ways:

$$y^{south} - y^{North} = \Delta x \beta^{south}\, \Delta x \beta^{North} \quad (3)$$

Where $\Delta x = x^{south} - x^{North}$ and $\Delta\beta = \beta^{south} - \beta^{North}$, or

As a result, it is considered that the decomposition in (3) represents a specific instance of a more general decomposition:

$$y^{south} - y^{North} = \Delta x\beta^{south} + \Delta x\beta^{North} \quad (4)$$

$$y^{south} - y^{North} = \Delta x\beta^{south} + \Delta x\beta^{North} + \Delta x\Delta\beta \quad (5)$$

= E + C + CE

The aforementioned data indicates that the variance in the usage of mosquito nets between the southern and the northern areas is caused by differences in endowments (E), coefficients (C), and the interaction of endowments and coefficients (C E).

The above illustration is applicable to the analysis of gap between each geopolitical zone and the rest of the country.

Results

Table 1: Result of the Blinder-Oaxaca Group Differences; Analysis of the presence of North-East Inequality in the Usage of Mosquito Net in Nigeria

Inequality in the usage of mosquito nets	**Other Regions**	**North- East**	**Regional gap**
Blinder-Oaxaca	0.352*** (0.004)	0.585*** (0.009)	-0.233*** (0.010)

*Source: The author's computation,2025. The indicators of statistical significance at the 1%, 5%, and 10% levels are ***, **, and *.*

The North-East inequality in the usage of mosquito nets in Nigeria is presented in Table 1 above. The results indicate that in the other geopolitical regions, the coefficient of the usage of mosquito nets, which is significant at a 1% level, is 0.352, as shown in column 1. Likewise, in column 2, in the North-eastern region, the usage of mosquito nets has a coefficient of 0.585 at 1% level of significance. The difference between mosquito net usage as shown in column 3 is -0.233, and it is significant at 1% level. This implies that there exists a significant inequality in the usage of mosquito nets between other geopolitical zones and the North-Eastern region.

Table 2: Result of the Decomposition of North-East Inequality in the Usage of Mosquito Net in Nigeria

VARIABLES	**Endowments**	**Coefficients**	**Interaction**
Age	0.045***	-0.715***	-0.039***
	(0.013)	(0.230)	(0.013)
age2	-0.038***	0.297**	0.032**
	(0.013)	(0.117)	(0.013)
Edulevel	-0.003	-0.018	-0.015
	(0.009)	(0.011)	(0.009)
Perception	-0.008***	0.043***	-0.008***
	(0.002)	(0.013)	(0.002)
Socialmedia	0.007*	-0.003**	-0.009**
	(0.004)	(0.001)	(0.004)
Urban	-0.002	0.036***	0.002
	(0.001)	(0.008)	(0.001)
Wealth	0.006	-0.107***	-0.054***
	(0.011)	(0.024)	(0.013)
Hhsex	-0.005	-0.012	-0.001
	(0.003)	(0.042)	(0.003)
Hheadage	-0.021***	0.795***	0.021***
	(0.007)	(0.195)	(0.007)
hage2	0.022***	-0.364***	-0.025***
	(0.008)	(0.094)	(0.008)
Total	0.005	-0.142***	-0.095***
	(0.010)	(0.012)	(0.011)
Constant		-0.095	
		(0.163)	
Observations	14,476	14,476	14,476

*Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1*

Source: Author's Computation, 2025.

In Table 2, the study breaks down the findings in Table 1 into the factors that contribute to the disparity in the utilization of mosquito nets between other regions and the North-East. The gap has been divided into three major parts: the overall endowment, the overall coefficient, and the overall interaction effects. The coefficient and interaction effects contributed significantly to the gap by -0.142 and -0.095, respectively. The interaction result revealed that age, perception, and wealth quintile contributed significantly but negatively to the north-east disparity in the usage of mosquito nets at 1% level of significance. This implies that the age gap, perception gap, and the wealth quintile differences that exist in the north-east would reduce the inequality in the usage of mosquito nets by 0.039, 0.008, and 0.054, respectively. However, the age of the household head contributed significantly and positively to the north-east disparity at 1% level of significance. The interaction variables widen the gap by 0.021.

The coefficient result revealed that at a 1% level of significance, the age gap and wealth quintile gap have a negative effect on north-east inequality in the usage of mosquito nets. Also, the gap in the usage of social media for information negatively affects the north-east disparity in the usage of mosquito nets at 5% level of significance. On the other hand, the perception gap, urban-rural dichotomy, and age of household head positively affect the north-east differences in the usage of mosquito nets at 1% level of significance. The findings reveal that the household age divide and perceptual differences between other zones and the North-eastern regions contribute to heightened north-east inequality in mosquito net utilization, which should be mitigated.

Table 3: Result of the Blinder-Oaxaca Group Differences; Examine the Presence of North-West Inequality in the Usage of Mosquito Nets in Nigeria

Inequality in the usage of mosquito nets	**Other Regions**	**North-West**	**Regional gap**
Blinder-Oaxaca	0.335***	0.566***	-0.231***
	(0.005)	(0.008)	(0.009)

*Source: Author's Compilation, 2025. Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1*

The North-west regional inequality in the usage of mosquito nets in Nigeria is presented in Table 3 above. The results indicate that in other regions, the coefficient of the usage of mosquito nets, which is significant at a 1% level, is 0.335, as shown in column 1. Also, in column 2, in the North-west area, the usage of mosquito nets has a coefficient of 0.566 at 1% significance. The difference between mosquito net usage in the North-western region and other regions is shown in column 3 as -0.231, and it is significant at 1% level. This implies that there exists a significant inequality in the usage of mosquito nets in the north-western areas.

Table 4: Result of the Decomposition of North-West Inequality in the Usage of Mosquito Net in Nigeria

VARIABLES	**Endowments**	**Coefficients**	**Interaction**
Age	0.037***	-0.450**	-0.026**
	(0.011)	(0.194)	(0.012)
age2	-0.025**	0.147	0.016
	(0.009)	(0.098)	(0.011)
Edulevel	0.029***	-0.044***	-0.051***
	(0.009)	(0.009)	(0.011)
Perception	-0.015***	0.045***	-0.017***
	(0.004)	(0.013)	(0.005)
socialmedia	-0.007**	0.002*	0.006*
	(0.005)	(0.001)	(0.004)
Urban	-0.005	0.008	0.006
	(0.004)	(0.005)	(0.004)
Wealth	0.011	-0.148***	-0.065***
	(0.009)	(0.024)	(0.011)
Hhsex	0.011	-0.124**	-0.019**
	(0.008)	(0.052)	(0.008)
Hheadage	0.032***	0.723***	-0.034***
	(0.007)	(0.150)	(0.008)
hage2	-0.020***	-0.282***	0.027***
	(0.006)	(0.071)	(0.008)
Total	0.047***	-0.121***	-0.157***

	(0.012)	(0.010)	(0.013)
Constant		0.001	
		(0.143)	
Observations	14,476	14,476	14,476

*Source: Author's Computation, 2025. Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1*

In Table 4, the study breaks down the findings in Table 3 into the factors that contribute to the disparity in the utilization of mosquito nets in the north-west in comparison to other regions. The endowment, coefficient, and interaction effects contributed significantly to the gap by 0.047, -0.121, and -0.157, respectively. The endowment result revealed that perception and social media usage contributed significantly but negatively to the north-west disparity in the usage of mosquito nets at 1% and 5% level of significance, respectively. This implies that the perception gap and the social media usage differences that exist in the north-west would reduce the inequality in the usage of mosquito nets by 0.015 and 0.007, respectively. However, the age of the respondent, educational level, and the age of the household head contributed significantly and positively to the north-west disparity at 1% level of significance. The endowment variables widen the gap by 0.037, 0.029, and 0.032, respectively.

The interaction result revealed that age, perception, educational level, age of the household head, and wealth quintile contributed significantly but negatively to the north-west disparity in the usage of mosquito nets at 1% level of significance. This implies that the age gap, perception gap, educational level differences, household head disparity, and the wealth quintile differences that exist in the north-west would reduce the inequality in the usage of mosquito nets by 0.026, 0.017, 0.034, and 0.065, respectively. However, social media usage contributed significantly and positively to the north-west disparity at a 10% level of significance. The interaction variable widens the gap by 0.006.

The coefficient result revealed that age gap, educational level differences, sex of household head, and wealth quintile gap negatively affect north-west inequality in the usage of mosquito nets at 5%, 1%, 1% and 1% level of significance. In contrast, the age of the household head and social media usage gap positively affect the north-west differences in the usage of mosquito nets at the 1% and 10% level of significance. The findings reveal that the household head age divide and social-media usage differences between the North-west and other regions contribute to heightening North-west inequality in mosquito net utilization, which should be reduced.

Table 5: Result of the Blinder-Oaxaca Group Differences; analysis of the presence of South-East Inequality in the Usage of Mosquito Net in Nigeria

Inequality in the usage of mosquito nets	**Other Regions**	**South-east**	**Regional gap**
Blinder-Oaxaca	0.417***	0.190***	0.227***
	(0.004)	(0.010)	(0.011)

*Source: Author's Compilation, 2025. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1*

South-eastern disparity in the usage of mosquito nets in Nigeria is presented in Table 5 above. The results indicate that in the other regions, the coefficient of the usage of mosquito nets at 1% level is 0.417, as shown in column 1. Likewise, in column 2, in the south-east area, the usage of mosquito nets has a coefficient of 0.190 at 1% level of significance. The difference between mosquito net utilization in other regions as against the south-eastern region shown in column 3 is 0.227, and it is significant at 1% level. This implies that there exists a significant inequality in the usage of mosquito nets in the south-eastern region.

Table 6: Result of the Decomposition of South-East Inequality in the Usage of Mosquito Net in Nigeria

VARIABLES	**Endowments**	**Coefficients**	**Interaction**
Age	-0.024*	-0.183	0.011
	(0.014)	(0.250)	(0.015)
age2	0.026*	0.140	-0.015
	(0.014)	(0.134)	(0.015)
Edulevel	-0.020*	-0.105***	0.038***
	(0.012)	(0.035)	(0.013)
perception	0.006*	0.036***	0.018***
	(0.004)	(0.008)	(0.004)
socialmedia	0.004*	0.005	-0.003
	(0.003)	(0.005)	(0.003)

Urban	0.001	-0.003	-0.001
	(0.002)	(0.001)	(0.002)
Wealth	0.052***	0.076	-0.017
	(0.011)	(0.052)	(0.012)
Hhsex	0.003*	-0.037	0.002
	(0.002)	(0.034)	(0.003)
Hheadage	0.009	0.241	-0.008
	(0.006)	(0.206)	(0.007)
hage2	-0.004	-0.103	0.006
	(0.006)	(0.101)	(0.006)
Total	0.053***	0.142***	0.032**
	(0.014)	(0.012)	(0.015)
Constant		0.077	
		(0.187)	
Observations	14,476	14,476	14,476

*Source: Author's Compilation, 2025. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1*

In Table 6, the study breaks down the findings in Table 5 into the factors that contribute to the disparity in the utilization of mosquito nets in the south-eastern region. The endowment, coefficient, and interaction effects contributed significantly to the gap by 0.053, 0.142, and 0.032, respectively. The endowment result revealed that age and educational level contributed significantly but negatively to the south-east disparity in the usage of mosquito nets at a 10% level of significance. This implies that the age gap and the educational level differences that exist in the south-east would reduce the inequality in the usage of mosquito nets by 0.024 and 0.020, respectively. On the other hand, perception, social media, and sex of household head contributed significantly and positively to the south-east disparity at a 10% level of significance. The endowment variables widen the gap by 0.006, 0.004, and 0.003, respectively.

The interaction result revealed that educational level and perception gap contributed significantly and positively to the south-east disparity at 1% level of significance. The interaction variable widens the gap by 0.038 and 0.018, respectively.

The coefficient result revealed that educational level differences negatively affect southeast inequality in the usage of mosquito nets at 1% level of significance. In contrast, the perception gap positively affects the south-east differences in the usage of mosquito nets at 1% level of significance. The findings reveal that perception differences contribute to Southeast inequality in mosquito net utilization, which should be mitigated.

Table 7: Result of the Blinder-Oaxaca Group Differences; Analysis of the presence of South-South Inequality in the Usage of Mosquito Net in Nigeria

Inequality in the usage of mosquito nets	**Other Regions**	**South-South**	**Regional gap**
Blinder-Oaxaca	0.423***	0.220***	0.203***
	(0.005)	(0.009)	(0.010)

*Source: Author's Computation, 2025. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1*

The south-south inequality in the usage of mosquito nets in Nigeria is presented in Table 7 above. The results indicate that in other regions, the coefficient of the usage of mosquito nets, which is significant at a 1% level, is 0.423, as shown in column 1. Also, in column 2, in that south-southern region, the usage of mosquito nets has a coefficient of 0.220 at 1% level of significance. The difference between mosquito net usage in the south-south region in comparison to other regions, shown in column 3, is 0.203, and it is significant at 1% level. This implies that there exists a significant inequality in the usage of mosquito nets in the south-south areas.

Table 8: Result of the Decomposition of South-South Inequality in the Usage of Mosquito Net in Nigeria

VARIABLES	Endowments	Coefficients	Interaction
Age	-0.016	-0.058	0.003
	(0.011)	(0.230)	(0.011)
age2	0.0143	0.042	-0.004
	(0.009)	(0.123)	(0.011)
Edulevel	0.018*	0.009	-0.003
	(0.009)	(0.028)	(0.010)
Perception	0.023***	-0.003	-0.001
	(0.003)	(0.007)	(0.003)
socialmedia	-0.001	-0.005*	0.001
	(0.001)	(0.003)	(0.001)
Urban	0.001	-0.011	-0.001
	(0.001)	(0.007)	(0.001)
wealth	0.026***	-0.058	0.014
	(0.009)	(0.044)	(0.011)
Hhsex	0.002	-0.077**	0.011**
	(0.004)	(0.032)	(0.005)
Hheadage	0.010**	-0.474***	-0.014**
	(0.005)	(0.151)	(0.006)
hage2	-0.011**	0.189***	0.011**
	(0.005)	(0.067)	(0.005)
Total	0.067***	0.119***	0.018
	(0.012)	(0.011)	(0.012)
Constant		0.564***	
		(0.162)	
Observations	14,476	14,476	14,476

*Source: Author's Computation, 2025. Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1*

In Table 8, the study breaks down the findings in Table 7 into the factors that contribute to the disparity in the utilization of mosquito nets in the south-south region. The endowment and coefficient effects contributed significantly to the gap by 0.067 and 0.119, respectively. The endowment result revealed that the age of the household head contributed significantly but negatively to the south-south disparity in the usage of mosquito nets at 5% level of significance. This implies that the age of the household head differences that exist in the south-south would reduce the inequality in the usage of mosquito nets by 0.010. However, educational level, perception, and wealth quintile contributed significantly and positively to the south-south disparity at 5%, 1% and 1% level of significance, respectively. The endowment variables widen the gap by 0.018, 0.023, and 0.026, respectively.

The coefficient result revealed that usage of social media differences, sex of household head, and age of household head gap negatively affect south-south inequality in the usage of mosquito nets at 10%, 5% and 1% level of significance, respectively. The findings reveal that the household head age divide, sex of household head differences, and social-media usage differences contribute to the reduced south-south inequality in mosquito net utilization in Nigeria, and it should be further encouraged.

Table 9: Result of the Blinder-Oaxaca Group Differences; Examine the Presence of South-West Inequality in the Utilization of Mosquito Net in Nigeria

Inequality in the usage of mosquito nets	Other Regions	South-west	Regional gap
Blinder-Oaxaca	0.417***	0.237***	0.180***
	(0.00441)	(0.00960)	(0.0106)

*Source: Author's Computation, 2025. Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1*

The south-west inequality in the usage of mosquito nets in Nigeria is presented in Table 9 above. The results indicate that in other regions, the coefficient of the usage of mosquito nets, which is significant at a 1% level, is 0.417, as shown in column 1. Likewise, in column 2, in the south-western region, the usage of mosquito nets has a coefficient of 0.237 at 1% level of significance. The difference between mosquito net usage in the south-west

region shown in column 3 is 0.180, and it is significant at 1% level. This implies that there exists a significant inequality in the usage of mosquito nets in the south-west areas.

Table 10: Result of the decomposition of South-West Inequality in the Usage of Mosquito Net in Nigeria

VARIABLES	Endowments	Coefficients	Interaction
Age	0.023	0.695***	-0.051***
	(0.017)	(0.246)	(0.019)
age2	-0.027	-0.371***	0.052***
	(0.017)	(0.135)	(0.019)
Edulevel	0.044***	0.081***	-0.030***
	(0.009)	(0.029)	(0.011)
Perception	0.009***	0.028***	0.011***
	(0.003)	(0.008)	(0.003)
socialmedia	-0.001	-0.006	0.004
	(0.002)	(0.004)	(0.003)
Urban	-0.020***	-0.034**	0.018**
	(0.007)	(0.015)	(0.008)
Wealth	0.014	-0.139**	0.039**
	(0.014)	(0.054)	(0.016)
Hhsex	0.003*	-0.042	0.003
	(0.002)	(0.033)	(0.002)
Hheadage	-0.001	-0.288*	0.001
	(0.002)	(0.169)	(0.002)
hage2	0.001	0.110	-0.001
	(0.002)	(0.076)	(0.002)
Total	0.048***	0.086***	0.046***
	(0.013)	(0.011)	(0.014)
Constant		0.051	
		(0.180)	
Observations	14,476	14,476	14,476

*Source: Author's Computation 2025. Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1*

In Table 10, the study breaks down the findings in Table 9 into the factors that contribute to the disparity in the utilization of mosquito nets in the south-west areas. The endowment, coefficient, and interaction effects contributed significantly to the gap by 0.048, 0.086, and 0.046, respectively. The endowment result revealed that the rural-urban dichotomy contributed significantly but negatively to the south-west disparity in the usage of mosquito nets at 1% level of significance. This implies that the rural-urban differences that exist in the south-west would reduce the inequality in the usage of mosquito nets by 0.020. However, educational level, perception, and the sex of the household head contributed significantly and positively to the south-west disparity at 1%, 1% and 10% level of significance, respectively. The endowment variables widen the gap by 0.044, 0.009, and 0.003, respectively.

The interaction result revealed that the rural-urban gap, age of the household head, and wealth quintile contributed significantly but negatively to the south-west disparity in the usage of mosquito net at 5%, 5% and 10% level of significance, respectively. This implies that the rural-urban gap, household head disparity, and the wealth quintile differences that exist in the south-west would reduce the inequality in the usage of mosquito nets by 0.034, 0.288, and 0.139, respectively. However, the age of the respondent, perception, and educational level contributed significantly and positively to the south-west disparity at 1% level of significance. The interaction variable widens the gap by 0.695, 0.028, and 0.081.

The coefficient result revealed that age gap and educational level differences negatively affect south-west inequality in the usage of mosquito nets at 1% level of significance. In contrast, perception gap, rural-urban gap, and wealth quantile differences positively affect the south-west differences in the usage of mosquito net at 1%, 5% and 5% level of significance, respectively. The findings reveal that the perception gap, rural-urban differences, and wealth disparity contribute to increased south-west inequality in mosquito net utilization, which should be reduced.

Table 11: Result of the Blinder-Oaxaca Group Differences; Investigate the Presence of North-Central Inequality in the Usage of Mosquito Nets in Nigeria

Inequality in the usage of mosquito nets	Other regions	North-central	Regional gap
Blinder-Oaxaca	0.404***	0.345***	0.058***
	(0.005)	(0.009)	(0.010)

*Source: The author's computation,2025. The indicators of statistical significance at the 1%, 5%, and 10% levels are ***, **, and *.*

The North-Central inequality in the usage of mosquito nets in Nigeria is presented in Table 11 above. The results indicate that in comparison with other regions, the coefficient of the usage of mosquito nets, which is significant at a 1% level, is 0.404, as shown in column 1. Likewise, in column 2, in the north-central region, the usage of mosquito nets has a coefficient of 0.345 at 1% level of significance. The difference between mosquito net usage in the North-central region shown in column 3 is 0.058, and it is significant at 1% level. This implies that there exists a significant inequality in the usage of mosquito nets in the North-central region.

Table 12: Result of the Decomposition of North-Central Inequality in the Usage of Mosquito Nets in Nigeria

VARIABLES	Endowments	Coefficients	Interaction
Age	-0.001	0.274	0.007
	(0.005)	(0.223)	(0.006)
age2	0.004	-0.199*	-0.011
	(0.006)	(0.114)	(0.007)
Edulevel	-0.001	-0.093***	0.002
	(0.001)	(0.017)	(0.002)
perception	0.008***	-0.006	-0.001
	(0.002)	(0.009)	(0.002)
socialmedia	-0.001	0.001	3.44e-05
	(0.001)	(0.002)	(0.001)
Urban	0.002	0.052***	-0.002
	(0.001)	(0.009)	(0.002)
Wealth	-0.001	-0.186***	0.005**
	(0.001)	(0.035)	(0.002)
Hhsex	-7.97e-05	-0.127***	0.001
	(0.001)	(0.033)	(0.001)
Hheadage	-0.001	-0.093	-0.003
	(0.005)	(0.147)	(0.006)
hage2	-0.001	0.023	0.002
	(0.004)	(0.065)	(0.004)
Total	0.009***	0.052***	-0.002
	(0.003)	(0.010)	(0.004)
Constant		0.405***	
		(0.153)	
Observations	14,476	14,476	14,476

*Source: The author's computation,2025. The indicators of statistical significance at the 1%, 5%, and 10% levels are ***, **, and *.*

In Table 12, the study breaks down the findings in Table 11 into the factors that contribute to the disparity in the utilization of mosquito nets in the North-central region. The endowment and coefficient effects contributed significantly to the gap by 0.009 and 0.052, respectively. The endowment result revealed that perception contributed significantly but negatively to the North-central disparity in the usage of mosquito nets at 1% level of significance. This implies that the perception differences that exist in the north-central region would reduce the inequality in the usage of mosquito nets by 0.008.

The coefficient result revealed that the educational level gap, wealth quintile differences, and sex of household head negatively affect north-central inequality in the usage of mosquito nets at 1% level of significance, respectively. On the other hand, rural-urban differences that exist in the North positively affect the North-central inequality in the usage of mosquito nets. The findings reveal that urbanization contributes to north-central inequality in the usage of mosquito nets.

DISCUSSION

The findings reveal that household head age divide and perceptual differences contribute significantly to heightened inequality in mosquito net utilization in the North-East. This implies that older household heads may be less receptive to adopting modern preventive health behaviors, such as the consistent use of mosquito nets. This buttresses the works of Haileselassie et al., (2023); Andrada et al. (2019); Osuorah et al., (2013). Additionally, regional perceptions possibly influenced by cultural, religious, or educational disparities may fuel skepticism towards mosquito net use in the North-East. The lack of awareness or misinformation could reduce demand, even when nets are distributed freely. Low mosquito net usage increases vulnerability to malaria, which is associated with high out-of-pocket treatment costs, loss of income due to illness, and reduced labor productivity. In the North-East, an already economically fragile zone due to insecurity, this further deepens poverty and inequality. Mitigating perceptual divides through targeted education campaigns could improve net utilization and support economic resilience.

In the North-West, inequality in mosquito net utilization is exacerbated by the age divide among household heads and differences in social media usage compared to the West. This means that younger household heads, who are more active on social media, are more likely to encounter health promotion messages and adopt recommended practices like mosquito net use. Older individuals or those without internet access are less exposed to such messaging. The digital divide limits access to health information, maintaining poor health outcomes and perpetuating high healthcare costs. Improved digital literacy and the integration of culturally relevant health communication via radio or community forums can increase awareness and mosquito net adoption, especially among older and rural populations in the North-West. This is in line with findings from Adedokun and Uthman (2020) and Storey et al. (2018)

Furthermore, the perception gap significantly contributes to inequality in mosquito net use in the South-East. Despite better health infrastructure in the South-East, regional misconceptions about the efficacy or necessity of mosquito nets may hinder their proper use. Cultural beliefs or low-risk perception of malaria may play a role. Underutilization of nets despite availability leads to avoidable malaria cases. This misalignment between health behavior and access increases household healthcare spending and affects labor productivity. Correcting misperceptions through community outreach and behavior change communication (BCC) would align resource availability with optimal usage, enhancing health and economic outcomes. This reiterates the findings of Galvin et al. (2011); Okafor and Ogbonnaya (2020)

Also, the South-South region exhibits a reduction in inequality regarding mosquito net use, attributed to a younger household head demographic, higher female household headship, and greater social media usage. This corroborates the works of Omole & Ndukwe (2023); Ojo et al. (2022). This demographic is more likely to engage with public health messaging, adopt protective measures, and prioritize child health. Women often prioritize health-seeking behavior, and their leadership in households correlates with better mosquito usage. Improved net utilization reduces malaria incidence, healthcare costs, and work absenteeism, enabling more stable incomes and long-term economic gains. Encouraging gender-sensitive policies and leveraging social media as a health promotion tool in other regions could replicate this success.

In the South-West, inequality in net use is driven by perception gaps, rural-urban differences, and wealth disparities. This means that urban residents and wealthier households tend to access and use nets more effectively due to higher education levels and exposure to health campaigns. In contrast, rural and poorer populations may lack both access and trust. Unequal net use sustains a cycle where poorer, rural communities remain malaria-prone, facing recurrent health expenses and productivity losses. Targeted interventions, such as subsidized net programs and rural education efforts, can narrow this gap and foster equitable economic development.

In the North-Central, urbanization emerges as a key factor influencing inequality in mosquito net usage. This implies that urbanized areas may have better access to health services and net distribution, but higher population density and transient populations might dilute the effectiveness of mass campaigns. Conversely, peri-urban and rural fringes may be underserved. Urban bias in net distribution could leave rural households at higher risk, affecting agricultural labor and food security. Equitable distribution strategies that account for both urban and rural needs are critical for comprehensive malaria control and economic stability in the North-Central region. This reiterates the work of Solanke et al. (2023).

CONCLUSION AND POLICY RECOMMENDATION

The findings indicate a clear regional disparity in the usage of mosquito nets across Nigeria's six geopolitical zones, reflecting deeper socio-cultural, economic, and environmental influences. Notably, the North-East and North-West zones exhibit a significant and positive relationship with mosquito net usage. This suggests a higher level of awareness, acceptance, or possibly greater exposure to malaria prevention campaigns and distribution

programs in these zones, where malaria remains a critical public health threat. The persistent conflict and humanitarian crises in parts of the North-East, for instance, may have intensified health interventions by international and government agencies, thereby raising the uptake of preventive measures like mosquito nets.

Conversely, the southern regions, South-East, South-South, and South-West, present a significant but negative correlation with mosquito net usage. The results indicate that an increase in population in these areas corresponds to a decrease in mosquito net usage. This counterintuitive trend may be influenced by factors such as complacency due to perceived lower malaria risk, urbanization, or differences in lifestyle and housing infrastructure, which reduce mosquito exposure. Furthermore, despite higher literacy levels and access to healthcare in the South, cultural attitudes, misinformation, or preference for alternative preventive methods could be dampening net usage. It may also reflect insufficient targeting or follow-through in public health campaigns in these areas.

For Nigeria as a whole, these findings emphasize the need for region-specific malaria prevention strategies. While the North appears to benefit from mosquito net interventions, the South requires more targeted education and distribution efforts that address local barriers to adoption. This also points to a broader need for tailored health communication strategies that resonate with the socio-economic realities and perceptions of each region. Policymakers must understand that a one-size-fits-all approach to malaria prevention may be inadequate, and greater attention should be paid to the underlying factors influencing behavioral responses to health interventions across Nigeria's diverse geopolitical landscape. Given the diverse regional contexts, such as the heightened inequality in the North-East and South-East and reduced disparities in the South-South, the National Malaria Elimination Programme (NMEP) should implement customized, region-specific behavior change communication (BCC) campaigns. These should address regional perceptions about mosquito net use, particularly in areas like the North-East and South-West, where such beliefs strongly influence behavior, employ local dialects and culturally relevant messaging, using trusted community leaders, religious authorities, and local media, and also emphasize the health benefits of consistent net usage, especially during peak transmission seasons.

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