

Regional Disparities and Temporal Trends in Malaria Parasitemia Among Children in Nigeria: A DHS-Derived Subnational Analysis, 2010–2021

Nuhu Itopa Idris¹

nuhuitopa@gmail.com

Iconic Open University

Jamilu Suleiman¹

Iconic Open University

Joseph John Kolo¹

Iconic Open University

Mustapha Bala¹

Iconic Open University

Shamsudeen Shuaibu²

Iconic Open University

Research Article

Keywords: Malaria, Nigeria, DHS, MIS, Subnational analysis, Temporal trends, Health inequality

Posted Date: May 25th, 2026

DOI: <https://doi.org/10.21203/rs.3.rs-9593111/v1>

License:   This work is licensed under a Creative Commons Attribution 4.0 International License.

[Read Full License](#)

Additional Declarations: No competing interests reported.

Abstract

Background:

Malaria remains a major cause of morbidity among children under five in Nigeria, with persistent geographic disparities despite intensified control efforts. While national surveys provide periodic estimates, there is limited synthesis of multi-year subnational trends.

Methods:

This study analyzed aggregated malaria parasitemia data for children aged 6–59 months derived from Demographic and Health Surveys (DHS) and Malaria Indicator Surveys (MIS) conducted between 2010 and 2021. Data were accessed via the Humanitarian Data Exchange. Descriptive analyses were conducted to examine temporal and geographic patterns. One-way analysis of variance (ANOVA) assessed differences across regions, and independent sample t-tests compared prevalence estimates by diagnostic method.

Results:

Malaria parasitemia declined over the study period; however, substantial regional disparities persisted. Northern regions, particularly the North West and North East, consistently recorded higher prevalence compared to southern regions. Differences across regions were statistically significant ($F(5,18) = 2.88$, $p = 0.044$), with post-hoc analysis indicating significantly higher prevalence in the North West compared to the South East. RDT-based prevalence estimates were significantly higher than microscopy-based estimates (mean difference ≈ 14.6 percentage points; $t = -9.01$, $p < 0.001$). State-level patterns revealed substantial heterogeneity in malaria burden.

Conclusion:

Despite overall declines, pronounced subnational inequalities remain in Nigeria. These findings highlight the need for geographically targeted malaria control strategies and reinforce the importance of subnational data in guiding resource allocation.

Background

Malaria remains a major public health burden in Nigeria, contributing substantially to morbidity and mortality among children under five years [1]. Nigeria accounts for a significant proportion of the global malaria burden, with transmission patterns varying across ecological and geographic zones [1]. Despite the scale-up of key interventions—such as insecticide-treated nets, indoor residual spraying, and improved case management—progress has been uneven, with persistent regional disparities [2–5].

Nationally representative surveys, including the Demographic and Health Survey (DHS) and Malaria Indicator Survey (MIS), provide robust estimates of malaria prevalence and geographic variation [2–5].

However, most analyses rely on single survey rounds, limiting the ability to assess temporal trends and evolving patterns of inequality.

This study addresses this gap by analyzing multi-year, subnational malaria parasitemia data from 2010 to 2021 using publicly available datasets [8].

Methods

Study Design and Data Source

This study employed a secondary analysis of aggregated malaria parasitemia data derived from DHS and MIS surveys conducted in 2010, 2015, 2018, and 2021. The dataset was accessed via the Humanitarian Data Exchange and includes subnational prevalence estimates among children aged 6–59 months.

Variables

The primary outcome was malaria parasitemia prevalence. Analyses were conducted using rapid diagnostic test (RDT)-based estimates for regional and state-level comparisons. Microscopy-based estimates were additionally used for diagnostic comparison. Geographic region and state were key explanatory variables, and survey year was included to assess temporal trends.

Data Processing

Data cleaning involved removal of metadata rows, filtering for relevant indicators, and conversion of prevalence values to numeric format. Observations were categorized by Nigeria's six geopolitical zones and by state. Regions were further grouped into northern (North Central, North East, North West) and southern (South East, South South, South West) zones for comparative analysis.

Statistical Analysis

Descriptive analyses were conducted to summarize malaria prevalence across regions, states, and survey years. Regional trends were visualized using line plots, variability across regions was assessed using boxplots, and subnational heterogeneity was explored using heatmaps.

Inferential analyses included one-way analysis of variance (ANOVA) to assess differences in malaria prevalence across regions and independent sample t-tests to compare prevalence estimates between RDT and microscopy. Statistical significance was assessed at the 5% level. All analyses were conducted using R statistical software.

Results

A total of four survey periods (2010, 2015, 2018, and 2021) were included. Malaria parasitemia declined over the study period; however, substantial variation persisted across regions and states.

Table 1 presents regional malaria prevalence estimates by diagnostic method and survey year. Across all regions, malaria prevalence declined over time for both rapid diagnostic test (RDT) and microscopy-based estimates, although the magnitude of reduction varied geographically. Northern regions—particularly the North West and North East—consistently recorded higher prevalence compared to southern regions throughout the study period. For example, RDT-based prevalence in the North West declined from 58.7% in 2010 to 21.0% in 2021 but remained higher than corresponding values in southern regions. In contrast, southern regions, especially the South West and South East, maintained relatively low prevalence levels across all survey years. Across all regions and time points, RDT-based estimates were consistently higher than microscopy-based estimates.

Table 1
Regional malaria prevalence (%) among children aged 6–59 months in Nigeria, 2010–2021 (pooled DHS/MIS estimates)

Region	Diagnostic method	2010	2015	2018	2021
North Central	RDT	45.1	50.7	37.0	32.3
	Microscopy	49.4	32.0	21.2	17.0
North East	RDT	46.8	42.8	30.5	30.5
	Microscopy	57.0	27.6	18.2	16.0
North West	RDT	58.7	37.4	36.4	21.0
	Microscopy	42.0	33.0	19.7	10.2
South East	RDT	20.7	17.4	13.3	10.4
	Microscopy	13.5	10.2	7.1	5.0
South South	RDT	31.3	28.4	19.6	15.7
	Microscopy	21.8	16.3	11.4	7.6
South West	RDT	17.0	15.0	12.3	10.0
	Microscopy	10.0	8.1	6.0	4.0
Note: RDT = Rapid Diagnostic Test. DHS = Demographic and Health Survey; MIS = Malaria Indicator Survey.					

Malaria prevalence trends across Nigeria's geopolitical zones (Fig. 1) show an overall decline, although northern regions—particularly the North West and North East—consistently maintained higher prevalence levels compared to southern regions.

The distribution of malaria prevalence across regions (Fig. 2) further indicates greater variability and higher median values in northern zones relative to southern zones.

This pattern is further reflected in a pronounced north–south gradient (Fig. 3), with substantially higher prevalence observed in northern regions.

At the state level, malaria prevalence patterns (Fig. 4) reveal clusters of high burden concentrated in northern states, while southern states generally exhibit lower prevalence.

One-way analysis of variance (ANOVA) indicated statistically significant differences in malaria prevalence across regions ($F(5,18) = 2.88$, $p = 0.044$). Post-hoc comparisons (Tukey HSD) showed that the North West had significantly higher prevalence compared to the South East ($p = 0.029$), while other pairwise differences were not statistically significant.

Malaria prevalence estimates based on rapid diagnostic tests (RDT) were significantly higher than those obtained using microscopy (mean difference ~ 14.6 percentage points; $t = -9.01$, $p < 0.001$).

Discussion

This study provides a multi-year, subnational analysis of malaria parasitemia in Nigeria, demonstrating both national progress and persistent regional inequalities. While malaria prevalence has declined over time, the burden remains disproportionately concentrated in northern regions.

The observed north–south gradient is consistent with established malaria transmission patterns in Nigeria and reflects differences in ecological conditions, intervention coverage, and socioeconomic factors. The persistence of higher prevalence in northern regions suggests that existing interventions may not be reaching or effectively serving the most affected populations.

A key contribution of this study is the use of multi-year, subnational data to highlight geographic heterogeneity in malaria burden. National averages may obscure high-burden areas, potentially leading to inefficient resource allocation.

The significantly higher prevalence estimates observed with RDT compared to microscopy likely reflect the persistence of HRP2 antigens following parasite clearance, leading to detection of recent infections not captured by microscopy.

These findings have important implications for malaria control policy in Nigeria. Strengthening subnational surveillance and prioritizing high-burden areas will be essential for achieving equitable malaria control and advancing toward elimination goals.

Limitations

This study is based on aggregated subnational data and does not include individual-level survey data, limiting the ability to adjust for demographic, socioeconomic, and environmental factors. As a result, causal inference cannot be established. Additionally, differences between RDT and microscopy estimates may reflect diagnostic variability rather than true differences in malaria prevalence.

Conclusion

Malaria prevalence has declined in Nigeria, but significant regional disparities persist. Addressing these inequalities through targeted, context-specific interventions is essential for improving malaria control outcomes and reducing disease burden among vulnerable populations.

Declarations

Availability of Data and Materials

The data used in this study are publicly available from the Humanitarian Data Exchange (<https://data.humdata.org/dataset/dhs-data-for-nigeria>).

Ethics Approval

This study used publicly available secondary data and did not require additional ethical approval.

Funding

No specific funding was received.

Competing Interests

The authors declare no competing interests.

Authors' Contributions

Nuhu Idris Itopa conceptualized the study, conducted the analysis, and drafted the manuscript.

Jamilu Suleiman contributed to data cleaning and analysis.

Joseph John Kolo contributed to interpretation and visualization.

Mustapha Bala contributed to literature review and editing.

Shamsudeen Shuaibu provided supervision and critical revision.

All authors approved the final manuscript.

References

1. World Health Organization. World malaria report 2023. Geneva: WHO; 2023.

2. National Population Commission (NPC), ICF Macro. Nigeria MIS 2010. Abuja; 2011.

3. NMEP, NPC, NBS, ICF. Nigeria MIS 2015. Abuja; 2016.

4. National Population Commission (NPC), ICF. Nigeria DHS 2018. Abuja; 2019.

5. NMEP, NPC, NBS, ICF. Nigeria MIS 2021. Abuja; 2022.

6. Agresti A, Kateri M. Categorical data analysis. Springer; 2025.

7. Bassey SE, Izah SC. Determinants of malaria prevalence in Nigeria. J Mosq Res. 2017.

8. Humanitarian Data Exchange. DHS data for Nigeria: malaria parasitemia (subnational). Available from: <https://data.humdata.org/dataset/dhs-data-for-nigeria>. Accessed Nov 2025

9. Kumwiche P. Epidemiological data analysis using R. JMIR Med Educ. 2023.

Figures

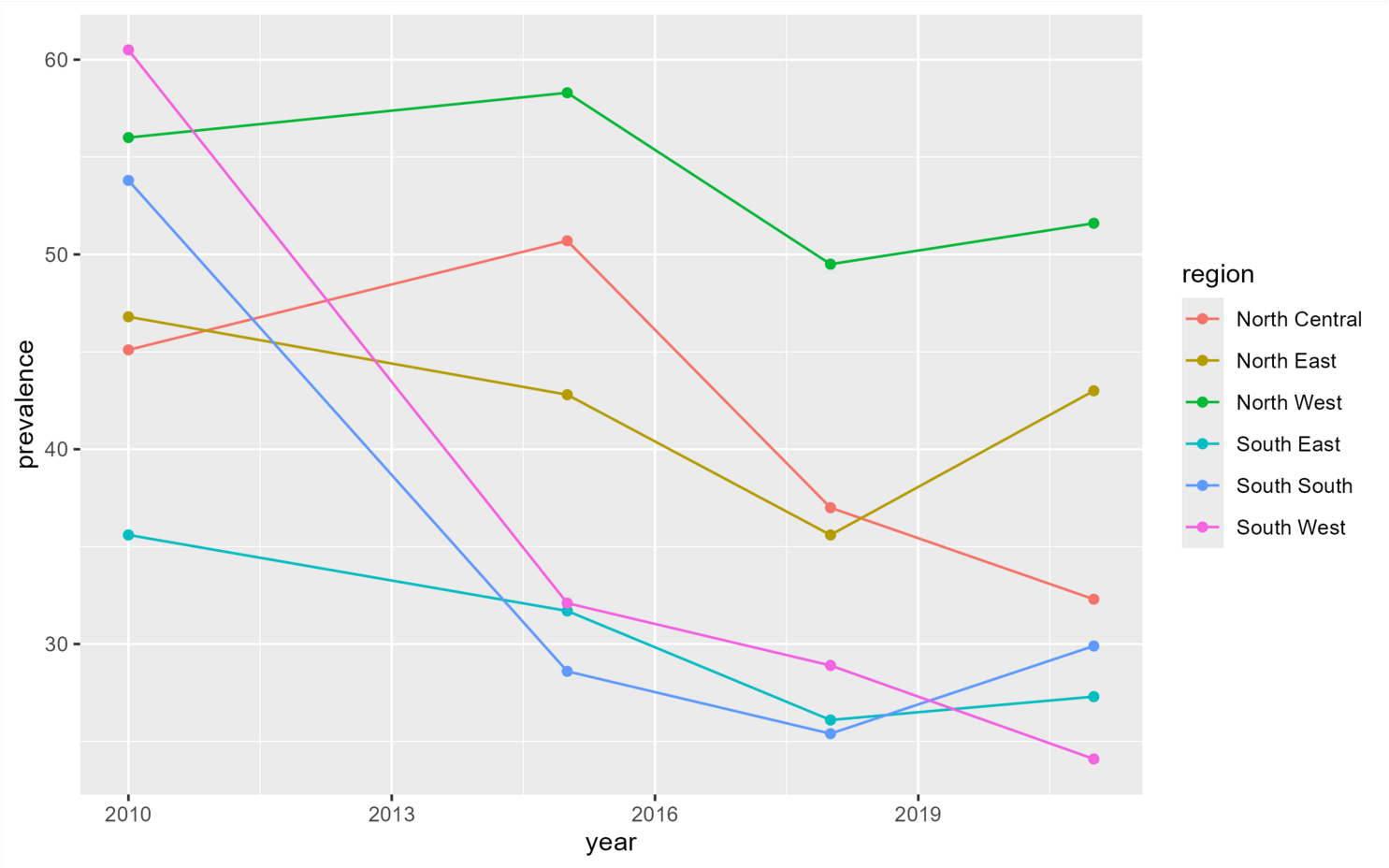


Figure 1

Temporal trends in malaria prevalence among children aged 6–59 months across Nigeria’s geopolitical zones, 2010–2021. Malaria prevalence declined across all regions over the study period; however,

northern regions—particularly the North West and North East—consistently exhibited higher prevalence compared to southern regions.

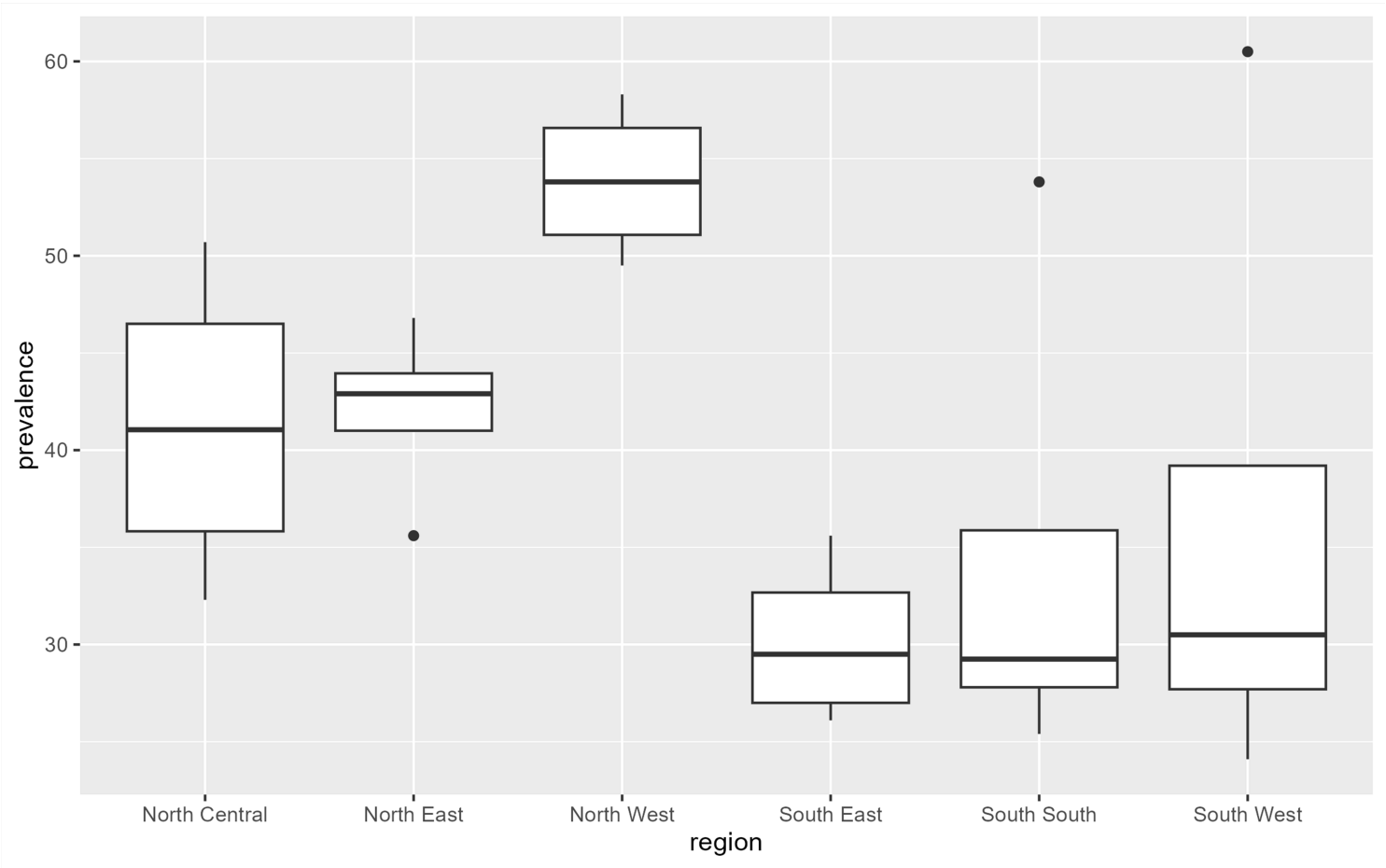


Figure 2

Distribution of malaria prevalence across Nigeria’s geopolitical zones. Boxplots display median values, interquartile ranges, and variability across regions. Northern regions show higher median prevalence and greater variability compared to southern regions.

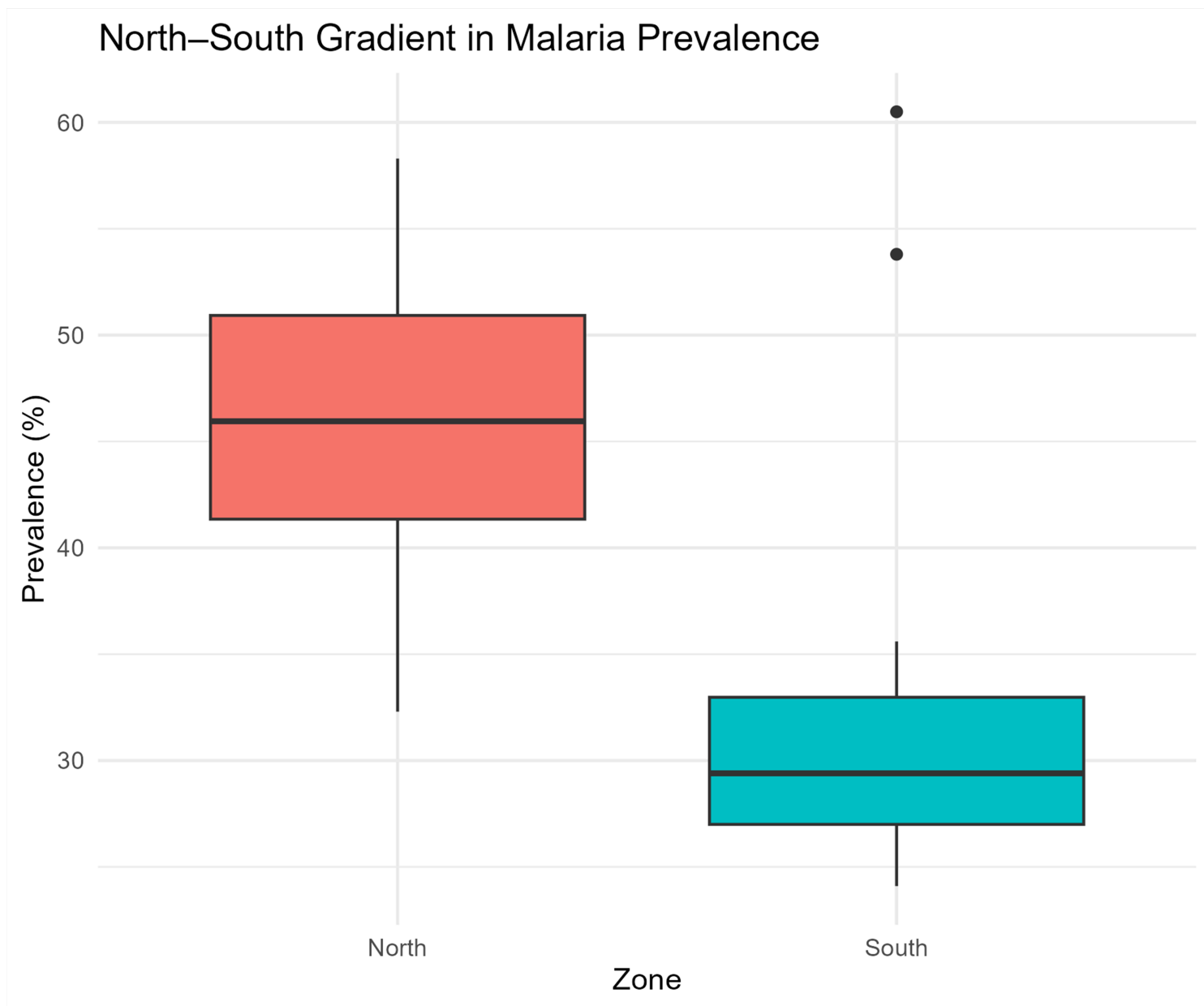


Figure 3

North–south gradient in malaria prevalence among children aged 6–59 months in Nigeria. Malaria prevalence is consistently higher in northern regions than in southern regions, demonstrating a clear geographic disparity.

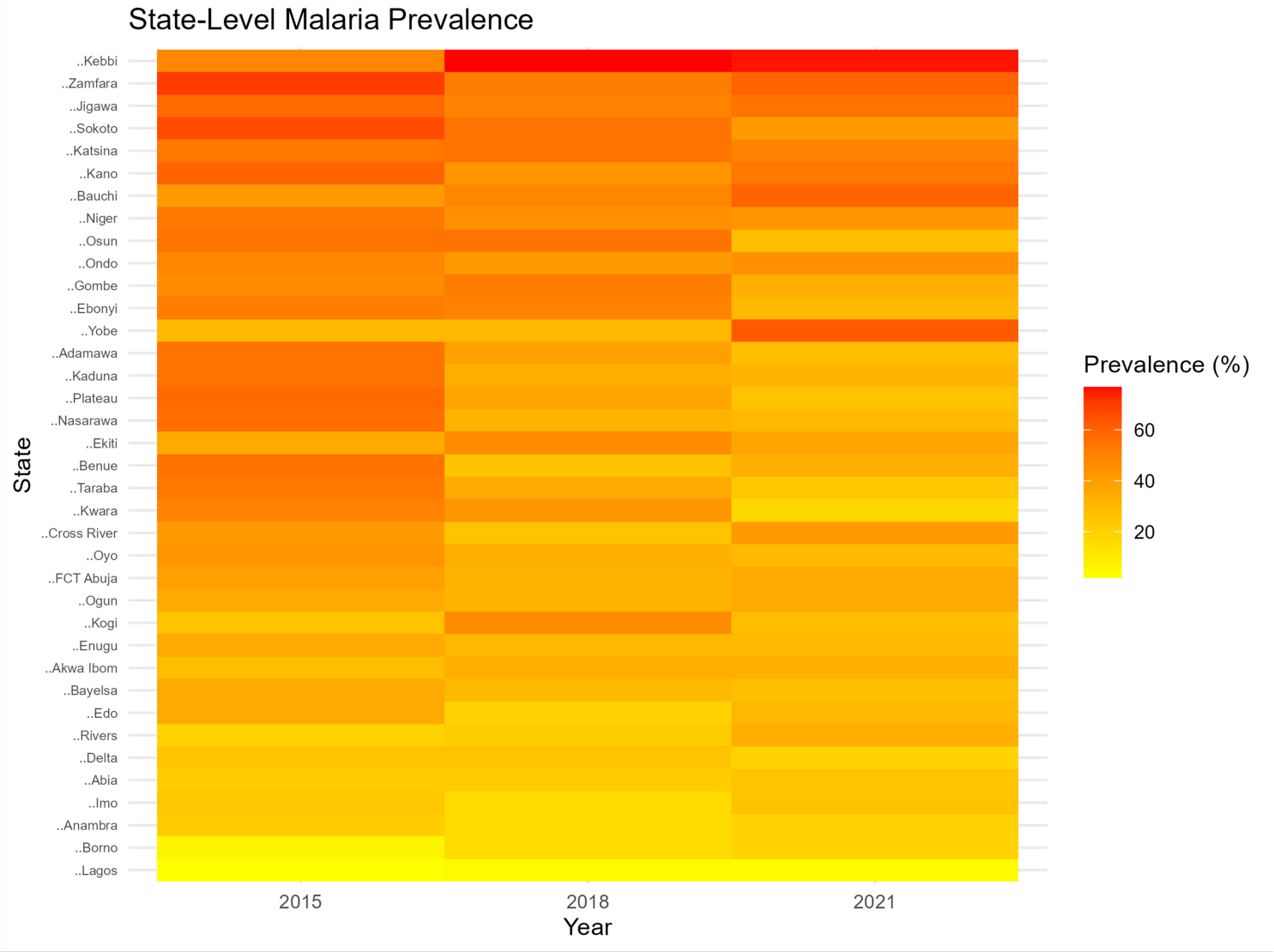


Figure 4

State-level malaria prevalence patterns across Nigeria, 2015–2021. Heatmap illustrates subnational variation in malaria prevalence among children aged 6–59 months. Darker colors indicate higher prevalence. High-burden clusters are concentrated in northern states, while southern states generally exhibit lower prevalence.