Coverage of Malaria Interventions in Nigeria

Secondary Analysis of Data from National Surveys

January 2019

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U.S. President's Malaria Initiative

MEASURE Evaluation

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Samantha Herrera served as the team leader for this research study, leading the design of the research protocol, overseeing the analysis, and writing up of the results. Yazoume Yé provided technical support for the research study design and overall technical guidance and support on the analysis and report. Tajrina Hai, Kirsten Zalisk, and Andrew Andrada provided support for the analysis and report writing. Cindy Young-Turner reviewed and edited the report. Uwem Inyang, Dr. Bala Audu Mohammed, and Perpetua Uhomibhi provided input into the study protocol, interpretation and write-up of the study findings. The knowledge management team at the University of North Carolina provided editorial, production, and design services.

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ABBREVIATIONS

ACT	artemisinin combination therapy
ANC	antenatal care
CHAID	chi-square automatic interaction detector
CI	confidence interval
DHS	Demographic and Health Survey
FCT	Federal Capital Territory
IPTp	intermittent preventive treatment in pregnancy
IRB	institutional review board
IRS	indoor residual spraying
ITN	insecticide-treated net
M&E	monitoring and evaluation
NDHS	Nigeria Demographic and Health Survey
NMEP	National Malaria Elimination Programme
NMIS	Nigeria Malaria Indicator Survey
NMSP	National Malaria Strategic Plan
PHC	primary healthcare
PMI	President's Malaria Initiative
RDT	rapid diagnostic test
SBC	social and behavior change
SP	sulfadoxine-pyrimethamine
WHO	World Health Organization

EXECUTIVE SUMMARY

Background

Malaria is a major public health burden in Nigeria, posing a risk to the entire population. In 2014, the country reported more than 7.8 million confirmed cases of malaria and more than 6,000 malaria deaths (World Health Organization [WHO], 2015). Malaria accounts for approximately 60 percent of outpatient visits and 30 percent of hospitalizations among children under five (WHO, 2015). Over the past decade, substantial efforts have been made in malaria control by the government and its partners to expand coverage of insecticide-treated net (ITNs), conduct intermittent preventive treatment in pregnancy (IPTp), and improve and scale up malaria case management. The President's Malaria Initiative (PMI) began work in Nigeria in 2010 and has been a key partner in the government's efforts to expand malaria control intervention coverage.

To further its efforts to reduce the malaria burden, the National Malaria Elimination Programme (NMEP) and its partners are working to scale up malaria interventions in line with the National Malaria Strategic Plan 2014–2020 (Federal Ministry of Health & Roll Back Malaria, 2014). The National Malaria Strategic Plan 2014–2020 outlines the country's efforts to significantly scale up malaria interventions to achieve its goals of attaining pre-elimination status and reducing malaria-related deaths to zero by 2020. To measure progress of malaria control achievements in the past decade in Nigeria and to guide future investments, Nigeria has implemented several population-based surveys, including the Nigeria Malaria Indicator Survey (NMIS) in 2010 and 2015, and the Nigeria Demographic and Health Survey (NDHS) in 2008 and 2013. These surveys provide information on malaria control intervention coverage and malaria morbidity at the state and national levels.

Methods

In response to a request from PMI/Nigeria, MEASURE Evaluation conducted this research study to provide further evidence to guide both PMI's and NMEP's efforts in malaria program implementation in Nigeria.

The study covered five research objectives: (1) provide state-level estimates for all 2015 NMIS indicators on malaria control intervention coverage and malaria morbidity; (2) examine key NMIS indicators for PMI- and non-PMI-supported states through a pooled analysis, assess performance against set national and PMI targets, and conduct a trend analysis of key NMIS indicators from 2008 to 2015 for PMI-supported states; (3) examine the relationship among household ITN ownership, access, and use and parasitemia and severe anemia prevalence in children under five; (4) assess the relationship between exposure to social and behavior change (SBC) messages and key malaria behavioral outcomes; and (5) conduct a profiling of different subnational populations to inform where to focus future malaria control investment to maximize impact.

The study consisted of secondary analysis of data from the 2008 and 2013 NDHS and the 2010 and 2015 NMIS. A number of different analytical techniques were used to answer the five research objectives. These analytical techniques included trend analyses, pooled analyses to examine differences between PMI- and non-PMI-supported states, multiple regression analyses, and chi-square automatic interaction detector (CHAID) analyses to profile malaria intervention coverage and malaria morbidity outcomes at the subnational level.

Results

Research Objective 1: State-level 2015 estimates for malaria intervention coverage and malaria morbidity

The study team calculated state-level point estimates with 95 percent confidence intervals for malaria intervention coverage and malaria morbidity indicators in the 2015 NMIS. We then compared these estimates with the national average to examine state-level performance. Interventions and morbidity outcomes examined were household ITN ownership and access, ITN use, case management, IPTp uptake, and parasitemia and severe anemia prevalence in children 6–59 months of age.

The results showed large variations in the coverage of vector control interventions across the states in 2015, with generally higher coverage in the North West and North East regions and lower coverage in the three southern regions of the country. At the state level, Bauchi, Jigawa, and Kaduna performed significantly better across the majority of vector control indicators compared to the national average. Most states had similar IPTp2 (37 percent) and IPTp3 (19 percent) coverage compared to the national average, although the Federal Capital Territory (FCT) Abuja, Kogi, Borno, Cross River, Ekiti, and Oyo States all had significantly higher coverage of both IPTp2 and IPTp3 than the national average, and Delta state had significantly lower coverage for both indicators. For case management, coverage of children under five with fever who had a finger or heel stick was very low nationally, and few states varied from the national average (13 percent). Care-seeking from a health provider for children with fever was slightly more varied across the states, with eight states performing significantly better than the national average (66 percent) and six performing significantly worse than the national average, with very low coverage in Sokoto (26 percent). The majority of states had similar or worse artemisinin-based combination therapy (ACT) treatment coverage, compared to the national average (38 percent), with only two states performing significantly better (Cross River and FCT Abuja). The majority of states did not vary significantly from the national average in malaria parasitemia (rapid diagnostic test [45 percent] or microscopy [27 percent]), or moderate (34 percent) and severe anemia prevalence (9 percent). Generally, malaria morbidity was significantly higher in a number of the states in the North West region, particularly Kebbi, Sokoto, and Zamfara states; it was generally lower in the South East region, particularly in Abia, Anambra, and Imo states.

At both the national and state levels, the majority of 2015 intervention coverage targets for vector control, IPTp, and case management were not achieved. However, at the national level, the 2015 targets for parasitemia and severe anemia were close to being achieved, with many states achieving the targets. Large gaps remain at the national and individual state levels to achieve the 2020 targets for vector control, IPTp, diagnostic testing and treatment coverage, and malaria morbidity. A few states have already achieved some of the 2020 targets.

Research Objective 2: Trend and pooled analysis of key indicators for PMI- and non-PMI-supported states and assessment of performance against set targets

Trends over time in women's knowledge of malaria and exposure to malaria SBC messages, malaria intervention coverage, case management, and malaria morbidity were assessed between 2008 and 2015 in both PMI- and non-PMI-supported states. Differences between PMI- and non-PMI-supported states were

examined using the 2015 NMIS data. In addition, the 2015 NMIS estimates for PMI-supported states were compared to set national NMEP targets to assess performance to date.

Knowledge of the main symptoms and correct treatment of malaria, knowledge of malaria prevention methods, and exposure to SBC malaria risk and prevention messages was generally lower in PMI-supported states in 2010 compared to non-PMI-supported states; however, by 2015, knowledge and exposure levels improved in PMI-supported states and were generally similar to or slightly higher than the levels in non-PMI-supported states. Knowledge of the cause of malaria was high in 2010 and 2015 across both PMI- and non-PMI-supported states. Despite improvements in knowledge of key prevention measures for malaria and exposure to at least one malaria-related SBC message in the past six months, levels still remained relatively low in 2015 (all under 50 percent).

Vector control coverage with ITNs and indoor residual spraying improved substantially in both PMI- and non-PMI-supported states between 2008 and 2015, with no significant differences in coverage between PMI- and non-PMI-supported states across the different survey years. Improvements were also observed in ITN use among the general population, children under five, and pregnant women between 2008 and 2015 in PMI- and non-PMI-supported states; however, by 2015, ITN use was higher among these populations in PMI-supported states. IPTp coverage improved significantly between 2008 and 2015 in both PMI- and non-PMI-supported states, but it was higher in PMI-supported states by 2015. Timely care-seeking for fever and diagnostic testing coverage improved slightly between 2008/2010 and 2015, but overall coverage remained low and similar across PMI- and non-PMI-supported states during this time period. ACT treatment coverage improved significantly between 2008 and 2015 in both PMI- and non-PMI-supported states; in 2015, coverage of ACT treatment was only slightly higher in PMI-supported sates.

Parasitemia (measured via microscopy) and severe anemia prevalence decreased significantly between 2010 and 2015 in PMI- and non-PMI-supported states. In 2015, parasitemia prevalence was significantly lower in non-PMI-supported states; however, no significant difference was observed in severe anemia prevalence between PMI- and non-PMI-supported states.

In terms of performance of PMI-supported states against the set 2015 NMEP targets, the majority of PMI-supported states did not achieve the targets for malaria intervention coverage. Most PMI-supported states, with the exception of Zamfara and Sokoto, did meet the 2015 NMEP target for severe anemia prevalence, and almost half met the target for malaria parasitemia prevalence. A large gap remains between the 2015 malaria intervention coverage levels and the 2020 targets.

Research Objective 3: Relationship between household ITN ownership and use and parasitemia and severe anemia prevalence in young children

The relationship between household ITN ownership, access, and use, and parasitemia (measured via microscopy) and moderate and severe anemia prevalence in children 6–59 months of age was examined through multiple logistic regression analyses.

A significant protective effect was found between parasitemia prevalence in children 6–59 months of age and ITNs owned for 2–6 months and for 7–12 months. The odds of parasitemia was approximately 30 percent lower among children from households that owned ITNs for 2–6 months or 7–12 months, compared to

children from households that did not own an ITN. No significant protective effective was observed for newly acquired ITNs (less than 2 months) or ITNs acquired more than 12 months ago. A borderline significant protective effect was also observed between parasitemia prevalence and ITN ownership of at least one ITN, with the odds of parasitemia among children from households that owned at least one ITN 19 percent lower than among children from households that do not own an ITN. No significant association was observed between household ITN access or ITN use among children 6–59 months of age and parasitemia prevalence.

When examining the relationship between ITN use and severe anemia prevalence in children 6–59 months of age, a significant protective effect was observed. The odds of severe anemia was 30 percent lower among children who used an ITN the previous night than among children who did not use an ITN. No significant association was observed between severe anemia and household ITN ownership or household ITN access; however, the results show a trend toward a protective effect. No significant association was observed between ITN ownership, household ITN access, or ITN use and moderate anemia prevalence in children 6-59 months of age.

Research Objective 4: Relationship between maternal exposure to malaria-related behavior change communication messages and malaria behavioral outcomes

The relationship between maternal exposure to malaria SBC messages and ITN use among children under five, ITN use among pregnant women, and care-seeking for children with fever from a health provider was examined through multiple logistic regression analyses. A significant positive association was observed between maternal exposure to ITN-related messages and ITN use among children under five; the odds of using an ITN among children whose mother was exposed to at least one ITN-related messages was 2.1 times greater than among children whose mother was not exposed to an ITN-related message.

The odds of ITN use among pregnant women who were exposed to at least one ITN-related message was 2.4 times greater than among pregnant women who were not exposed to an ITN-related message. A borderline significant association was observed between maternal exposure to care-seeking and treatment messages and care-seeking for children with fever; the odds of children having care sought for them when they got a fever was 1.6 times greater among children whose mother was exposed to a care-seeking message than among children whose mothers were not exposed to care-seeking messages.

The relationship between women's exposure to malaria SBC messages and IPTp uptake was assessed using a case study approach, looking at the odds of exposure and uptake of IPTp (two or more doses and three or more doses). A positive association was found between malaria SBC message exposure and women's uptake of IPTp2 and IPTp3. Overall, the odds of exposure to at least one malaria message among women who received IPTp2 was 1.7 times greater than the odds of exposure among women who did not receive IPTp2, and the odds of exposure to at least one malaria message among women who received IPTp3 was 2 times greater than the odds of exposure among women who did not receive IPTp3. These results demonstrate a positive effect of maternal exposure to malaria-related prevention messages and use of ITNs by children under five and care-seeking behavior for children with fever, and between women's exposure to malaria messages and their uptake of malaria prevention behaviors in pregnancy.

Research Objective 5: Subnational profiling of malaria intervention coverage and malaria morbidity

The study conducted a profiling of different subnational groups for key malaria intervention coverage and malaria morbidity outcomes using the 2015 NMIS. This analysis was carried out using CHAID modeling. The specific outcomes assessed were household ITN ownership; ITN use among children under five, pregnant women, and the general population; IPTp (three or more doses); ACT treatment coverage for children with fever; exposure to at least one malaria SBC message in the past six months; and parasitemia and severe anemia prevalence among children 6–59 months of age.

The best predictor for ITN ownership and use among all three populations examined was region of the country, with large variations in coverage levels across the different regions. Other important predictors of ITN ownership and use were education level of the mother or head of the household, household wealth quintile, and household size. For household ITN ownership, more efforts should be focused on targeting interventions to improve ITN ownership among small-size households in the three southern regions of the country and the North Central region, and among medium and large-size households in the North Central and South South regions. For ITN use across all populations of interest, efforts should be placed on improving use in the three southern regions and in medium and large-size households in which there are insufficient ITNs to cover all household members.

For IPTp (3+ doses), the greatest predictor of uptake was place of residence. The results indicate that efforts should be focused on improving coverage among women from rural areas across all six regions who have no formal education or a primary level of education only. Place of residence was also the best predictor for ACT treatment among children under five with fever. The CHAID results indicate that efforts should be targeted to improving treatment coverage among children from rural areas and specifically among children whose mother has no formal education.

The best predictor of exposure to at least one malaria SBC message among women 15–49 years of age was household wealth quintile, with greater levels of exposure associated with increasing household wealth. There was greater variation in terms of subgroups to target to improve message exposure; the main groups are as follows: (1) women from households in the middle wealth quintile and from rural areas across all regions of the country except the North Central region, and (2) women from households in the lowest wealth quintile from the North West and South West regions.

Household wealth quintile was also the most significant predictor of parasitemia and severe anemia in children 6–59 months of age, with increasing household wealth associated with lower levels of malaria morbidity. Age of the child and region of the country were also significant predictors of malaria morbidity. To have the greatest impact on parasitemia prevalence, resources should be targeted to help reduce prevalence among children 24–59 months of age across all regions of the country from households in the bottom two wealth quintiles because they comprise almost half of all children with parasitemia infection. To reduce severe anemia prevalence, emphasis should be placed on interventions for children 12–35 months of age from the North East, North Central, and South South regions and from households in the lowest wealth quintile, and children from households in the second wealth quintile across all regions of the country.

Conclusions and Recommendations

The results from this research study highlight the substantial improvements in malaria intervention coverage and reductions in malaria morbidity in Nigeria between 2008 and 2015. The country has seen some greater gains in intervention coverage in PMI-supported states, specifically in vector control and IPTp coverage. Despite the significant gains experienced, large gaps remain to be filled to attain the set 2020 national targets for malaria intervention coverage and malaria morbidity reduction. The subnational profiling results provide important guidance on where to focus the scale-up of malaria control interventions to have the greatest impact—both in terms of targeting those at greatest risk for malaria and making the greatest gains in coverage to achieve the 2020 national targets. Table 1 provides a summary of recommendations by research objective.

Table 1. Summary of recommendations by research objective

	Thematic area	Key issues	Recommendations
1	Coverage of vector control interventions (ITNs/long-lasting ITNs)	• Coverage of household ITN ownership, access, and use has improved between 2008 and 2015, with generally greater improvements in PMI-supported states; however, coverage levels are far below the national targets. • Household ITN ownership and use was substantially lower in the southern regions and among several subpopulations identified.	• Continue carrying out ITN distribution using mass campaigns and targeted distribution through antenatal care (ANC) and schools, with a focus on targeted distribution among the identified subgroups with lower coverage and uptake. • Consider use of rapid surveys to track ITN ownership, access, and use among identified subgroups with lower ownership coverage and use of ITNs, and identify barriers to ownership and use.
2	Coverage of IPTp	• IPTp coverage has improved between 2008 and 2015, in both PMI- and non-PMI-supported states; however, coverage levels are far below the national targets. • IPTp coverage was substantially lower among pregnant women from rural areas across all regions of the country with low levels of education and among pregnant women from urban areas in the South West and South South regions.	• Integrate routine monitoring of quality of ANC into supervisory visits at primary healthcare (PHC) facilities to identify and address issues related low administration of IPTp. Prioritize routine monitoring, mentoring, and refresher trainings for health providers on malaria in pregnancy care for identified subpopulations with substantially lower IPTp coverage. • Consider conducting operational research to understand health providers' perspectives on low uptake of IPTp at PHC facilities, targeting this research to the locations of subgroups identified with lower IPTp coverage.
3	Malaria case management	• Small improvements in diagnostic testing coverage have been made between 2010 and 2015; however, coverage levels remain far below national targets. • Trends in care-seeking for children under five with fever have fluctuated between 2008 and 2015, with overall small improvements during this time period. Prompt care-seeking for children with fever has also improved over the same time period; however, coverage levels overall are low. • Substantial improvements have been observed in ACT treatment coverage among children with fever between 2008 and 2015; however, coverage levels remain far below national targets. Further, ACT treatment coverage was substantially lower among children from rural areas, with the lowest coverage among those whose mother has no formal education.	• Integrate routine monitoring of quality of care into supervisory visits at PHC facilities, to identify and address issues related to proper malaria case management. Prioritize routine monitoring, mentoring, and refresher trainings for health providers in rural PHC facilities. • Tailor SBC interventions and messages to reinforce timely care-seeking for fever, to demand diagnostic testing for fever at PHC facilities and to improve knowledge of ACT treatment for malaria. Prioritize SBC messages in rural areas among women of reproductive age who have less formal education.

	Thematic area	Key issues	Recommendations
4	SBC intervention coverage	• Study findings suggest a positive association between maternal exposure to malaria SBC messages and ITN use among children under five, ITN use among pregnant women, and uptake of IPTp. However, maternal exposure to malaria messages nationally was low overall, and coverage is very uneven, with large differences by place of residence, region, and wealth quintile.	• Consider conducting operational research to understand which sources or messages are the most effective in positively influencing uptake or use of malaria preventions interventions to inform future SBC programming. • Prioritize and target SBC communication interventions to the following subpopulations to improve overall coverage and equity of coverage: women from rural areas across all regions except the North Central region, women from households in the middle wealth quintile, and women from the North West and South West regions from households in the lowest wealth quintile.
5	Malaria morbidity burden	• National parasitemia and severe anemia levels have shown significant reductions between 2010 and 2015 and are close to or at national target levels. However, reductions have been uneven and unequitable across the country, with children from households in the lowest wealth quintiles experiencing the highest malaria burden.	• Integrate routine monitoring of quality of malaria case management care into supervisory visits at PHC facilities to identify and address issues related to proper malaria case management, particularly among subpopulations in the lowest wealth quintiles. • Ensure optimal coverage of malaria prevention interventions, such as ITN ownership and use, among subpopulations from the lowest wealth quintiles.

1. BACKGROUND

1.1 Malaria in Nigeria

1.1.1 Epidemiology

Malaria is a major public health burden in Nigeria, with the entire population at risk for malaria. In 2014, the country reported more than 7.8 million confirmed cases of malaria and more than 6,000 malaria deaths (World Health Organization [WHO], 2015). About 21 percent of deaths among children under five in Nigeria are caused by malaria. Malaria accounts for approximately 60 percent of outpatient visits and 30 percent of hospitalizations among children under five (WHO, 2015). Malaria is a large burden on the health system and has severe social and economic costs, costing approximately 480 billion naira (USD $1.3 billion) in out-of-pocket treatments, prevention costs, and loss of productive labor (Federal Ministry of Health & Roll Back Malaria, 2014).

Plasmodium falciparum is the predominant parasite species (95.1%) in the country, followed by *P. malariae* (1.6%), *P. ovale* (0.2%), and mixed species (4.1%) (WHO, 2012). Approximately 85 percent of Nigerians live in areas of mesoendemic transmission, and about 15 percent live in areas of hyper-holoendemic transmission (National Malaria Elimination Programme [NMEP], National Population Commission [NPopC], National Bureau of Statistics [NBS], & ICF International, 2016). In 2015, the national prevalence of malaria among children under five was 27 percent (via microscopy) (NMEP, NPopC, NBS, & ICF International, 2016). There are wide geographical differences in malaria prevalence, however, with the percentage of children under five with malaria (via microscopy) as high as 64 percent in Kebbi State and 63 percent in Zamfara State in the North West region, and as low as 5 percent in Imo State in the South East region and Kogi State in the North Central region, and near zero prevalence in Lagos (NMEP, NPopC, NBS, & ICF International, 2016).

1.1.2 Intervention Coverage

Over the past decade, substantial efforts have been made to scale up malaria control interventions in Nigeria. As a result of these efforts, household ownership of at least one insecticide-treated net (ITN) reached 69 percent nationally by 2015 (NMEP, NPopC, NBS, & ICF International, 2016). By 2015, ITN use the previous night reached 37 percent among the general population, 44 percent among children under five, and 49 percent among pregnant women (NMEP, NPopC, NBS, & ICF International, 2016). Coverage of intermittent preventive treatment in pregnancy (IPTp) of at least three or more doses in 2015 reached just under 20 percent of women who had a live birth in the previous two years (NMEP, NPopC, NBS, & ICF International, 2016). Among children under five with fever in the two weeks preceding the survey, 66 percent received advice or treatment for the fever, 13 percent received a diagnostic test, and 38 percent received artemisinin-based combination therapy (ACT) among those who received any antimalarial (NMEP, NPopC, NBS, & ICF International, 2016).

1.2 Key Milestones in National Malaria Control Strategy

The Federal Ministry of Health's NMEP, in close collaboration with other key stakeholders in Nigeria, formulates policy and coordinates efforts nationwide to implement effective malaria control interventions, including ITNs, targeted indoor residual spraying (IRS), IPTp, and prompt and effective case management.

The current National Malaria Strategic Plan (NMSP) 2014–2020, outlines the country's efforts to significantly expand malaria interventions to achieve its goals of attaining pre-elimination status and reducing malaria-related deaths to zero by 2020. The NMSP 2014-2020 is the fourth plan developed by the country to guide its efforts in malaria control. Table 2 outlines the key milestones in Nigeria's malaria control strategy, beginning in 1999 when the NMEP began collaboration with the Roll Back Malaria Partnership.

Table 2. Key milestones in Nigeria's malaria control strategy

Year	Milestone
1999	National Malaria Control Programme (NMCP) began collaboration with Roll Back Malaria Partnership Demographic Health Survey (DHS) conducted
2000	Abuja Declaration signed
2001	First NMSP (2001-2005) adopted
2003	DHS conducted
2004	IPTp adopted as a policy
2005	NMCP adopted ACT as the first-line treatment for uncomplicated malaria
2006	Second NMSP (2006-2010) adopted ACTs made available over the counter
2007	Rapid diagnostic tests adopted
2008	DHS conducted Artemisinin and other monotherapies banned; testing before treatment recommended by NMCP
2009	Third NMSP (2009-2013) adopted—new plan changed its focus from covering vulnerable groups to universal coverage
2010	Nigeria became a President's Malaria Initiative (PMI)country First Nigeria Malaria Indicator Survey (NMIS) conducted Affordable Medicines for Malaria launched in Nigeria
2011	PMI began supporting malaria control interventions in Nigeria
2013	Change in name from NMCP to NMEP DHS conducted
2014	Fourth National Malaria Strategic Plan (2014–2020) adopted NMEP adopted one ITN for every two people in a household strategy IPTp 3+ doses policy adopted
2015	Second NMIS conducted

1.3 Overview of the President's Malaria Initiative support in Nigeria

Nigeria became a President's Malaria Initiative (PMI) country in 2010, with support beginning in 2011. PMI has been a key player in the government's efforts to expand malaria control intervention coverage. The initial focus of PMI support was in the states of Cross River, Zamfara, and Nassarawa, but since 2011, it has

expanded its support to reach 11 states.[1] PMI works with the states and other partners to ensure that all functional heath facilities are supported and focuses its efforts in the following key areas: (1) prevention through ITNs, IRS, and IPTp; (2) diagnosis and treatment through procurement and distribution of rapid diagnostic tests (RDTs), ACTs, and sulfadoxine-pyrimethamine (SP); (3) training of health workers in malaria diagnosis, malaria treatment, and prevention of malaria in pregnancy; (4) support for monitoring and evaluation, including building capacity in monitoring and evaluation in the NMEP and state malaria programs and strengthening the health management information system; and (5) social and behavior change (SBC) interventions to increase demand and use of malaria control interventions. PMI has also provided support for program management at the national and state levels, including supporting coordination structures, providing supportive supervision, and supporting health governance. Between 2010 and 2016, PMI provided Nigeria with USD $420 million for malaria control efforts (NMEP, NPopC, NBS, & ICF International, 2016).

1.4 Rationale for Research Study

To measure progress of malaria control achievements to date in Nigeria and to guide future investments, Nigeria has implemented Nigeria Malaria Indicator Surveys (NMIS). The first NMIS was implemented in 2010, and a second survey was recently conducted in 2015. The NMIS provides information on malaria control intervention coverage and malaria morbidity at the state and national levels. In response to a request from PMI/Nigeria, MEASURE Evaluation conducted a series of secondary analyses of the 2015 NMIS data set to provide further evidence to guide both PMI's and NMEP's efforts in malaria program implementation in Nigeria. To do this, MEASURE Evaluation worked in collaboration with the PMI/Nigeria and NMEP teams to refine the proposed research objectives and analysis plan and develop programmatic and policy recommendations based on the findings.

[1] States that received PMI support between 2011 and 2106 were Akwa Ibom, Bauchi, Benue, Cross River, Ebonyi, Kebbi, Kogi, Nassarawa, Oyo, Sokoto, and Zamfara. In 2016, Kogi State was replaced with Plateau State.

2. RESEARCH OBJECTIVES

This research study covered the following objectives:

- Research objective 1: Provide state-level estimates for all 2015 NMIS indicators on malaria control intervention coverage and malaria morbidity.
- Research objective 2: Examine key NMIS indicators for PMI- and non-PMI-supported states through a pooled analysis, assess performance against set national and PMI targets, and conduct a trend analysis of key NMIS indicators from 2008 to 2015 for PMI-supported states.
- Research objective 3: Examine the relationship between household ITN ownership, access, and use and parasitemia and severe anemia prevalence in children 6–59 months of age.
- Research objective 4: Assess the relationship between exposure to SBC messages and key malaria behavioral outcomes (e.g., ITN use, IPTp uptake, and care-seeking for fever).
- Research objective 5: Conduct a profiling of different subnational populations to inform where best to target future malaria control investment to maximize impact.

3. METHODS

3.1 Research Study Design

This research study consisted of secondary data analysis of population-based national household survey data collected in Nigeria between 2008 and 2015. The analytical techniques used to conduct the secondary analyses to answer the five research objectives were trend analyses, pooled analyses to examine differences between PMI- and non-PMI-supported states, multiple regression analyses, and chi-square automatic interaction detector (CHAID) analyses.

3.2 Data Sources and Outcome Indicators

The data sources were the 2008 Nigeria Demographic and Health Survey (NDHS), the 2010 NMIS, the 2013 NDHS, and the 2015 NMIS. The research study examined patterns and trends of key outcome indicators listed in Appendix 1.

3.3 Data Analysis

Research Objective 1

This research objective assessed state-level estimates for all 2015 NMIS indicators on malaria control intervention coverage and malaria morbidity.

Research questions:

- Are there variations in coverage of malaria control interventions and malaria morbidity among the states in Nigeria?
- How different are the state-level coverage and morbidity estimates from the national level?

To answer these questions, we computed percentage estimates and 95 percent confidence intervals (CIs) for 18 indicators using the 2015 NMIS. The indicators included ITN ownership, access and use; vector control coverage (ITN household ownership or IRS in the past 12 months); IPTp uptake; case management coverage for children with fever; and parasitemia and moderate and severe anemia prevalence among children 6–59 months of age. We also calculated percentage point differences between states and the national level and compared 95 percent confidence intervals to determine whether the estimates between the states and the national level were significantly different.

Research Objective 2

This research objective examined key NMIS indicators for PMI- and non-PMI-supported states through a pooled analysis, conducted a trend analysis of key NMIS indicators from 2008 to 2015 for PMI- and non-PMI-supported states, and assessed 2015 indicator performance against national and PMI targets.

Research questions:

- Has there been a significant increase in malaria intervention coverage in PMI-supported states between 2008 and 2015?

- Has there been a significant decrease in malaria morbidity in PMI-supported states between 2010 and 2015?
- Have PMI-supported states attained national and PMI targets for malaria intervention coverage?
- Are there differences in malaria knowledge, malaria intervention coverage, and malaria morbidity between PMI- and non-PMI-supported states between 2008/2010 and 2015?

To answer these questions, we calculated the percentage and 95 percent CIs for 23 key malaria outcome indicators for both PMI- and non-PMI-supported states (using a pooled estimate) using data from the 2008 NDHS, 2010 NMIS, 2013 NDHS, and 2015 NMIS, pending their availability. The outcome indicators assessed included malaria knowledge among women 15–49 years of age, exposure to malaria messages among women 15–49 years of age, malaria intervention coverage (ITN ownership, access, and use; IPTp uptake; and case management), and malaria morbidity in children 6–59 months of age (parasitemia and moderate and severe anemia prevalence). To test for significant differences between PMI- and non-PMI-supported states across the 23 outcome measures, a Pearson's chi-square test was performed. A p-value below 0.05 was considered to be statistically significant.

To examine whether there was a significant change in malaria knowledge, malaria intervention coverage, and malaria morbidity between 2008/2010 and 2015 for PMI- and non-PMI-supported states, we conducted a logistic regression using the 2008 NDHS or 2010 NMIS as the baseline year. The 2015 malaria intervention coverage estimates calculated for PMI- and non-PMI-supported states were compared to national and PMI targets to assess whether targets were achieved.

Research Objective 3

This research objective examined the relationship between household ITN ownership and ITN use, and parasitemia and moderate or severe anemia prevalence in children 6–59 months of age.

Research questions:

- Is there a significant association between household ITN ownership and ITN use and parasitemia prevalence (via microscopy) in children 6–59 months of age?
- Is there a significant association between household ITN ownership and ITN use and moderate or severe anemia prevalence in children 6–59 months of age?

To examine the relationship between household ITN ownership and ITN use and malaria parasitemia and moderate or severe anemia prevalence in children 6–59 months of age, we used data from the 2015 NMIS. We examined household ITN ownership through three different measures: household ownership of at least one ITN, household ITN ownership of at least one ITN by the age of the ITN (e.g., 0–<2 months, 2–6 months, 7–12 months, >12 months), and household access (defined as one ITN for every two people in the household). We also examined the relationship between ITN use the previous night for children 6–59 months of age and the three outcomes of interest. We assessed whether there was a significant association between household ITN ownership and ITN use and parasitemia prevalence, moderate anemia prevalence, and severe anemia prevalence, while controlling for other background characteristics (predictor variables) associated with ITN ownership and ITN use and the outcome of interest based on published literature.

Research Objective 4

This research objective assessed the relationship between exposure to malaria SBC messages and key malaria behavioral outcomes (ITN use, care-seeking for fever, and IPTp uptake).

Research questions[2]:

- Are the children (under five years of age) of women 15–49 years of age who reported that they were exposed to malaria SBC messages in the past six months more likely to have slept under an ITN the previous night than children whose mother was not exposed to malaria SBC messages?
- Are pregnant women who reported that they were exposed to malaria SBC messages in the past six months more likely to have slept under an ITN the previous night than pregnant women who were not exposed to malaria SBC messages?
- Are the children with fever in the past two weeks preceding the survey of mothers 15–49 years of age who were exposed to malaria SBC messages in the previous six months more likely to have had treatment or advice sought from an appropriate health provider than children from mothers who were not exposed to malaria SBC messages?
- Are women who had a live birth in the two years preceding the survey who received IPTp (2+ and 3+ doses) more likely to have been exposed to malaria SBC messages in the past six months?

To examine the relationship between women's exposure to malaria SBC messages and ITN use among children under five and pregnant women, and care-seeking for fever, we used data from the 2015 NMIS. Women's exposure to malaria SBC messages was defined as whether they recalled having heard at least one malaria-related message (e.g., regarding ITN use or care-seeking for fever) in the past six months. We assessed whether there was a significant association between women's exposure to at least one malaria-related SBC message and the specific outcome of interest, while controlling for other background characteristic variables that influence exposure to SBC messages and the outcome of interest.

To examine the relationship between women's exposure to malaria SBC messages and the uptake of IPTp (2+ and 3+ doses), we used a case-control study approach using data from the 2015 NMIS.[3] We assessed women who received IPTp and examined retrospectively whether they reported being exposed to malaria SBC messages in the past six months and conducted a comparison between those who were exposed to those messages and those who were not exposed. We calculated an odds ratio (OR) and 95 percent CI, and we also stratified results by different subgroups to account for other key background characteristics that influence IPTp uptake (e.g., woman's age, place of residence, wealth quintile, parity, and residence in PMI or non-PMI-supported state).

[2] In the research study protocol, we included examining the dose-response relationship between exposure to malaria SBC message in the past six months and the key malaria behavioral outcomes; however, the exposure was too low to carry out this analysis.

[3] Due to a misalignment with the time frame for the measurement of uptake of IPTp (measured among women with a live birth in the previous two years) and the time frame for measurement of exposure to malaria SBC messages (measured in the past six months), we do not recommend assessing the relationship between them using multiple regression analysis. We therefore, proposed to use a case-control study approach to answer this specific research question.

Research Objective 5

This research objective involved profiling different subnational populations to inform where to target future malaria control investment to maximize impact.

Research questions:

- What subgroups or subnational populations are more (or less) likely to come from households that own an ITN or engage in key malaria behaviors, specifically the use of an ITN the previous night (among children under five, pregnant women, and the general population), IPTp uptake (three or more doses), and provision of ACT treatment for children with fever?
- What subgroups of women of reproductive age are more (or less) likely to have been exposed to malaria SBC messages in the past six months?
- What subgroups of children 6–59 months of age are more likely to have parasitemia infection or severe anemia?

We used the 2015 NMIS to carry out this analysis. The specific outcomes of interest examined in the profiling included household ownership of at least one ITN; ITN use among children under five, pregnant women, and the general population; uptake of three or more doses of IPTp among women who had a live birth in the past two years; ACT treatment for children under five years of age; women's exposure to at least one malaria SBC message in the past six months; parasitemia prevalence (via microscopy) in children 6–59 months of age; and severe anemia prevalence in children 6–59 months of age. We used the CHAID model to conduct the profiling. The CHAID model is an algorithm that is used for examining relationships between a specified outcome of interest (e.g., ITN use) and other predictor variables. It is a sequential fitting algorithm; the model selects predictor variables that have the strongest interaction with the outcome of interest and visually displays (hierarchically) the relationships with the predictor variables in a tree diagram. It is a useful model for identifying subgroups that are more or less likely to experience an outcome of interest (Florey, 2012). At each step, the model selects the predictor variable that has the strongest association with the outcome of interest. The predictor variable with the strongest association becomes the first branch of the tree, with a leaf for each category that is significantly different. In each leaf, the model assesses whether there are further predictor variables in that category that are significantly related to the outcome of interest. This process is repeated for each leaf and level of the tree until no further significant predictors remain.

To carry out the analysis, we first calculated percentage estimates and conducted a chi-square test to identify significant associations between the outcome of interest and select background characteristics (predictor variables). Then we ran a CHAID model for each outcome of interest and the predictor variables that were found to be significantly associated with the outcome of interest. The output of the CHAID model is presented in a hierarchical tree structure that consists of nodes and branches. Specifically, it includes a root node, parent nodes, child nodes, and terminal nodes. The root node (Node 0) is the starting node and comprises the population with the outcome of interest. Parent nodes are upper nodes compared to lower-level child nodes. Terminal nodes are any node that does not have child nodes. For each terminal node, the model provides the following:

- **Demographic weight in the sample,** which refers to the number and percentage of the population of interest that belong to a selected category (e.g. the outcome of interest)
- **Gain,** which is the percentage of total cases in the target category for the node
- **Response,** which is the percentage of cases in the node in the specified target category
- **Gain index percentage,** which is the ratio of the node response percentage for the target category compared to the overall target category response percentage for the entire sample. The gain index represents the increased probability of the outcome of interest in the terminal node compared to the overall population.

3.4 Ethical Considerations

This research study consisted of analysis of existing data, thus no further institutional review board (IRB) approval was sought. The data sources analyzed (2008 NDHS, 2010 NMIS, 2013 NDHS, and 2015 NMIS) all received prior IRB approval from the ICF IRB and the Nigeria Health Research Ethics Committee of the Federal Ministry of Health. The research protocol was reviewed and approved by PMI/Nigeria and the NMEP.

3.5 Limitations

A few limitations are important to note with the research study. First, the research study relied solely on secondary data sources, and therefore the study was limited to the data that were available. For research objective 2, in which trends over time were assessed in malaria knowledge, exposure to malaria prevention messages, vector control intervention coverage, and malaria morbidity, only two data points were available to assess trends from 2008 to 2015 for a number of indicators. This limited our ability to understand the more nuanced changes in coverage over the assessment period. For research objectives 3, 4, and 5, which included multiple regression analyses and CHAID modeling, we were limited to assessing the relationship between the outcome of interest and background variables available in the 2015 NMIS data set. Second, due to overall low exposure to specific malaria prevention messages, we were unable to create a valid exposure index to conduct dose-response analyses for research objective 4. Third, in the 2015 NMIS, due to issues with insecurity, only urban areas in Borno state were sampled, and therefore these state-level estimates are not representative of the state as a whole. Fourth, PMI intervention states were purposively selected to receive support, and therefore they may be different from other states.

4. RESULTS

4.1 Research Objective 1: Provide State-Level Estimates for All 2015 NMIS Indicators on Malaria Control Intervention Coverage and Malaria Morbidity

4.1.1 Description of the Sample

The 2015 NMIS included a total sample of 7,745 households across the 36 states and the Federal Capital Territory (FCT) Abuja. Information on 37,962 individuals, of which 7,023 were children under five years of age, was collected from the surveyed households. The survey collected information on background characteristics, knowledge of malaria, exposure to malaria prevention messages, coverage of malaria control interventions (ITNs and IRS), fever management in children under five years of age, and anemia and malaria parasitemia prevalence in children 6–59 months of age.

4.1.2 State-Level Differences in Coverage of Vector Control Interventions

Differences in state-level coverage compared to the national average for key vector control coverage indicators are presented in Table 3 (see Appendix 2 for the full results tables). The table presents the national estimate for each indicator, the NMEP 2015 and 2020 targets (if defined), and each state's percent deviation from the national estimate. States that are performing significantly better than national average for an indicator are shaded in green, those performing similar or close to the national average are shaded in gray, and states that are performing significantly worse than the national average for an indicator are shaded in red.

Overall, there are significant differences in coverage of vector control interventions across the states and across the indicators examined. At the regional level, the North West and North East regions are generally performing better than the national average across the different vector control indicators, with a few exceptions in Borno, Gombe, Kebbi, and Taraba States; the majority of the states in the three southern regions are generally performing worse than the national average across the majority of the indicators, with a few exceptions in Akwa Ibom, Cross River, Ebonyi, and Ekiti States. At the state level, Bauchi, Jigawa, and Kaduna States are performing significantly better than the national average across almost all of the vector control indicators assessed, and Lagos and Ogun States have significantly lower coverage across the majority of the indicators.

Household ITN ownership of at least one ITN (key indicator 1) ranged from 38 percent in Kwara State to 97 percent in Bauchi State. Household access to an ITN (key indicator 2) also varied considerably, with the highest coverage observed in Akwa Ibom, Cross River, Ebonyi, and Jigawa States (all 20 percent or more above the national average) and the lowest coverage observed in Borno and Lagos States. Population ITN access (key indicator 3) was highest in Bauchi, Ebonyi, Jigawa, and Kaduna States (all 20 percent or more above the national average), and lowest in Benue, Kwara, Lagos, and Ogun States (ranging from 25 to 28 percent below the national average).

ITN use among the general population (key indicator 4), children under five years of age (key indicator 6), and pregnant women (key indicator 7) was highest in Jigawa and Kaduna States, and very low in Abia, Edo, Imo, Lagos, and Ugun States. ITN use among those with access to an ITN (key indicator 5) was highest in

Borno and Jigawa states, and very low in Abia and Imo states. Key indicator 8, use of existing ITNs, was highest in Borno and Jigawa (30 percent or more above the national average), and lowest in Abia, Edo, and Imo States (ranging from 36 to 46 percent below the national average). Key indicators 9 and 10 measure household vector control coverage—households that own at least one ITN or had IRS in the past 12 months and households that own at least one ITN for every two people or had IRS in the past 12 months. Coverage of both indicators was highest in Bauchi, Jigawa, and Katsina States (close to or higher than 20 percent above the national average), and lowest in Benue, Edo, Kwara, and Ogun States (ranging from 16 to 31 percent below the national average).

The 2015 NMEP target for household access to an ITN (key indicator 2) was set at 47 percent; 11 states met the target: Akwa Ibom, Anambra, Bauchi, Cross River, Ebonyi, Ekiti, Jigawa, Kaduna, Katsina, Rivers, and Zamfara. The 2015 target for the percent of the general population that slept under an ITN the previous night (key indicator 4) was set at 60 percent; this target was achieved in Jigawa and Kaduna States, and Bauchi came close to achieving it. The NMEP set a target of 60 percent of children under five years of age using an ITN the previous night (key indicator 6) for 2015; Bauchi, Jigawa, Kaduna, Sokoto, and Zamfara States achieved the target. A target of 77 percent of pregnant woman using an ITN the previous night (key indicator 7) was set for 2015; Jigawa, Kaduna, and Kebbi States achieved the target.

Across the key indicators that have set targets for 2020, a significant gap remains between the 2015 national coverage levels and the 2020 NMEP targets. None of the individual states have reached the 2020 targets, although a few states are close to attaining the targets. For example, 86 percent of pregnant woman in Jigawa slept under an ITN the previous night in 2015, which is a gap of less than 10 percent of the 2020 target (95 percent).

Table 3. State-level differences in vector control coverage compared to national level

Region/state		Key indicators—Deviation from national estimate									
		1	2	3	4	5	6	7	8	9	10
NMEP 2015 target		None	47%	None	60%	None	60%	77%	None	None	None
NMEP 2020 target		None	90%	None	90%	None	80%	95%	None	None	None
National estimate		68.8%	34.9%	54.7%	37.3%	64.5%	43.6%	49.0%	60.8%	69.0%	35.5%
North Central	Benue	-27	-19	-25	-13	3	-6	-11	8	-27	-19
	FCT Abuja	-24	-12	-21	-20	-11	-25	-30	-1	-21	-7
	Kogi	-14	-15	-17	-15	-6	-12	-14	-4	-14	-15
	Kwara	-31	-21	-28	-21	-7	-23	-32	0	-31	-22
	Nassarawa	8	-2	2	7	6	4	3	4	8	0
	Niger	-8	1	-10	1	15	-5	-6	19	-8	1
	Plateau	10	-1	3	1	-6	11	-8	-5	9	-2
North East	Adamawa	2	-4	-6	-6	-6	-11	-13	10	2	-4
	Bauchi	29	18	21	22	17	24	16	16	28	19
	Borno	-5	-24	-13	20	29	13	9	30	-5	-25
	Gombe	18	3	14	-4	-11	-3	3	-16	19	5
	Taraba	-16	-18	-22	-10	9	-11	-16	16	-15	-18
	Yobe	14	7	12	19	11	12	21	28	14	9
North West	Jigawa	27	21	21	38	25	33	37	23	26	20
	Kaduna	23	18	20	24	19	23	30	27	23	17
	Kano	19	5	13	7	-4	15	6	8	19	5
	Katsina	28	19	19	16	14	15	3	5	28	18
	Kebbi	18	-13	-5	0	2	-5	29	12	18	-12
	Sokoto	9	-11	-8	11	20	18	10	24	8	-12
	Zamfara	20	12	15	19	10	24	24	17	20	13
South East	Abia	-17	-5	-15	-30	-48	-35	-40	-43	-16	-5
	Anambra	6	13	7	-13	-28	-17	-29	-32	6	15
	Ebonyi	20	28	22	13	-2	8	0	-17	20	27
	Enugu	-12	-15	-13	-23	-28	-25	-31	-25	-12	-16
	Imo	-23	-15	-23	-31	-54	-37	-49	-46	-23	-15
South South	Akwa Ibom	5	20	13	-1	-10	-4	13	-23	5	19
	Bayelsa	-23	-12	-20	-19	-14	-25	-39	-26	-23	-11
	Cross River	14	20	18	12	1	3	12	-4	14	20
	Delta	-26	-11	-21	-19	-12	-22	-26	-24	-25	-10
	Edo	-30	-17	-23	-27	-43	-24	-49	-36	-30	-16
	Rivers	7	12	10	-6	-15	-3	-26	-22	6	11
South West	Ekiti	5	15	8	-10	-25	-13	-22	-25	4	14
	Lagos	-25	-23	-27	-26	-18	-31	-43	-29	-24	-21
	Ogun	-30	-16	-25	-25	-35	-25	-42	-32	-30	-16
	Ondo	-19	-9	-18	-17	-10	-23	-1	-9	-19	-10
	Osun	-3	3	-1	-16	-26	-21	-17	-29	-3	3
	Oyo	-18	-16	-11	-6	-2	-10	4	2	-18	-17

Key

- Performing below national estimate
- Performing better than national estimate
- Performing similar to national estimate

Key indicators: (1) Percentage of households with at least one ITN and percentage of households that do not own any ITN; (2) Percentage of households with at least one ITN for every two people; (3) Percentage of population with access to an ITN within their household; (4) Percentage of population that slept under an ITN the previous night; (5) Percentage of population that slept under an ITN the previous night among those with access to an ITN; (6) Percentage of children under five years of age who slept under an ITN the previous night; (7) Percentage of pregnant women who slept under an ITN the previous night; (8) Percentage of existing ITNs used the previous night; (9) Percentage of households with at least one ITN or sprayed by IRS in the last 12 months; (10) Percentage of households with at least one ITN for every two people or sprayed by IRS in the last 12 months

Notes: The deviance was calculated by subtracting the state-level estimate from the national estimate; 95 percent confidence intervals were calculated for each point estimate and used to determine whether the state-level estimate varied significantly from the national estimate.

Sources: 2015 MIS, Nigeria National Malaria Strategic Plan 2014–2020

4.1.3 State-Level Differences in Coverage of IPTp

Differences in state level coverage of IPTp2+ and IPTp3+ compared to the national average are presented in Table 4. States that performed significantly above the national average are shaded in green, those that performed close to the national average are shaded in gray, and those that performed significantly below the national average are shaded in red. Similar to vector control coverage, there is substantial variation in coverage of IPTp2+ and IPTp3+ across the states and the FCT Abuja. IPTp2 coverage ranged from 10 percent in Niger State to 77 percent in Borno State; IPTp3+ coverage ranged from 4 percent in Delta State to 45 percent in Borno and Ekiti States.

For coverage of two or more doses of SP, most states (24) are performing around the national average of 37 percent coverage. Nine states performed significantly above the national average, with the highest coverage above the national average in Borno (39 percent higher), Edo (38 percent higher), and Lagos (33 percent higher) States. Four states performed significantly lower than the national average, with the lowest coverage below the national average observed in Niger (28 percent lower) and Delta (24 percent lower) States. For coverage of three or more doses of IPTp, the majority of the states (22) performed close to the national average of 19 percent. Ten states performed significantly above the national average, with the highest coverage above the national average in Borno and Ekiti States (both 26 percent higher coverage than the national average). Five states performed significantly lower than the national average, with the lowest coverage below the national average in Delta (15 percent lower) and Kano (13 percent lower) States.

No states achieved the 2015 NMEP target (55 percent) for coverage of three or more doses of SP, and there is a significant gap to close across all states and the FCT Abuja to reach the NMEP goal of 100 percent of pregnant women receiving at least three or more doses of SP by 2020.

Table 4. State-level differences in coverage of IPTp intervention compared to national level

Region/state		Key indicator—Percentage deviation from national estimate	
		Two or more doses of IPTp	Three or more doses of IPTp
NMEP 2015 target		None	55%
NMEP 2020 target		None	100%
National estimate		37%	19%
North Central	Benue	0	2
	FCT Abuja	24	17
	Kogi	21	19
	Kwara	-17	-4
	Nassarawa	-4	-1
	Niger	-28	-11
	Plateau	-18	-7
North East	Adamawa	-6	3
	Bauchi	5	-1
	Borno	39	26
	Gombe	14	19
	Taraba	-10	2
	Yobe	23	16
North West	Jigawa	-8	-11
	Kaduna	-16	-3
	Kano	-12	-13
	Katsina	-3	5
	Kebbi	-5	9
	Sokoto	-9	-3
	Zamfara	-9	-8
South East	Abia	-1	5
	Anambra	6	1
	Ebonyi	7	22
	Enugu	5	17
	Imo	8	-11
South South	Akwa Ibom	-11	-7
	Bayelsa	-9	-10
	Cross River	18	12
	Delta	-24	-15
	Edo	38	17
	Rivers	12	-3
South West	Ekiti	22	26
	Lagos	33	-9
	Ogun	16	0
	Ondo	-2	-10
	Osun	-7	-7
	Oyo	22	19

Key
- Performing below national estimate
- Performing better than national estimate
- Performing similar to national estimate

Notes: The deviance was calculated by subtracting the state-level estimate from the national estimate; 95 percent confidence intervals were calculated for each point estimate and used to determine whether the state-level estimate varied significantly from the national estimate.
Sources: 2015 MIS, Nigeria National Malaria Strategic Plan 2014–2020

4.1.4 State-Level Differences in Case Management Intervention Coverage

Differences in state-level coverage for case management interventions for children under five years of age compared to the national average are presented in Table 5. States that performed better than the national average are shaded in green, those that performed similar to the national average are shaded in gray, and those that performed worse than the national average are shaded in red. The key indicators examined include

diagnostic testing (finger or heel stick) for children with fever, whether treatment from a health provider was sought and was sought the same or next day from the onset of the fever, and coverage of ACT treatment among children who received any antimalarial treatment.

The majority of states (29) had coverage of diagnostic testing for fever in children under five years of age similar to the national level. Coverage was significantly higher in Nassarawa, Ondo, Ogun, and Oyo States compared to the national average of 13 percent, and coverage was significantly lower in Borno, Gombe, Kano, and Sokoto states. There was greater state-level variation in coverage of care-seeking from a health provider for children with fever; with coverage significantly higher in Bauchi, Enugu, Gombe, Imo, Kano, Kogi, Nassarawa, and Niger States, and significantly lower in Bayelsa, Kebbi, Kwara, Ogun, Sokoto, and Taraba States. Most states (29) had coverage of prompt care-seeking from a health provider similar to the national average; however, there was significantly higher coverage in Borno, Kano, Kogi, and Nassarawa States, and significantly lower coverage in Jigawa, Ogun, and Sokoto States. Most states (29) had ACT treatment coverage similar to the national average. ACT treatment coverage was substantially higher in Cross River State and FCT Abuja and (by 30 percent or more), and it was significantly lower in Abia, Bayelsa, Gombe, Kaduna, Kebbi, and Taraba (ranging from 23 to 31 percent below the national average).

The 2015 NMEP target for diagnostic testing coverage for children with fever was set at 50 percent (Table 5); the only state that achieved the target was Oyo State (58.7 percent). The 2020 target is set at 100 percent of children with fever receiving a diagnostic test, and a substantial gap remains across all states and the FCT Abuja to achieve the target.

Table 5. State-level differences in case management coverage compared to national level

Region/state		Key indicators—Deviation from national estimate			
		1	2	3	4
NMEP 2015 target		50%	None	None	None
NMEP 2020 target		100%	None	None	None
National estimate		12.6%	66.1%	35.4%	37.6%
North Central	Benue	-4	15	19	12
	FCT Abuja	5	15	-8	30
	Kogi	-3	27	23	-7
	Kwara	-4	-20	-17	-1
	Nassarawa	13	17	22	-1
	Niger	-1	16	0	11
	Plateau	7	9	9	8
North East	Adamawa	-2	-11	-9	-7
	Bauchi	-6	23	4	23
	Borno	-13	15	25	-6
	Gombe	-9	19	13	-31
	Taraba	2	-16	-8	-24
	Yobe	6	-6	6	2
North West	Jigawa	-2	12	-14	12
	Kaduna	4	-7	3	-23
	Kano	-8	19	26	2
	Katsina	1	-14	-14	5
	Kebbi	-4	-22	0	-30
	Sokoto	-8	-40	-22	-5
	Zamfara	-5	-11	-17	4
South East	Abia	-2	13	16	-25
	Anambra	-2	-1	6	29
	Ebonyi	-8	7	10	19
	Enugu	1	22	13	-1
	Imo	6	22	4	10
South South	Akwa Ibom	-2	3	-18	-14
	Bayelsa	-6	-10	-13	-23
	Cross River	-2	-4	-9	36
	Delta	-5	-5	-2	-12
	Edo	-2	10	16	20
	Rivers	3	7	-8	12
South West	Ekiti	4	3	18	-6
	Lagos	-3	-1	13	-20
	Ogun	15	-32	-33	0
	Ondo	16	-7	-8	-6
	Osun	-4	4	-2	-4
	Oyo	46	17	39	25

Key

- Performing below national estimate
- Performing better than national estimate
- Performing similar to national estimate

Key indicators: (1) Percentage of children under five years of age with fever in the past two weeks who had a finger or heel stick; (2) Percentage of children under five years of age with fever in the last two weeks for whom advice or treatment was sought by health provider; (3) Percentage of children under five years of age with fever in the last two weeks for whom advice or treatment was sought from a health provider the same or next day; (4) Percentage receiving an ACT, among children under five years of age with fever in the last two weeks who received any antimalarial treatment

Notes: The deviance was calculated by subtracting the state-level estimate from the national estimate; 95 percent confidence intervals were calculated for each point estimate and used to determine whether the state-level estimate varied significantly from the national estimate. Sources: 2015 MIS, Nigeria National Malaria Strategic Plan 2014–2020

4.1.5 State-Level Differences in Malaria Morbidity

Differences in malaria morbidity prevalence at the state and national levels for children 6–59 months of age are presented in Table 6. States that performed better than the national average are shaded in green (statistically significant lower prevalence), those that performed similar to the national average are shaded in gray, and those that performed worse than the national average are shaded in red (statistically significant higher prevalence).

Malaria parasitemia prevalence measured using RDTs (key indicator 1) and microscopy (key indicator 2) was significantly lower than the national average in Abia, Anambra, Borno, Imo, Kogi (microscopy only), Lagos, and Rivers States, and it was significantly higher than the national average in Benue (microscopy only), Kebbi (microscopy only), Sokoto, and Zamfara States. Moderate anemia prevalence showed some variation across the states, with significantly lower prevalence than the national average in Abia, Anambra, Benue, Borno, Enugu, Imo, Laos, and Osun States, and significantly higher prevalence than the national average in Cross River, Kebbi, and Zamfara States. Slightly less variation was observed across the states in severe anemia prevalence, with significantly lower prevalence than the national average in Abia, Benue, Delta, Lagos, and Niger States, and significantly higher prevalence than the national average in Kano, Ondo, Sokoto, and Zamfara States. Generally, malaria morbidity is higher in a number of the states in the North West region, particularly Kebbi, Sokoto, and Zamfara States, and it is generally lower in the South East region, particularly in Abia, Anambra, and Imo States.

The 2015 target for parasitemia prevalence was set at 26 percent (key indicator 2); the target was achieved by 18 states and almost achieved at the national level (27 percent). The 2015 target for severe anemia (key indicator 4) was set at 9 percent; this was achieved by the majority of states (27) and at the national level (9.3 percent). The NMEP has set a target of less than 1 percent parasitemia prevalence (measured via microscopy) and 3 percent severe anemia prevalence among children 6–59 months of age by 2020. A significant gap still exists for the majority of states to reach the parasitemia prevalence target, with only two states (Borno and Lagos) close to achieving the target. For severe anemia, most states have a large gap to close to achieve the target, with only five states that have achieved the target or that are close to achieving the target (Abia, Benue, Delta, Lagos, and Niger States).

Table 6. State-level differences in malaria morbidity prevalence compared to national level

Region/state		Key indicators—Deviation from national estimate			
		1	2	3	4
NMEP 2015 target		None	26.4%	None	9.0%
NMEP 2020 target		None	<1.0%	None	3.0%
National estimate		45.1%	27.4%	33.8%	9.3%
North Central	Benue	10	17	-9	-8
	FCT Abuja	-7	-7	-1	0
	Kogi	-19	-22	-2	-4
	Kwara	5	-1	-4	-4
	Nassarawa	12	9	2	-3
	Niger	8	6	8	-9
	Plateau	13	8	-6	1
North East	Adamawa	10	7	-7	2
	Bauchi	-4	-8	-3	-2
	Borno	-40	-27	-20	-8
	Gombe	1	1	-10	-4
	Taraba	8	16	5	-1
	Yobe	-15	-9	-5	-4
North West	Jigawa	13	1	6	8
	Kaduna	10	9	7	5
	Kano	15	0	7	17
	Katsina	9	0	5	7
	Kebbi	4	36	30	-6
	Sokoto	21	19	5	10
	Zamfara	25	35	18	12
South East	Abia	-24	-19	-12	-8
	Anambra	-24	-17	-22	-3
	Ebonyi	6	3	9	-1
	Enugu	-10	-17	-18	-5
	Imo	-21	-22	-13	-5
South South	Akwa Ibom	-17	-5	3	-5
	Bayelsa	-9	4	5	-4
	Cross River	-4	-1	14	-2
	Delta	-20	-7	-6	-5
	Edo	-10	-9	-6	-1
	Rivers	-26	-20	-9	-4
South West	Ekiti	-9	1	-9	-3
	Lagos	-43	-27	-13	-7
	Ogun	-11	-13	1	-5
	Ondo	3	-6	7	-9
	Osun	10	6	-12	1
	Oyo	-3	-8	-7	-3

Key

- Performing below national estimate
- Performing better than national estimate
- Performing similar to national estimate

Key indicators: (1) Percentage of children 6–59 months of age with malaria infection (via RDT); (2) Percentage of children 6–59 months of age with malaria infection (via microscopy); (3) Percentage of children 6–59 months of age with a hemoglobin measurement of 8–9.9 g/dL (moderate anemia prevalence); (4) Percentage of children 6–59 months of age with a hemoglobin measurement of <8 g/dL (severe anemia prevalence)

Notes: The deviance was calculated by subtracting the state-level estimate from the national estimate; 95 percent confidence intervals were calculated for each point estimate and used to determine whether the state-level estimate varied significantly from the national estimate. Sources: 2015 MIS, Nigeria National Malaria Strategic Plan 2014–2020

4.1.6 Summary of Research Objective 1 Results

Overall, there was a large variation in coverage of vector control interventions across the states in Nigeria in 2015. Vector control coverage was generally higher in the North West and North East regions, compared to the national average, and coverage was generally lower across most indicators in the three southern regions. At the state level, Bauchi, Jigawa, and Kaduna performed significantly better across almost all vector control indicators, compared to the national average. The majority of the states had coverage of IPTp2 and IPTp3 similar to the national average. FCT Abuja and Borno, Cross River, Ekiti, Kogi, and Oyo States all had significantly higher coverage than the national average of both IPTp2 and IPTp3. Delta State had significantly lower coverage for both indicators. For case management, coverage of children under five with fever who had a finger or heel stick was very low nationally, and few states varied from the national estimate. Care-seeking from a health provider for children with fever was slightly more varied across the states, with eight states performing significantly better than the national average, and six performing significantly worse than the national average, with very low coverage in Sokoto (40 percent below the national average). Prompt care-seeking was generally low nationally (35 percent); five states performed above the national average and only a few states performed significantly below the national average. The majority of the states had ACT treatment coverage similar to or worse than the national average, with only two states performing significantly better (FCT Abuja and Cross River State). The majority of states did not vary significantly from the national average in malaria parasitemia or moderate and severe anemia prevalence. Generally, malaria morbidity was significantly higher in a number of the states in the North West region, particularly Kebbi, Sokoto, and Zamfara States, and malaria morbidity was generally lower in the South East region, particularly in Abia, Anambra, and Imo States.

In general, at the national and state levels, 2015 intervention coverage targets for vector control, IPTp, and case management were not achieved. The 2015 targets for parasitemia and severe anemia were achieved in many states and were close to being achieved at the national level. Large gaps remain at the national and individual state levels to achieve the 2020 targets for vector control, IPTp, diagnostic testing and treatment coverage, and malaria morbidity. Only a few states have achieved or are close to achieving some of the set targets.

4.2 Research Objective 2: Compared Performance between PMI- and non-PMI-Supported States

4.2.1 Description of the Sample

Table 7 presents a summary of the sample from the 2008 NDHS, 2010 NMIS, 2013 NDHS, and 2015 NMIS surveys used in conducting analysis for research objective 2.

Table 7. Summary of sample from NDHS and NMIS surveys

Sample	2008 NDHS	2010 NMIS	2013 NDHS	2015 NMIS
Household sample	34,070	5,895	38,522	7,745
Population sample	150,199	30,387	176,574	37,674
Women 15–49 years of age sample	33,385	6,344	38,948	8,034
Children under five years of age sample	25.684	6,199	30,194	7,023

4.2.2 Malaria Knowledge Levels in PMI- and Non-PMI-Supported States

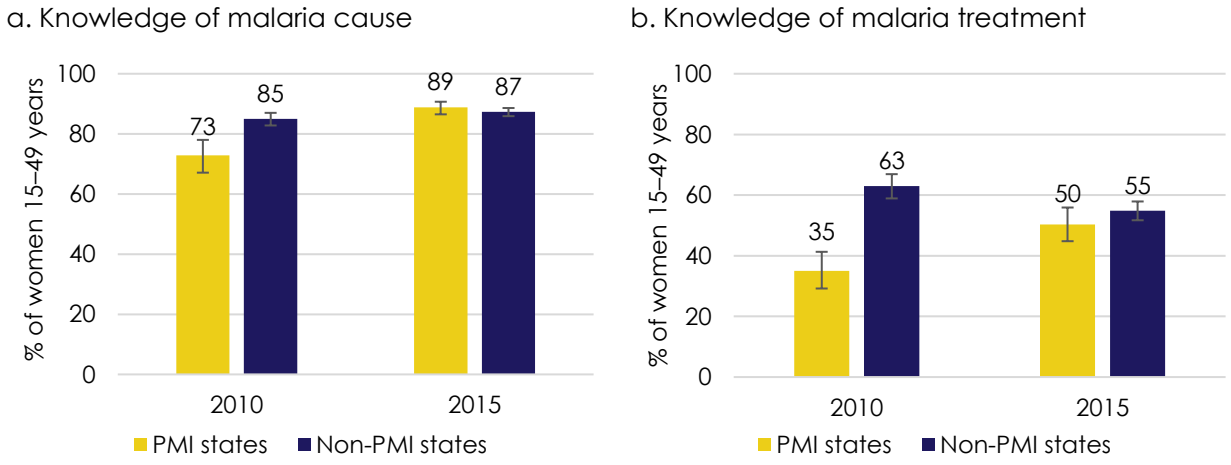
In the 2010 and 2015 NMIS, women 15–49 years of age were asked a series of questions to assess their knowledge related to malaria, including whether they could correctly identify the cause and main symptom of malaria (fever), the correct treatment for malaria (ACT), key prevention methods, and specific ways pregnant women can avoid getting malaria.

Knowledge of Cause and Treatment of Malaria

Knowledge of the cause of malaria was generally high across both survey years (Figure 1a). Knowledge levels increased significantly, from 73 percent to 88 percent in PMI-supported states between 2010 and 2015 ($p<0.001$), and knowledge levels remained stable in non-PMI-supported states during this same time period (ranging from 85 to 87 percent, $p=0.246$). The percentage of women with knowledge of the cause of malaria was similar in PMI- and non-PMI-supported states in 2015 ($p=0.128$).

Knowledge levels of correct treatment (ACT) for malaria in PMI-supported states increased, from 35 percent in 2010 to 50 percent in 2015 ($p<0.01$), but decreased in non-PMI-supported-states during that same time period, from 63 percent to 55 percent ($p<0.01$) (Figure 1b). In 2015, knowledge levels of correct treatment for malaria was similar in PMI-supported and non-PMI-supported states ($p=0.166$).

Figure 1. Women's knowledge of cause and treatment of malaria in PMI- and non-PMI-supported states, 2010–2015



Source: 2010 and 2015 NMIS

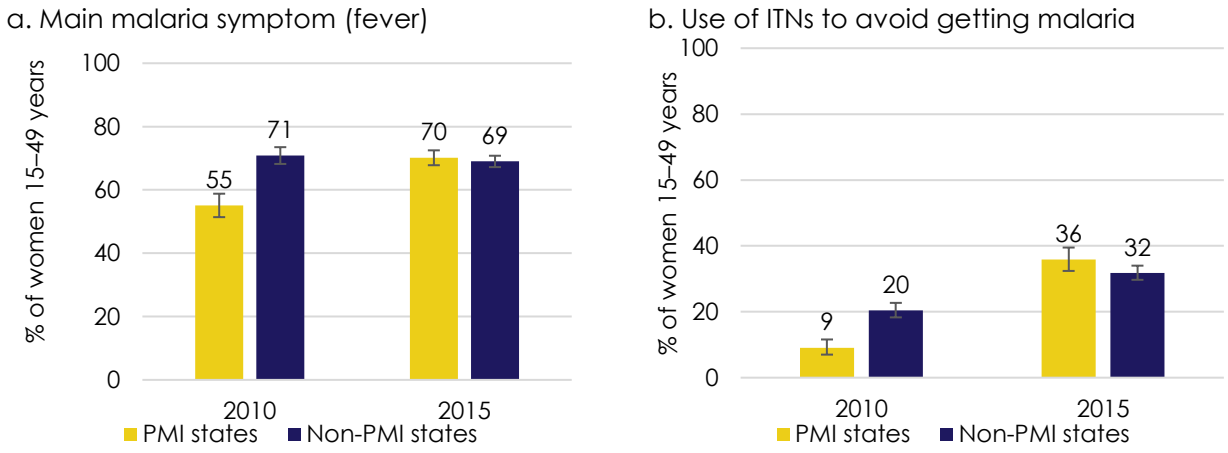
Knowledge of Malaria Symptoms and Prevention Methods

The percentage of women who identified fever as a symptom of malaria improved significantly, from 55 percent in 2010 to 70 percent in 2015 in PMI-supported states ($p<0.001$) and remained stable at around 70 percent in non-PMI-supported states during the same time period (Figure 2a). No significant difference was observed in knowledge of fever as a symptom for malaria between PMI- and non-PMI-supported states in 2015 ($p=0.441$).

Women's knowledge of using an ITN to avoid getting malaria increased significantly between 2010 and 2015, from 9 percent in 2010 to 36 percent in 2015 in PMI-supported states ($p<0.001$), and from 20 percent in

2010 to 32 percent in 2015 in non-PMI-supported states (p<0.001) (Figure 2b). No significant differences in knowledge of ITN use to avoid getting malaria were observed between PMI- and non-PMI-supported states in 2015.

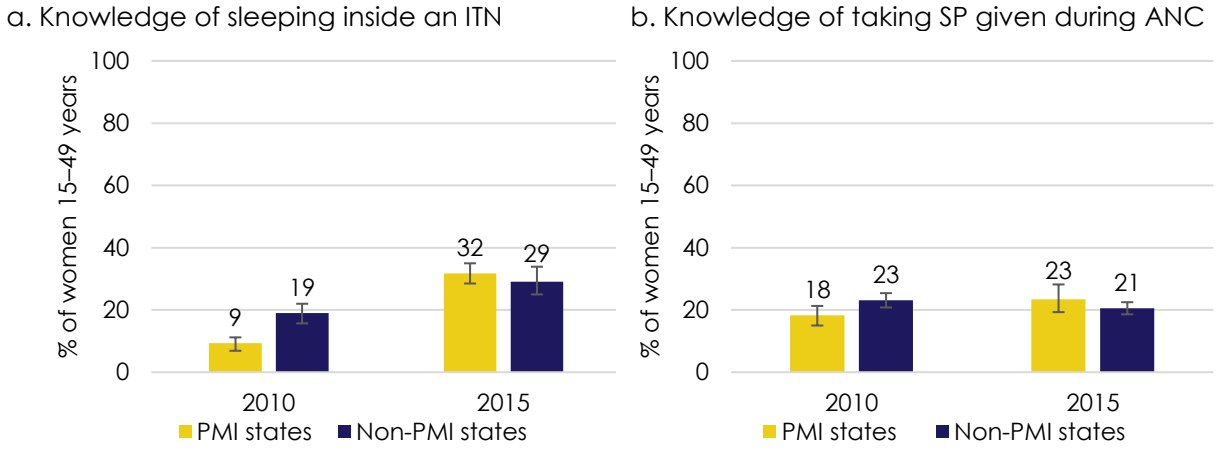
Figure 2. Women's knowledge of main symptom of malaria and malaria prevention methods in PMI- and non-PMI-supported states, 2010–2015



Source: 2010 and 2015 NMIS

Women were also asked about specific ways pregnant women can avoid malaria, including sleeping under an ITN and taking SP given during antenatal care (ANC) visits (Figures 3a-b). Women's knowledge of sleeping under an ITN as a means to avoid malaria during pregnancy increased significantly, from 9 percent in 2010 to 32 percent in 2015 (p<0.001) in PMI-supported states, and from 19 percent in 2010 to 32 percent in 2015 in non-PMI-supported states (p<0.001). Women's knowledge of taking SP during ANC remained relatively stable between 2010 and 2015 in both PMI- and non-PMI-supported states (with both slightly more than 20 percent in 2015). No significant differences were observed in knowledge of use of ITNs and SP to avoid malaria in pregnancy between PMI- and non-PMI-supported states in 2015.

Figure 3. Women's knowledge of how pregnant women can avoid getting malaria in PMI- and non-PMI-supported states, 2010–2015



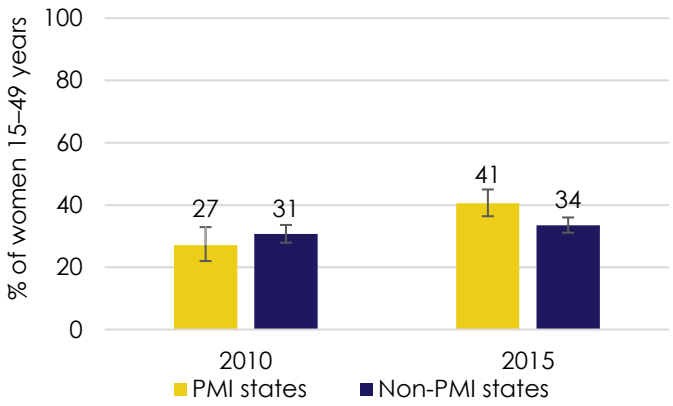
Source: 2010 and 2015 NMIS

4.2.3 Exposure to Malaria Messages in PMI- and Non-PMI-Supported States

Women were asked whether they had seen or heard any malaria messages in the past six months (Figure 4), and, if so, they were asked to recall the specific messages they had seen or heard (Figure 5). In PMI-supported states, the percentage of women who were exposed to at least one malaria message rose significantly, from 27 percent in 2010 to 41 percent in 2015 ($p<0.01$); in non-PMI-supported states, women's exposure levels remained relatively stable during the same period (with a slight increase from 31 percent to 34 percent). Overall, exposure to malaria messages was higher among women in PMI-supported states compared to women in non-PMI-supported states in 2015 ($p<0.01$).

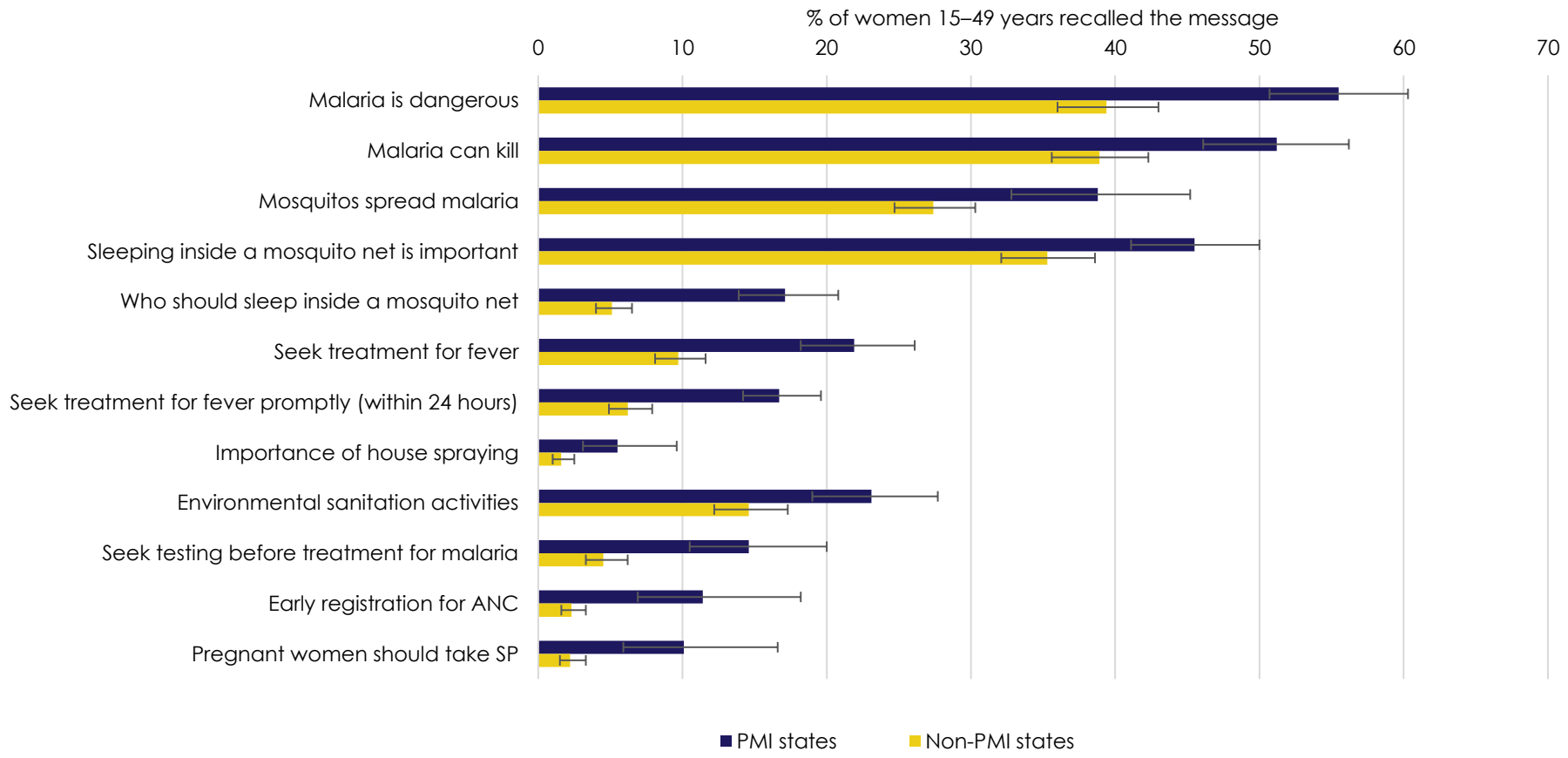
In both PMI- and non-PMI-supported states, the most commonly recalled malaria messages were "malaria is dangerous," "malaria can kill," "who should sleep inside a mosquito net," and "sleeping inside a mosquito net is important." Messages related to care-seeking for fever, prevention of malaria in pregnancy, and indoor house spraying were not frequently recalled. Recall of malaria messages was higher in PMI-supported states, compared to non-PMI-supported states.

Figure 4. Women's exposure to at least one malaria-related message in PMI- and non-PMI-supported states, 2010–2015



Source: 2010 and 2015 NMIS

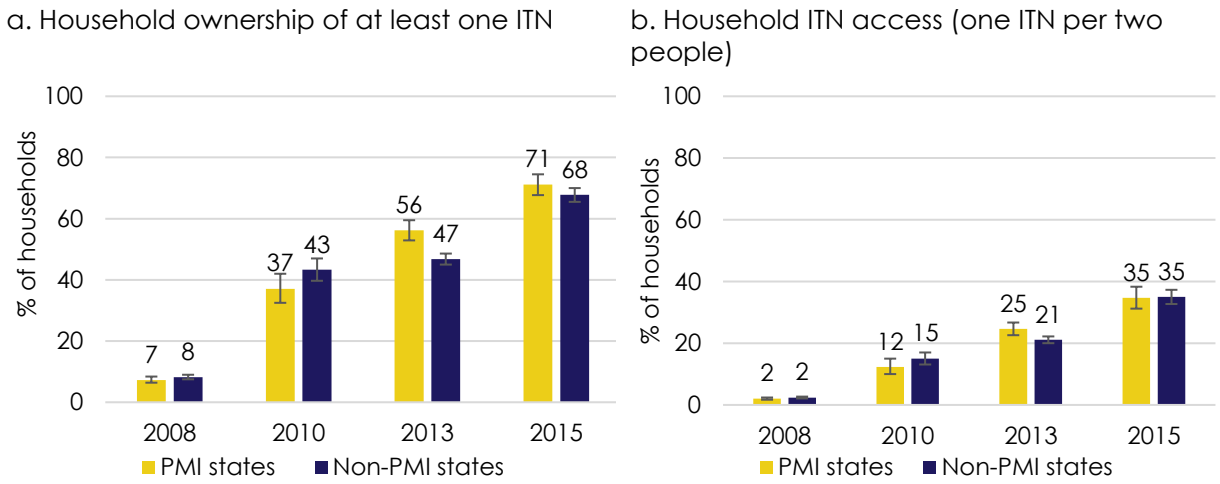
Figure 5. Women's exposure to different malaria messages in the past 6 months in PMI- and non-PMI-supported states, 2015



4.2.4 Vector Control Coverage in PMI- and Non-PMI-Supported States

Household ownership of at least one ITN improved significantly in both PMI- and non-PMI-supported states between 2008 and 2015, increasing from 7 percent to 71 percent in PMI-supported states ($p<0.001$) and increasing from 8 percent to 68 percent in non-PMI-supported states ($p<0.001$) (Figure 6a). The percentage of households with at least one ITN for every two people (household ITN access) improved significantly during the same period, increasing from 2 percent in 2008 to 35 percent in 2015 in both PMI- and non-PMI-supported states ($p<0.001$) (Figure 6b). No significant differences in coverage of household ownership of at least one ITN and household ITN access were observed between PMI- and non-PMI-supported states in 2015.

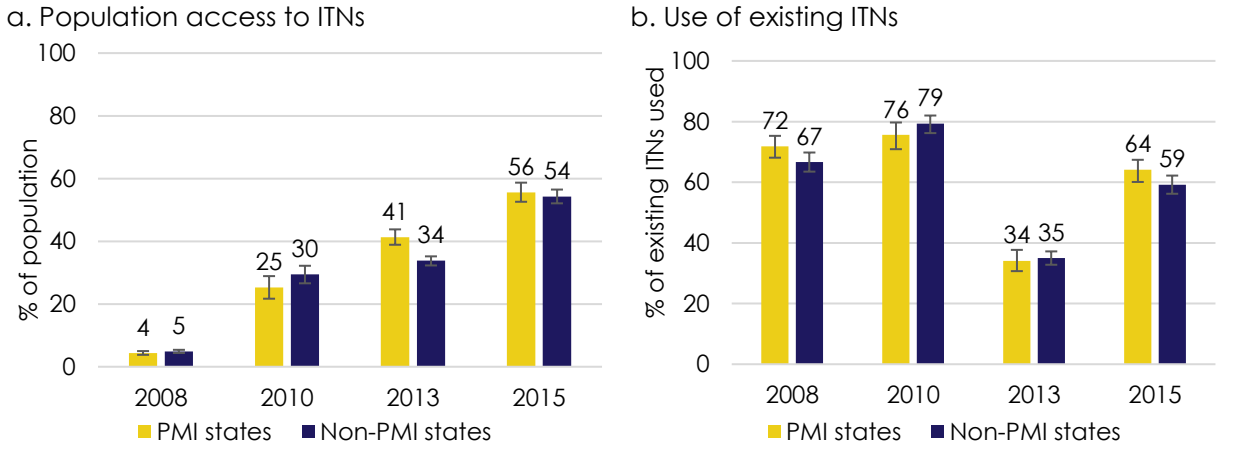
Figure 6. Household ownership of at least one ITN and household ITN access in PMI- and non-PMI-supported states, 2008–2015



Source: 2008 and 2013 NDHS, 2010 and 2015 NMIS

The percentage of the population with access to an ITN in their household increased significantly in both PMI-supported and non-PMI-supported states between 2008 and 2015, from 4 percent to 56 percent in PMI-supported states ($p<0.001$), and from 5 percent to 54 percent in non-PMI-supported states ($p<0.001$) (Figure 7a). Use of existing ITNs decreased significantly during this same period, however, from 72 percent to 64 percent in PMI-supported states ($p<0.001$), and from 67 percent to 59 percent in non-PMI-supported states ($p<0.001$) (Figure 7b). In 2013, there was a significant decrease in use of existing ITNs in both PMI- and non-PMI-supported states (around 35 percent), compared to all other survey years. In 2015, population access to an ITN in their household was similar in PMI- and non-PMI-supported states, and use of existing ITNs was slightly higher in PMI-supported states.

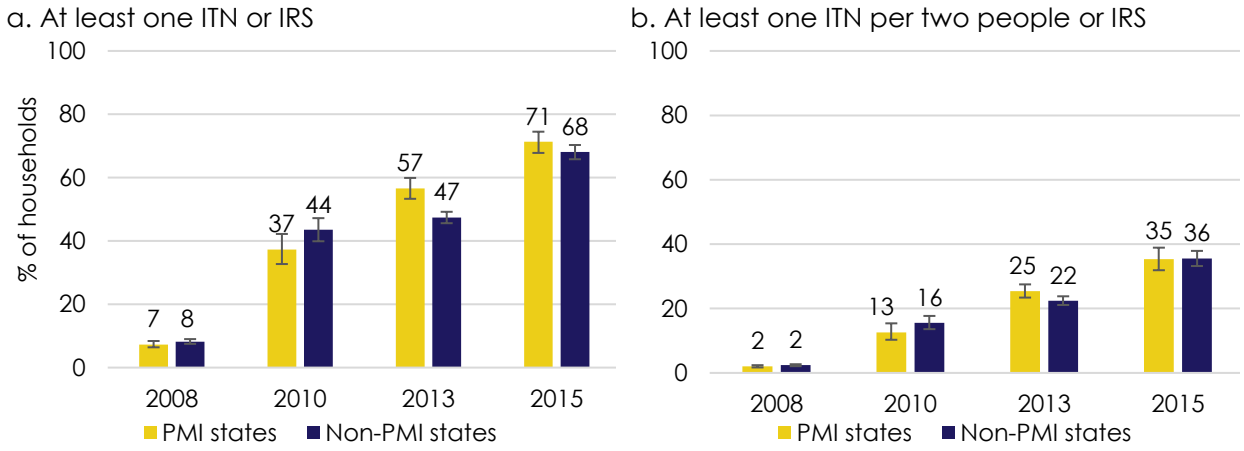
Figure 7. Population access to ITNs and use of existing ITNs in PMI- and non-PMI-supported states, 2008–2015



Source: 2008 and 2013 NDHS, 2010 and 2015 NMIS

The percentage of households with at least one ITN or sprayed by IRS in the past 12 months improved significantly between 2008 and 2015 in both PMI- and non-PMI-supported states, from 7 percent to 71 percent in PMI-supported states ($p<0.001$), and from 8 percent to 68 percent in non-PMI-supported states ($p<0.001$) (Figure 8a). The percentage of households with at least one ITN for every two people or sprayed by IRS in the past year also increased significantly, from 2 percent in 2008 to 35 percent in 2015 in both PMI- and non-PMI-supported states ($p<0.001$ for both PMI- and non-PMI states) (Figure 8b). No significant differences in household vector control coverage were observed between PMI- and non-PMI-supported states in 2015.

Figure 8. Household ITN ownership and IRS coverage in PMI- and non-PMI-supported states, 2008–2015

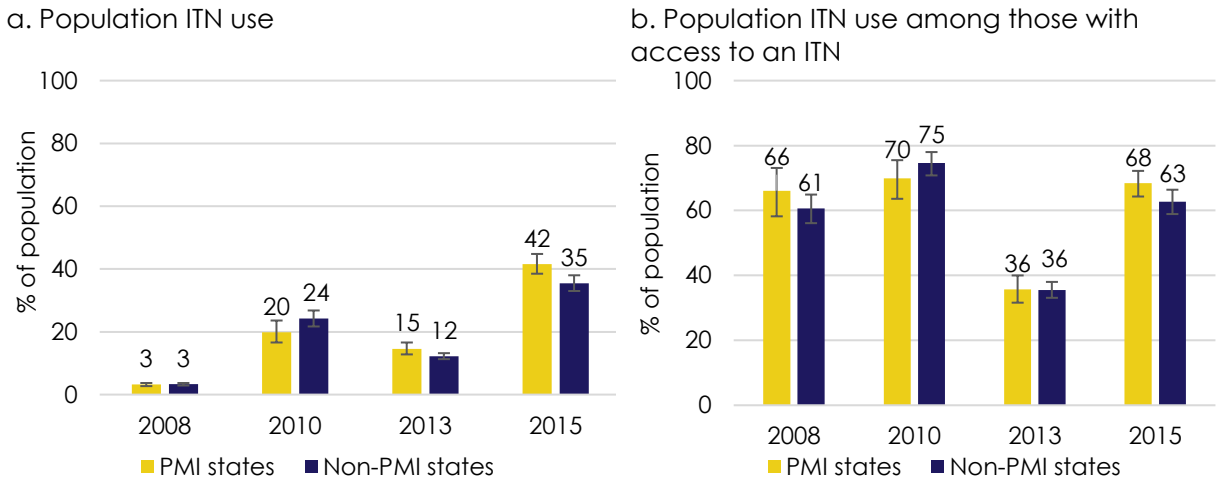


Source: 2008 and 2013 NDHS, 2010 and 2015 NMIS

The percentage of the population that slept under an ITN the previous night increased significantly between 2008 and 2015 in both PMI- and non-PMI-supported states, from 3 percent to 42 percent in PMI-supported states ($p<0.001$), and from 3 percent to 35 percent in non-PMI-supported states ($p<0.001$) (Figure 9a). There

was a substantial drop in ITN use in 2013, however, in both PMI- and non-PMI-supported states. The percentage of the population that slept under an ITN the previous night among those with access to an ITN remained relatively stable in both PMI- and non-PMI-supported states during the same time period (Figure 9b), although a similar significant decrease in use was observed in 2013. In 2015, population ITN use was higher in PMI-supported states compared to non-PMI-supported states ($p<0.01$ for ITN use, $p<0.05$ for ITN use among those with access to an ITN).

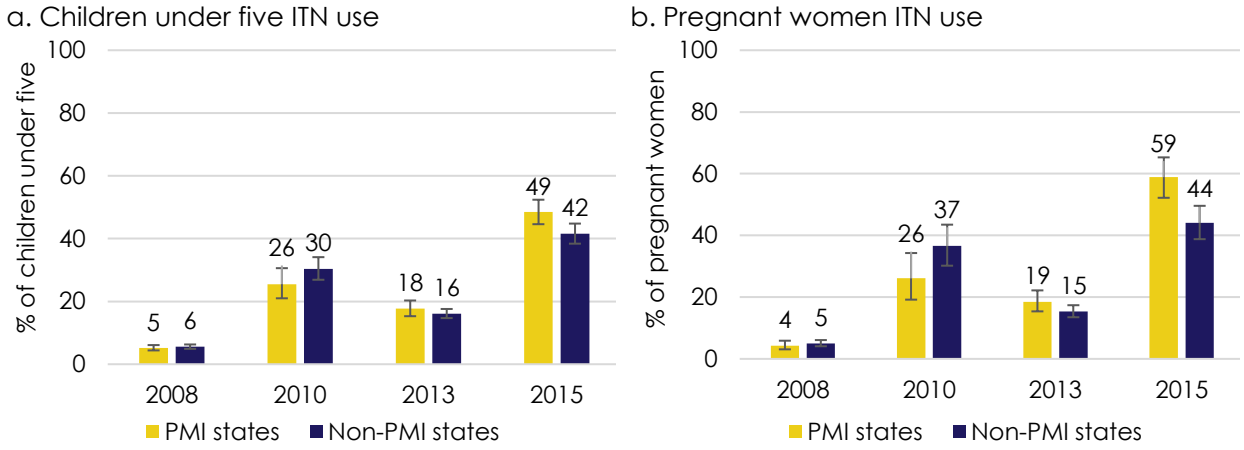
Figure 9. Population ITN use in PMI- and non-PMI-supported states, 2008–2015



Source: 2008 and 2013 NDHS, 2010 and 2015 NMIS

The percentage of children under five years of age who slept under an the ITN the night before the survey increased significantly, from 5 percent in 2008 to 49 percent in 2015 ($p<0.001$) in PMI-supported states, and from 6 percent in 2008 to 42 percent in 2015 ($p<0.001$) in non-PMI-supported states (Figure 10a). The percentage of pregnant women who slept under an ITN the previous night also increased significantly, from 4 percent in 2008 to 60 percent in 2015 ($p<0.001$) in PMI-supported states, and from 5 percent in 2008 to 44 percent in 2015 ($p<0.001$) in non-PMI suported states (Figure 10b). Similar to the results for population ITN use, ITN use in children under five years of age and pregnant women overall increased substantially between 2008 and 2015 but experienced a significant decrease in 2013. In 2015, ITN use among children under five and pregnant women was significantly higher in PMI-supported states, compared to non-PMI-supported states ($p<0.01$ for both children under five and pregnant women).

Figure 10. ITN use among children under five and pregnant women in PMI- and non-PMI-supported states, 2008–2015

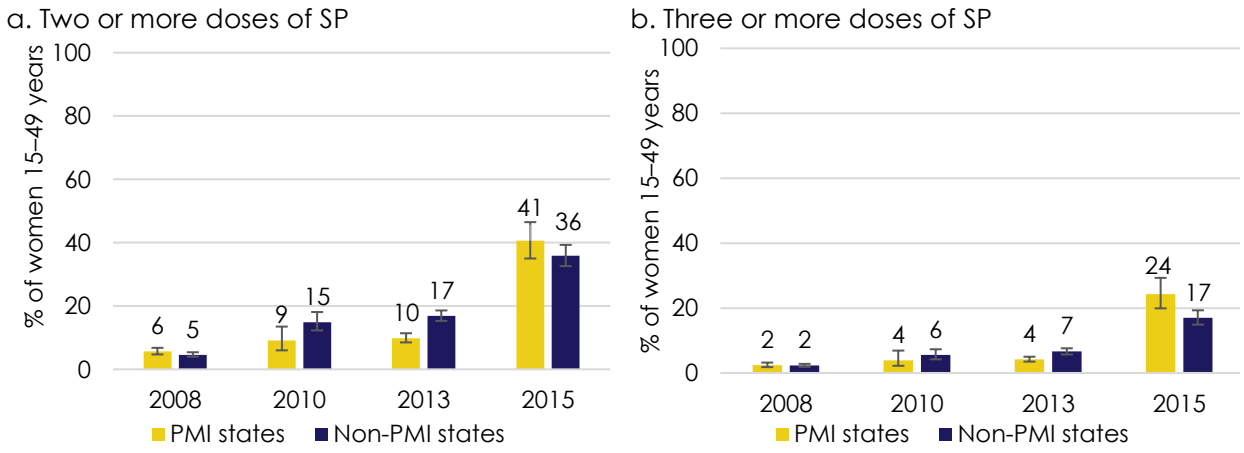


Source: 2008 and 2013 NDHS, 2010 and 2015 NMIS

4.2.5 IPTp Coverage in PMI- and Non-PMI-Supported States

Coverage of IPTp (two or more doses of SP and three or more doses of SP during ANC visits) from 2008 to 2015 is presented in Figures 11a–b. The percentage of pregnant women receiving two or more doses of SP during an ANC visit increased significantly, from 6 percent in 2008 to 41 percent in 2015 ($p<0.001$) in PMI-supported states, and from 5 percent in 2008 to 36 percent in 2015 ($p<0.001$) in non-PMI-supported states (Figure 11a). Coverage of three or more doses of SP during an ANC visit increased significantly, from 2 percent to 24 percent ($p<0.001$) in PM- supported states, and from 6 percent to 17 percent ($p<0.001$) in non-PMI-supported states during the same period (Figure 11b). In 2015, coverage of two or more doses of SP during an ANC visit was similar in PMI- and non-PMI-supported states; however, coverage of three or more doses of IPTp was significantly higher in PMI-supported states ($p<0.01$).

Figure 11. IPTp coverage in PMI- and non-PMI-supported states, 2008–2015



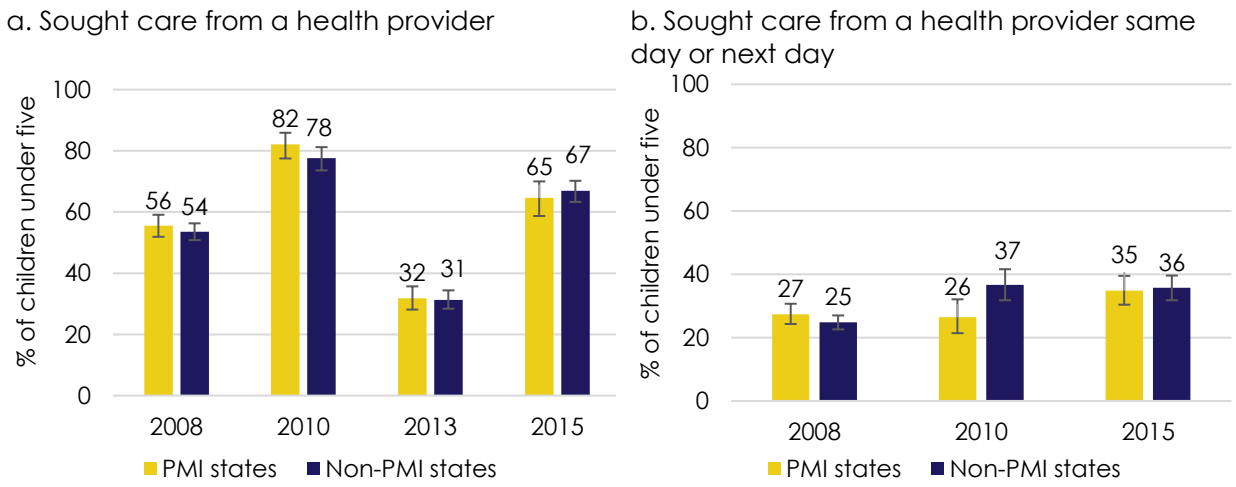
Source: 2008 and 2013 NDHS, 2010 and 2015 NMIS

4.2.6 Case Management Coverage in PMI- and Non-PMI-Supported States

In the NDHS and NMIS, mothers are asked to report the history of fever in children under five years of age during the two weeks prior to the survey. Among children who experienced fever, a series of further questions are asked about care-seeking to assess case management of malaria, including the source of advice or treatment, the timing of when advice or treatment was sought (available in the 2008 NDHS, 2010 NMIS, and 2015 NMIS), whether the child received a finger or heel stick (available in the 2010 NMIS, 2013 NDHS, and 2015 NMIS), the treatment received, and the type of antimalarial used.

The percentage of children under five years of age with fever in the previous two weeks for whom advice or treatment was sought from a health provider increased significantly, from 56 percent in 2008 to 65 percent in in 2015 in PMI-supported states ($p<0.05$), and from 54 percent in 2008 to 67 percent in 2015 in non-PMI-supported states ($p<0.001$) (Figure 12a). Similar improvements were observed in timely care-seeking for fever (care sought the same or next day after the onset of fever), with an increase from 27 percent in 2008 to 35 percent in 2015 in PMI-supported states ($p<0.05$), and from 25 percent in 2008 to 36 percent in 2015 in non-PMI-supported states ($p<0.001$) (Figure 12b). No significant differences were observed in care-seeking for fever (including timely care-seeking) between PMI- and non-PMI-supported states in 2015.

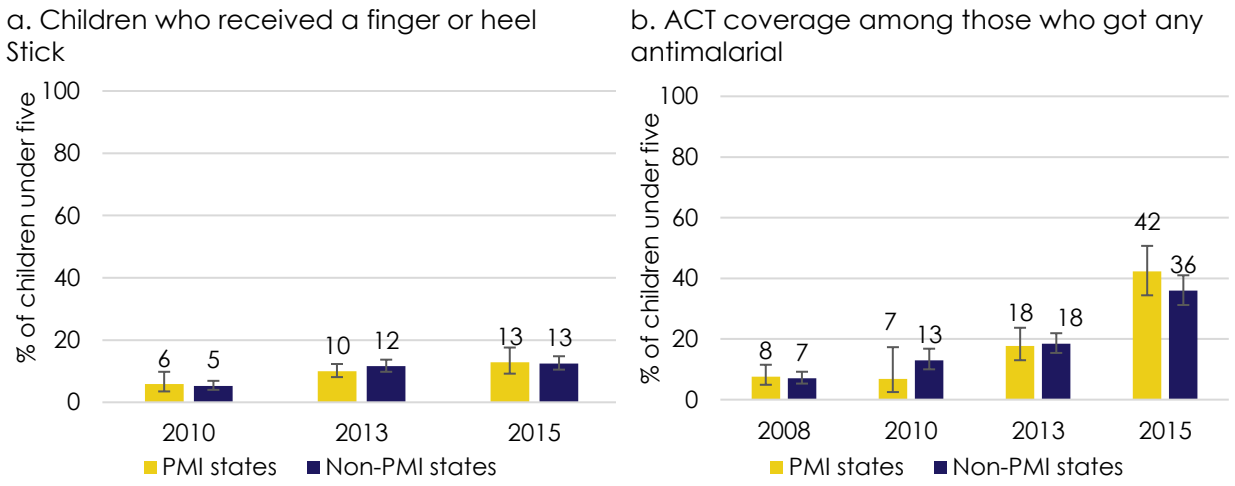
Figure 12. Care-seeking for children under five with fever in PMI- and non-PMI-supported states, 2008–2015



Source: 2008 and 2013 NDHS, 2010 and 2015 NMIS

The percentage of children under five with fever who received a finger or heel stick (proxy measure for receipt of an RDT) increased, from 6 percent in 2010 to 13 percent in 2015 in PMI-supported states ($p<0.05$), and from 5 percent in 2010 to 13 percent in 2015 in non-PMI-supported states ($p<0.001$) (Figure 13a). Between 2008 and 2015, the percentage of children under five who received an ACT, among those who received any antimalaria, increased significantly, from 8 percent to 42 percent ($p<0.001$) in PMI-supported states, and from 7 percent to 36 percent in non-PMI-supported states ($p<0.001$) (Figure 13b). No significant differences in coverage of diagnostic testing for malaria and ACT coverage for children with fever in the past two weeks were observed between PMI- and non-PMI-supported states in 2015.

Figure 13. Case management coverage in PMI- and non-PMI-supported states, 2008/2010–2015

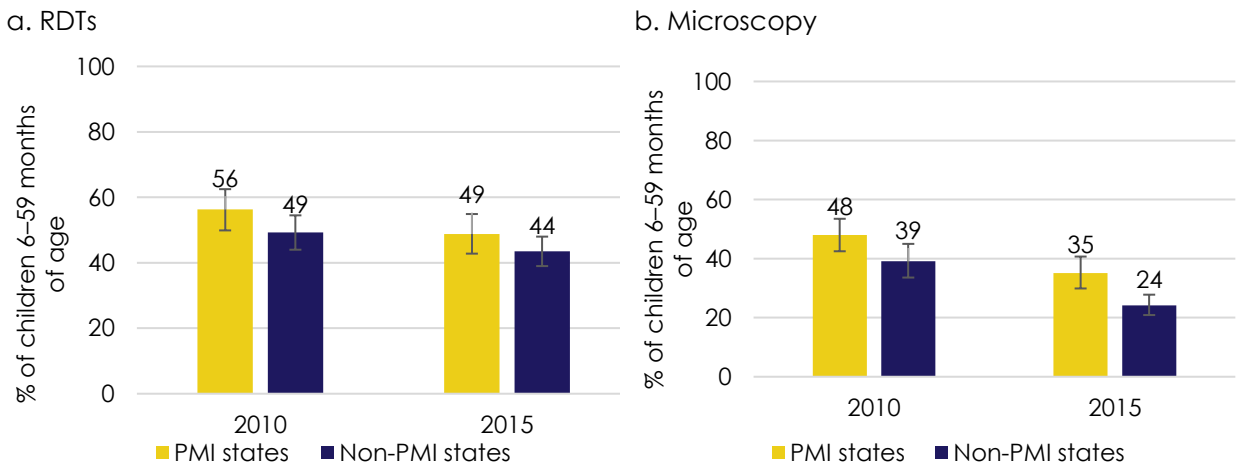


Source: 2008 and 2013 NDHS, 2010 and 2015 NMIS

4.2.7 Malaria Morbidity in PMI- and Non-PMI-Supported States

Parasitemia prevalence measured by RDT and microscopy and moderate and severe anemia prevalence among children 6–59 months of age were assessed in the 2010 and 2015 NMIS. Between 2010 and 2015, parasitemia prevalence measured through RDTs decreased, from 56 percent to 43 percent in PMI-supported states, and from 49 percent to 44 percent in non-PMI-supported states; these decreases, however, were not statistically significant (Figure 14a). Parasitemia prevalence measured via microscopy showed a significant decrease during this same time period, from 48 percent in 2010 to 35 percent in 2015 ($p<0.01$) in PMI-supported states, and from 39 percent in 2010 to 24 percent in 2015 ($p<0.001$) in non-PMI-supported states (Figure 14b). In 2015, parasitemia prevalence measured through microscopy was significantly lower in non-PMI-supported states, compared to PMI-supported states.

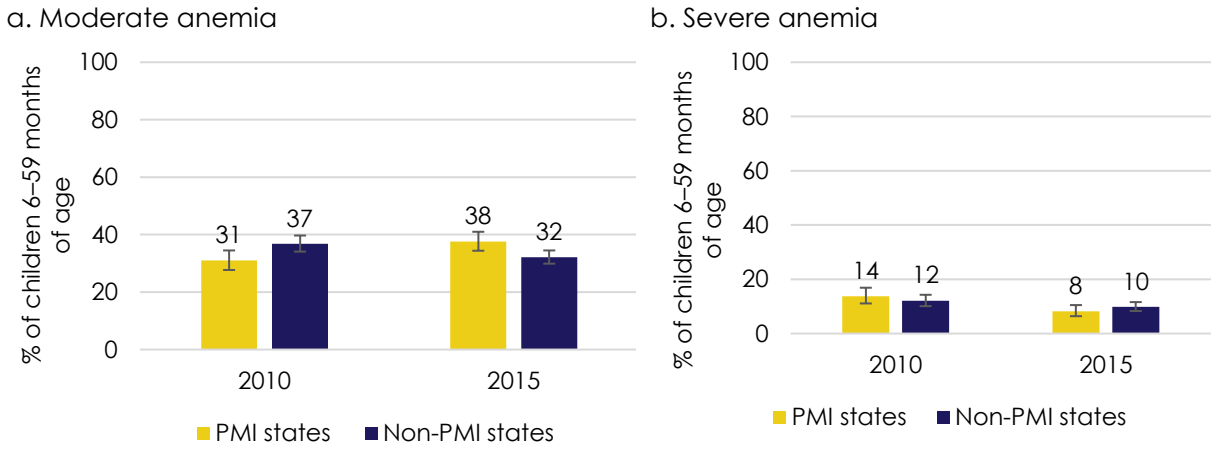
Figure 14. Parasitemia prevalence in children 6–59 months of age in PMI- and non-PMI-supported states, 2010–2015



Source: 2010 and 2015 NMIS

Between 2010 and 2015, the prevalence of moderate anemia (hemoglobin level 8–9.9 g/dL) in children 6–59 months of age increased in PMI-supported states, from 31 percent to 38 percent ($p<0.001$), but decreased in non-PMI-supported states, from 37 percent to 32 percent ($p<0.001$) (Figure 15a). The prevalence of severe anemia (hemoglobin level <8 g/dL) decreased between 2010 and 2015 in PMI-supported states, from 14 percent to 8 percent ($p<0.001$), and also decreased in non-PMI-supported states, from 12 percent to 10 percent ($p<0.001$) (Figure 15b). In 2015, moderate anemia prevalence was significantly higher in PMI-supported states ($p<0.01$), and severe anemia prevalence was similar in PMI- and non-PMI-supported states.

Figure 15. Moderate and severe anemia prevalence in children 6–59 months of age in PMI- and non-PMI-supported-states, 2010–2015



Source: 2010 and 2015 NMIS

4.2.8 Performance of PMI-Supported States Compared to National and PMI Targets for Malaria Intervention Coverage

A summary of malaria intervention coverage and malaria morbidity prevalence for PMI-supported states for 2015, including pooled estimates for all PMI-supported states, is presented in Table 8. The table includes key malaria indicators for which the NMEP and PMI have set targets and highlights PMI-supported states that met or exceeded the 2015 NMEP target (shaded in green). The key indicators examined include the following: (1) household ownership of at least one ITN for every two people, (2) ITN use among the general population, (3) ITN use among children under five, (4) ITN use among pregnant women, (5) receipt of IPTp three or more doses during ANC visits, (6) diagnostic testing coverage for children with fever, (7) women's exposure to malaria SBC messages in the past six months, (8) women's knowledge of ways to avoid malaria, (9) severe anemia prevalence in children 6–59 months of age, and (10) malaria parasite prevalence in children 6–59 months of age (via microscopy).

Across the intervention coverage indicators, the majority of PMI-supported states did not achieve the 2015 NMEP targets. A handful of states out of the 11 supported states met the 2015 target for household ownership of at least one ITN for every two people (five states) and ITN use among children under five (four states). For ITN use among pregnant women, diagnostic testing for children with fever, and women's exposure to malaria SBC messages, only one or two states met the 2015 target, and the majority of states were

well below the target. For ITN use among the general population, IPTp (3+ doses), and women's knowledge of ways to avoid malaria, no state achieved the 2015 target. The majority of states, with the exception of Sokoto and Zamfara States, achieved the 2015 NMEP target for severe anemia prevalence. Five of the 11 states met the 2015 target for parasitemia prevalence. Overall, Table 8 highlights that most of the states did not achieve 2015 targets (with the exception of severe anemia prevalence) and the large gap that remains between current malaria intervention coverage levels and the 2020 targets.

Table 8. Summary of PMI performance against set targets

Target	Key indicators									
	1	2	3	4	5	6	7	8	9	10
PMI target (%)	**90**	**None**	**85**	**85**	**85**	**None**	**None**	**None**	**None**	**None**
NMEP 2020 target (%)	**90**	**90**	**80**	**95**	**100**	**100**	**90**	**100**	**3**	**<1**
NMEP 2015 target (%)	**47**	**60**	**50**	**77**	**55**	**50**	**50**	**100**	**9**	**26.4**
Cross River	55.2	49.6	46.7	61.1	31.2	10.8	47.2	83.6	7.2	26.1
Nassarawa	33	44.4	47.9	51.9	17.6	25.4	19.3	87.7	6.5	35.9
Zamfara	47.3	56.6	67.2	72.5	10.8	7.2	26.3	97.1	21.4	62.6
Bauchi	53	59.2	67.2	64.6	18.3	7.1	38.6	96	6.9	19.6
Sokoto	24	48.7	61.3	59.2	16.2	4.9	39.2	94.6	19.4	46.6
Benue	15.6	24.6	37.2	38.2	21	9.1	26.3	79	1.6	44.5
Ebonyi	62.7	50	52	49.4	41	5.1	42.8	99.3	7.9	30
Oyo	18.6	31.4	33.5	52.5	38.2	58.7	65.1	97.6	6.4	19.2
Kogi	20.2	22.3	32	34.6	38.3	9.8	23.4	85.3	5.1	5.4
Akwa Ibom	54.8	36.8	39.8	62	11.6	10.9	60	78.1	4.1	22.8
Kebbi	22.1	37.6	38.8	77.8	27.6	8.6	46.2	95.2	3.7	63.6
PMI-supported states (pooled)	34.7	41.6	48.5	58.9	24.3	12.9	40.6	91	8.2	35.1

Key

States that achieved the 2015 target

Key indicators: (1) Percentage of households with at least one ITN for every two people; (2) Percentage of the population that slept under an ITN the previous night; (3) Percentage of children under five years of age who slept under an ITN the previous night; (4) Percentage of pregnant women who slept under an ITN the previous night; (5) Percentage of women who received IPTp (3+ doses) during ANC visits; (6) Percentage of children under five years of age with fever in the last two weeks who had a finger or heel stick (MIS indicator specifically refers to children under five years of age and NMEP indicator target refers to all persons); (7) Percentage of women 15–49 years of age exposed to malaria behavior change communication messages in the six months preceding the survey; (8) Percentage of women 15–49 years of age with knowledge of ways to avoid malaria; (9) Severe anemia prevalence (hemoglobin measurement of <8g/dL) in children 6–59 months of age; (10) Malaria parasite prevalence in children 6–59 months of age (via microscopy)
Source: 2015 MIS

4.2.9 Summary of Research Objective 2 Results

Knowledge of the main symptom and the correct treatment of malaria, knowledge of malaria prevention methods, and exposure to malaria SBC messages were generally lower in PMI-supported states in 2010, compared to non-PMI-supported states; however, by 2015, knowledge and exposure levels improved in PMI-supported states and were generally similar or slightly higher than knowledge and exposure levels in non-PMI-supported states. Knowledge of the cause of malaria was high in 2010 and 2015 across both PMI- and non-PMI-supported states. Although improvements were seen in knowledge of key prevention measures for malaria and exposure to at least one malaria-related SBC message in the past six months, levels still remained relatively low in 2015 (all less than 50 percent).

Vector control coverage with ITNs and IRS improved in both PMI- and non-PMI-supported states between 2008 and 2015, with few differences in coverage between PMI- and non-PMI-supported states across the different survey years. Similar improvements in ITN use among the general population, children under five, and pregnant women were observed between 2008 and 2015 in PMI- and non-PMI-supported states; however, by 2015, ITN use was higher overall among these populations in PMI-supported states. IPTp coverage improved significantly between 2008 and 2015 in both PMI- and non-PMI-supported states but was higher in PMI-supported states by 2015.

Timely care-seeking for fever and diagnostic testing coverage improved slightly between 2008/2010 and 2015, but overall coverage remained low across both PMI- and non-PMI-supported states during this time period. ACT treatment coverage improved significantly between 2008 and 2015 in both PMI- and non-PMI-supported states. By 2015, coverage of ACT treatment was only slightly higher in PMI-supported sates.

Parasitemia (measured via microscopy) and severe anemia prevalence decreased significantly between 2010 and 2015 in PMI- and non-PMI-supported states. In 2015, parasitemia prevalence was significantly lower in non-PMI-supported states; however, no significant difference was observed in severe anemia prevalence between PMI- and non-PMI-supported states.

The majority of PMI-supported states did not achieve the 2015 NMEP targets for malaria intervention coverage. Most PMI-supported states, with the exception of Sokoto and Zamfara States, met the 2015 NMEP target for severe anemia prevalence, and almost half of the PMI-supported states met the target for malaria parasitemia prevalence. A large gap remains between current malaria intervention coverage levels and the 2020 set targets.

4.3 Research Objective 3: Relationship between Household ITN Ownership and ITN Use, and Prevalence of Parasitemia and Severe Anemia in Children 6–59 Months of Age

4.3.1 Description of the Sample and Model-Building Process

Using data from 2015 NMIS, we examined the cross-sectional relationship between household ITN ownership and use and malaria parasitemia, moderate anemia, and severe anemia prevalence in children 6–59 months of age using multiple logistic regression, while controlling for other background characteristics associated with ITN ownership and use and the outcome of interest (parasitemia, moderate anemia, and

severe anemia prevalence). We examined household ITN ownership through three different measures: household ownership of at least one ITN, household ITN ownership by age of the ITN (0–1 month, 2–6 months, 7–12 months, and greater than 12 months), and household ITN access. A summary of the 12 regression models that we ran, along with the background characteristics (predictor variables) included in the models, the target population, and sample size for each of the models, is presented in Appendix 3.

To build the models, we first examined the unadjusted bivariate association between each predictor variable and the outcome of interest. We then separately examined the association between the explanatory variables of interest and the outcome variables, while controlling for potential confounding variables of interest (predictor variables). Correlations between the selected explanatory variables of interest and the predictor variables were checked for collinearity and interaction. All nine predictor variables were retained, because none were highly correlated with another. A significant interaction between place of residence and region was found for the models examining the relationship between ITN ownership and use and parasitemia and moderate anemia prevalence. The interaction term was therefore included in the final models.[4] All the models were restricted to one randomly selected child 6–59 months of age per household to avoid cluster effects.

4.3.2 Household ITN Ownership, Access, and Use and Parasitemia Prevalence (through Microscopy) in Children 6–59 Months of Age

The model assessing the relationship between parasitemia prevalence (measured through microscopy) in children 6–59 months of age and household ITN ownership by age of the net is presented in Table 9. A significant protective effect was observed between parasitemia prevalence and households that owned an ITN for 2–6 months and for 7–12 months; the odds of parasitemia was approximately 30 percent lower among children that lived in households that owned a net for 2–6 months (OR: 0.72, $p<0.05$) and among children that lived in households that owned a net for 7–12 months (OR: 0.70, $p<0.001$), than children from households with no ITN. For ITNs owned for more than a year, no significant protective effect was observed.

Significant associations were also found between parasitemia prevalence and the age of the child, mother's education level, place of residence, region of the country, wealth quintile, malaria risk zone, and residence in a PMI-supported state. The odds of parasitemia was almost two times higher in children 24–59 months of age, compared to children 6–23 months of age (OR: 1.94, $p<0.001$). Children whose mother has a secondary or higher level of education had 25 percent lower odds of malaria parasitemia, compared to children whose mother has no formal education (OR: 0.75, $p<0.05$). The odds of parasitemia in children living in rural areas was three times greater than in children living in urban areas (OR: 3.02, $p<0.01$). The odds of malaria parasitemia in children increased with decreasing household wealth status; children from the lowest wealth quintile households had almost 10 times greater odds of parasitemia, compared to children from the highest wealth quintiles households (OR: 9.73, $p<0.001$). Region of the country was also significantly associated with parasitemia prevalence; the odds of parasitemia in children from the North West and South West regions was 2.5 times greater than in children from the North Central region (North West: OR: 2.62, $p<0.05$; South West: OR: 2.52, $p<0.05$). Children living in medium malaria risk zones had 1.4 times greater odds of malaria parasitemia, compared to children living in low risk malaria zones (OR: 1.37, $p<0.05$); children living in high

[4] For the models with a significant interaction term, the full model results with the interaction term coefficients are presented in the results tables in Appendix 2.

malaria risk zones had 2.2 times greater odds of malaria parasitemia, compared to children living in low malaria risk zones (OR: 2.22, p<0.001). A significant association was found between PMI-supported states and malaria parasitemia; children residing in a PMI-supported state had 1.5 times greater odds of malaria parasitemia, compared to children residing in a non-PMI-supported state (OR: 1.49, p<0.001). This significant relationship likely reflects the targeting of PMI support to states that are more highly burdened by malaria.

We also developed models assessing the relationship between parasitemia prevalence and household ownership of at least one ITN, household access to an ITN, and ITN use among children 6–59 months of age (model results are provided in Appendix 2). A borderline significant protective effect was observed between parasitemia prevalence and household ownership of at least one ITN (OR: 0.81, p=0.057), and no significant relationship was observed between parasitemia prevalence and household ITN access or ITN use.

Table 9. Household ownership of ITNs by age of net and parasitemia prevalence in children 6–59 months of age, 2015

Background characteristic	N	Parasitemia prevalence (%)	Adjusted OR (95% CI)	p-value
ITN ownership by age of net				
No ITN	785	22.3	1.00 (reference)	-
ITN owned 0–1 month	96	38.9	1.53 (0.93–2.50)	0.091
ITN owned 2–6 months	588	29.0	**0.72 (0.53–0.97)**	**0.029**
ITN owned 7–12 months	1,004	25.5	**0.70 (0.54–0.90)**	**0.006**
ITN owned >12 months	676	21.4	0.89 (0.68–1.18)	0.428
Sex of child				
Male	1,592	25.9	1.00 (reference)	-
Female	1,558	23.8	0.85 (0.71–1.02)	0.079
Age of child				
6–23 months	1,050	18.2	1.00 (reference)	-
24–59 months	2,100	28.2	**1.94 (1.59– 2.38)**	**<0.001**
Mother's education				
No formal education	1,327	36.8	1.00 (reference)	-
Primary education	541	25.5	0.90 (0.70–1.17)	0.425
Secondary or higher education	1,283	12.3	**0.75 (0.57–0.99)**	**0.045**
Place of residence				
Urban	1,179	9.4	1.00 (reference)	-
Rural	1,971	34.1	**3.02 (1.51–6.01)**	**0.002**
Wealth quintiles				
Highest	714	3.2	1.00 (reference)	-
Fourth	581	15.3	**3.58 (2.21–5.80)**	**<0.001**
Middle	570	25.9	**4.96 (2.98–8.27)**	**<0.001**
Second	686	39.6	**8.86 (5.22–15.04)**	**<0.001**
Lowest	600	42.2	**9.73 (5.57–16.98)**	**<0.001**

Background characteristic	N	Parasitemia prevalence (%)	Adjusted OR (95% CI)	p-value
Region				
North Central	566	30.2	1.00 (reference)	-
North East	423	25.2	0.44 (0.13–1.47)	0.183
North West	945	35.6	**2.63 (1.23–5.63)**	**0.013**
South East	275	10.1	2.05 (0.91–4.65)	0.084
South South	361	18.1	2.17 (0.83–5.67)	0.116
South West	580	13.1	**2.52 (1.17–5.42)**	**0.018**
Number of household members				
1–4	953	20.3	1.00 (reference)	-
5–7	1,384	25.4	1.09 (0.87–1.36)	0.475
8+	813	29.3	1.15 (0.90–1.47)	0.271
Malaria risk zone				
Low (<25%)	834	12.1	1.00 (reference)	-
Medium (25% to <40%)	1,704	28.6	**1.37 (1.02–1.83)**	**0.036**
High (40% or higher)	612	31.8	**2.22 (1.60–3.07)**	**<0.001**
PMI-supported state				
No	2,172	20.5	1.00 (reference)	-
Yes	978	34.7	**1.49 (1.20–1.85)**	**<0.001**

Note: N = sample size; CI = confidence interval; OR = odds ratio; bolded p-values = statistically significant

4.3.3 Household ITN Ownership and Moderate or Severe Anemia Prevalence in Children 6–59 Months of Age

Moderate Anemia Prevalence

There was no significant relationship found between moderate anemia prevalence in children 6–59 months of age and the four predictor variables of interest examined (household ITN ownership of at least one ITN, household ITN ownership by age of net, household ITN access, and ITN use among children 6–59 months of age). The models did find a significant relationship between moderate anemia prevalence and age and sex of the child, place of residence, region of the country, household wealth quintile, and residence in a PMI-supported state. The full results of the models are provided in Appendix 2.

Severe Anemia Prevalence

The model assessing the relationship between severe anemia prevalence and ITN use the previous night in children 6–59 months of age is presented in Table 10. We observed a significant protective effect: children who slept under an ITN the previous night had 33 percent lower odds of severe anemia, compared to children who did not sleep under an ITN the previous night (OR: 0.67, $p<0.05$).

We also found significant associations between parasitemia prevalence in children and the age of the child, mother's education level, region of the country, household wealth quintile, malaria risk zone, and residence in a PMI-supported state. Older children 24–59 months of age had 28 percent lower odds of severe anemia, compared to younger children 6–23 months of age (OR: 0.72, $p<0.001$). Children whose mother has a

primary level of education had 44 percent lower odds of severe anemia, compared to children whose mother has no formal education (OR: 0.56, p<0.01). A borderline significant protective effect was observed for children whose mother has a secondary or higher level of education (OR: 0.71, p=0.095). The odds of severe anemia in children increased with decreasing household wealth status; children from the lowest wealth quintiles households had 12 times higher odds of severe anemia, compared to children from the highest wealth quintile households (OR: 11.99, p<0.001). Region of the country was also associated with severe anemia; the odds of severe anemia in children from the North West, South East, and South South regions was more than 2 times higher than in children from the North Central region (North West: OR: 2.80, p<0.001; South East: OR: 2.14, p<0.05; South South: OR: 2.19, p<0.05). Children living in medium malaria risk zones had almost 1.6 times greater odds of severe anemia, compared to children living in low malaria risk zones (OR: 1.57, p<0.05). A significant protective effect was also found for PMI-supported states; children residing in a PMI-supported state had 43 percent lower odds of severe anemia, compared to children residing in a non-PMI-supported state (OR: 0.57, p<0.001).

Models assessing the relationship between severe anemia and household ownership of at least one ITN, household ITN ownership by age of net, and household access to an ITN found no significant association, although the results showed a trend toward a protective effect of these interventions on severe anemia prevalence (model results are provided in Appendix 2).

Table 10. ITN use and severe anemia prevalence in children 6–59 months of age, 2015

Background characteristic	N	Severe anemia (%)	Adjusted OR (95% CI)	p-value
Used an ITN the previous night				
No	1,870	8.5	1.00 (reference)	-
Yes	1,495	12.1	**0.67 (0.51–0.87)**	**0.003**
Sex of child				
Male	1,700	10.5	1.00 (reference)	-
Female	1,665	9.8	1.01 (0.79–1.30)	0.941
Age of child				
6–23 months	1,106	12	1.00 (reference)	-
24–59 months	2,258	9.3	**0.72 (0.55–0.93)**	**0.012**
Mother's education				
No formal education	1,435	16.7	1.00 (reference)	-
Primary education	581	6.6	**0.56 (0.38–0.83)**	**0.004**
Secondary or higher education	1,349	4.6	0.71 (0.47–1.06)	0.095
Place of residence				
Urban	1,231	5.5	1.00 (reference)	-
Rural	2,134	12.8	0.91 (0.63–1.33)	0.640
Wealth quintile				
Highest	739	1.9	1.00 (reference)	-
Fourth	623	5	**3.08 (1.49–6.35)**	**0.002**
Middle	609	9	**6.38 (3.06–13.28)**	**<0.001**

Background characteristic	N	Severe anemia (%)	Adjusted OR (95% CI)	p-value
Second	757	16.2	**12.68 (5.85–27.52)**	**<0.001**
Lowest	638	18.6	**11.99 (5.33–26.95)**	**<0.001**
Region				
North Central	601	5	1.00 (reference)	-
North East	445	7.7	0.86 (0.54–1.39)	0.543
North West	1,024	20	**2.80 (1.85–4.24)**	**<0.001**
South East	290	6.8	**2.14 (1.15–3.98)**	**0.016**
South South	390	6.1	**2.19 (1.19–4.04)**	**0.012**
South West	616	4.6	1.81 (0.99–3.30)	0.053
Number of household members				
1–4	1,013	9.3	1.00 (reference)	-
5–7	1,465	9.5	0.99 (0.72–1.35)	0.934
8+	887	12.2	0.93 (0.66–1.30)	0.676
Malaria risk zone				
Low (<25%)	871	7.2	1.00 (reference)	-
Medium (25% to <40%)	1,825	10	**1.57 (1.09–2.27)**	**0.015**
High (40% or higher)	669	6.1	0.66 (0.41–1.05)	0.082
PMI-supported state				
No	2,329	10.8	1.00 (reference)	-
Yes	1,036	8.6	**0.57 (0.42–0.76)**	**<0.001**

Note: N = sample size; CI = confidence interval; OR = odds ratio; bolded p-values = statistically significant

4.3.4 Summary of Research Objective 3 Results

The study found a significant protective effect between parasitemia prevalence (measured through microscopy) in children 6–59 months of age and household ownership of ITNs for 2–6 months and 7–12 months. Children from these households had approximately 30 percent lower odds of parasitemia infection, compared to children from households that did not own an ITN. No significant protective effective was observed for newly acquired ITNs (less than 2 months) or ITNs acquired more than 12 months ago. The study found a borderline significant protective effect between parasitemia prevalence and ITN ownership of at least one ITN. Other significant predictors of parasitemia infection in children included age of the child, region of the country, place of residence, household wealth quintile, mother's education level, residence in a PMI-supported state, and malaria risk zone.

No significant relationship was observed between moderate anemia prevalence among children 6–59 months of age and the four predictor variables of interest—household ITN ownership, ITN ownership by age of net, household ITN access, and ITN use among children 6–59 months of age. A significant relationship was observed between moderate anemia prevalence and age and sex of the child, place of residence, region of the country, household wealth quintile, and residence in a PMI-supported state.

A significant protective effect was observed between severe anemia prevalence and ITN use among children 6–59 months of age, with 33 percent lower odds of severe anemia among children who used an ITN the previous night, compared to children who did not use an ITN. Significant associations were also found between severe anemia prevalence and age of the child, region of the country, household wealth quintile, residence in a PMI-supported state, and malaria risk zone.

4.4 Research Objective 4: Relationship between Exposure to Behavior Change Communication Messages and Key Malaria Behavioral Outcomes

4.4.1 Description of the Sample and Model-Building Process

Using data from 2015 NMIS, we examined the cross-sectional relationship between women's exposure to malaria-related SBC messages and ITN use among children under five and pregnant women, and care-seeking from a health provider for children with fever using multiple logistic regression, while controlling for other background characteristics associated with message exposure and the outcomes of interest. We defined two exposure to malaria SBC message variables based on the outcome of interest being examined: (1) recall of at least one ITN-related malaria message, and (2) recall of at least one care-seeking or treatment-related message. A summary of the three regression models that were run, along with the background characteristics (predictor variables) that were included in the models, the target population, and sample size for each of the models, is presented in Appendix 3.

To build the models, we first examined the unadjusted bivariate association between each predictor variable and the outcome of interest. We then separately examined the association between the explanatory variables of interest and the outcome variables, while controlling for potential confounding variables of interest (predictor variables). Correlations between the selected explanatory variables of interest and the predictor variables were checked for collinearity and interaction. All the predictor variables were retained, because none were highly correlated with another. A significant interaction between place of residence and region was found for the model examining the relationship between ITN use in pregnant women and malaria SBC message exposure. For the model assessing the relationship between care-seeking for fever and malaria SBC message exposure, a significant interaction between wealth and the number of ITNs owned by the household was found. The interaction terms were therefore included in the final respective models.[5] For the models examining an outcome among children under five years of age, the models were restricted to one randomly selected child per household to avoid cluster effects.

To examine the relationship between women's exposure to malaria SBC messages and the uptake of IPTp (2+ and 3+ doses), we used a case-control study approach using data from the 2015 NMIS, assessed women who received IPTp, and examined retrospectively whether they reported being exposed to at least one malaria-related SBC message.[6] We stratified the results by different subgroups to account for other key

[5] For the models with a significant interaction term, the full model results with the interaction term coefficients are presented in the results tables Appendix 2.

[6] Due to a misalignment with the time frame for the measurement of uptake of IPTp (measured among women with a live birth in the previous two years) and the time frame for measurement of exposure to malaria SBC messages (measured in the past six months), we do not recommend assessing the relationship between them using multiple regression analysis. We therefore propose to use a case-control study approach to answer this specific research question.

background characteristics that influence IPTp uptake (e.g., woman's age, woman's education level, place of residence, household wealth quintile, parity, and residence in a PMI or non-PMI-supported state).

4.4.2 Maternal Exposure to SBC Messages and ITN Use Among Children Under Five

The model assessing the relationship between ITN use among children under five and maternal exposure to at least one ITN-related malaria message in the past six months is presented in Table 11. We found a significant positive association between maternal exposure to ITN-related SBC messages and ITN use among children under five; the odds of using an ITN among children whose mother was exposed to at least one ITN-related messages was 2.1 times greater than among children whose mother was not exposed to an ITN-related message (OR=2.12, p<0.001). Significant associations were also found between ITN use in children under five and household wealth quintile, region of the country, number of household members, malaria risk zone, PMI-supported state, and household ownership of a radio and TV; no significant associations were observed between ITN use and sex and age of the child or mother's education level. A borderline significant association was observed between ITN use and place of residence, with the odds of ITN use 19 percent lower among children living in rural areas than among children living in urban areas (OR=0.81, p=0.067).

The odds of ITN use among children under five increased as household wealth quintile decreased; children from the poorest households had 4.4 times greater odds of using an ITN the previous night, compared to children from the least poor households (OR: 4.41, p<0.001). Children from the North West region had 2.1 times greater odds of using an ITN, compared to children from the North Central region (OR=2.11, p<0.001). Children from the South East, South South, and South West regions had significantly lower odds of using an ITN the previous night, compared to children from the North Central region. Children from households that had eight or more members had 31 percent lower odds of using an ITN the previous night, compared to children from households that have one to four members (OR=0.69, p<0.001). Children living in medium and high malaria risk zones had about 30 percent lower odds of using an ITN the previous night, compared to children living in low malaria risk zones (medium: OR=0.70, p<0.01; high: OR=0.69, p<0.01). Children residing in a PMI-supported state had 1.4 times greater odds of using an ITN the previous night, compared to children residing in a non-PMI-supported state (OR=1.41, p<0.01). Children who lived in households that own a radio or a TV had almost 1.4 times higher odds of using an ITN the previous night, compared to children from households that did not own a radio or TV (radio: OR=1.37, 95% CI: 1.14–1.64; TV: OR=1.36, 95% CI: 1.04–1.78).

Table 11. Maternal exposure to ITN-related malaria SBC messages in the past six months and ITN use among children under five

Background characteristic	N	ITN use (%)	OR (95% CI)	p-value
Exposed to SBC ITN-related message				
No	2,415	41.0	1.00 (reference)	-
Yes	411	58.7	**2.12 (1.65–2.72)**	**<0.001**
Sex of child				
Male	1,457	43.9	1.00 (reference)	-
Female	1,369	43.4	1.00 (0.85–1.18)	0.991
Age of child				
0–11 months	394	41.5	1.00 (reference)	-
12–23 months	808	43.5	0.96 (0.73–1.25)	0.742

Background characteristic	N	ITN use (%)	OR (95% CI)	p-value
24–35 months	692	49.2	1.12 (0.85–1.48)	0.412
36–47 months	552	41.8	0.83 (0.62–1.10)	0.197
48–59 months	381	38.5	0.82 (0.60–1.13)	0.227
Mother's education				
No formal education	1,193	54.4	1.00 (reference)	-
Primary education	469	41.2	1.06 (0.82–1.35)	0.670
Secondary or higher education	1,165	33.5	1.14 (0.89–1.46)	0.295
Place of residence				
Urban	1,054	34.3	1.00 (reference)	-
Rural	1,773	49.1	0.81 (0.64–1.01)	0.067
Wealth quintiles				
Highest	645	26.2	1.00 (reference)	-
Fourth	523	33.1	**1.56 (1.18–2.07)**	**0.002**
Middle	502	47.1	**2.97 (2.07–4.26)**	**<0.001**
Second	611	52.2	**3.87 (2.50–5.99)**	**<0.001**
Lowest	545	61.5	**4.41 (2.74–7.08)**	**<0.001**
Region				
North Central	515	39.3	1.00 (reference)	-
North East	366	50.6	1.22 (0.93–1.60)	0.160
North West	857	65.2	**2.11 (1.62–2.74)**	**<0.001**
South East	230	22.9	**0.43 (0.30–0.61)**	**<0.001**
South South	328	32.4	**0.67 (0.49–0.94)**	**0.018**
South West	532	24.1	**0.53 (0.38–0.73)**	**<0.001**
Number of household members				
1–4	939	43.5	1.00 (reference)	-
5–7	1,182	40.8	0.83 (0.69–1.01)	0.064
8+	705	48.5	**0.69 (0.55–0.87)**	**0.001**
Malaria risk zone				
Low	726	36.8	1.00 (reference)	-
Medium	1,537	47.7	**0.70 (0.54–0.89)**	**0.004**
High	563	41.2	**0.69 (0.53–0.91)**	**0.008**
PMI-supported state				
No	1,949	42.5	1.00 (reference)	-
Yes	877	46.2	**1.41 (1.15–1.72)**	**0.001**
Household owns radio				
No	1,134	44.5	1.00 (reference)	-
Yes	1,693	43.0	**1.37 (1.14–1.64)**	**0.001**
Household owns TV				
No	1,499	52.5	1.00 (reference)	-
Yes	1,327	33.5	**1.36 (1.04–1.78)**	**0.026**

Note: N = sample size; CI = confidence Interval; OR = odds ratio; bolded p-values = statistically significant

4.4.3 Exposure to SBC Messages and ITN Use Among Pregnant Women

The model examining the relationship between pregnant women's exposure to at least one ITN-related malaria SBC message in the past six months and their use of an ITN the previous night is presented in Table 12. The odds of ITN use the previous night among pregnant women who were exposed to at least one ITN-related message was 2.4 times greater than among pregnant women who were not exposed to an ITN-related SBC message (OR=2.42, p<0.01). Significant associations were also observed between pregnant women's ITN use and parity, place of residence, household wealth quintile, region, malaria risk zone, and

residence in a PMI-supported state; no significant relationship was found between pregnant women's ITN use and woman's age, education level, household size, or household ownership of a radio or TV.

Women who had one or more children had greater odds of using an ITN the previous night, compared to women who were pregnant with the first child. Pregnant women living in rural areas had 3.8 times greater odds of using an ITN the previous night, compared to pregnant women living in urban areas (OR=3.78, p<0.05). The odds of ITN use was more than 2 times higher among pregnant women from the bottom three wealth quintiles, compared to pregnant women from the least poor households. Pregnant women living in the North East region had 6.6 times greater odds and women living in the North West region had 7.5 times greater odds of using an ITN the previous night, compared to pregnant women from the North Central region (North East: OR=6.61, p<0.01; North West: OR=7.50, p<0.01). Pregnant women living in medium malaria risk zones had 56 percent lower odds of using an ITN the previous night, compared to pregnant women living in low malaria risk zones (OR=0.54, p<0.001). No significant difference was observed in ITN use among pregnant women living in high malaria risk zones and low malaria risk zones. Pregnant women residing in PMI-supported states had more than 3 times greater odds of using an ITN the previous night, compared to pregnant women residing in non-PMI-supported states (OR=3.28, p<0.001).

Table 12. Pregnant women's exposure to ITN-related malaria SBC messages in the past six months and use of ITNs

Background characteristic	N	ITN use (%)	OR (95% CI)	p-value
Exposed to ITN-related SBC message				
No	775	46.8	1.00 (reference)	-
Yes	128	61.7	**2.42 (1.46–4.00)**	**0.001**
Age group				
15–19	132	48.3	1.00 (reference)	-
20–34	649	49.4	1.13 (0.66–1.94)	0.661
35–49	122	46.8	1.67 (0.82–3.41)	0.156
Parity				
0	186	32.6	1.00 (reference)	-
1	166	51.6	**2.68 (1.54–4.64)**	**<0.001**
2	158	53	**2.89 (1.66–5.03)**	**<0.001**
3 or more	394	53.8	**1.89 (1.10–3.25)**	**0.021**
Education level				
No formal education	409	61.9	1.00 (reference)	-
Primary education	157	47.9	1.08 (0.68–1.71)	0.744
Secondary or higher	338	33.7	1.12 (0.68–1.85)	0.651
Place of residence				
Urban	273	36	1.00 (reference)	-
Rural	630	54.5	**3.78 (1.18–12.06)**	**0.025**
Wealth				
Highest	176	30.4	1.00 (reference)	-
Fourth	143	30.7	1.18 (0.65–2.14)	0.580
Middle	168	49.4	**2.41 (1.19–4.92)**	**0.015**
Second	184	58.5	**2.49 (1.07–5.78)**	**0.033**
Lowest	232	66.1	**2.66 (1.09–6.51)**	**0.032**
Region				
North Central	132	37.8	1.00 (reference)	-
North East	140	55.5	**6.61 (1.92–22.75)**	**0.003**
North West	326	67.8	**7.50 (2.21–25.48)**	**0.001**

Background characteristic	N	ITN use (%)	OR (95% CI)	p-value
South East	79	22.7	2.15 (0.64–7.25)	0.217
South South	108	33.3	2.05 (0.55–7.72)	0.287
South West	119	33.2	1.31 (0.39–4.40)	0.666
Number of household members				
1–4	393	43	1.00 (reference)	-
5–7	263	50.5	1.15 (0.76–1.75)	0.499
8+	247	56.6	0.80 (0.58–1.37)	0.593
Malaria risk zone				
Low	238	44.8	1.00 (reference)	-
Medium	500	50.6	**0.44 (0.27–0.70)**	**<0.001**
High	165	49.6	1.07 (0.63–1.84)	0.802
PMI-supported state				
No	606	44	1.00 (reference)	-
Yes	297	58.9	**3.28 (2.20–4.89)**	**<0.001**
Household ownership of radio				
No	344	51	1.00 (reference)	-
Yes	546	48	1.12 (0.79–1.59)	0.511
Household ownership of TV				
No	539	58	1.00 (reference)	-
Yes	352	35	1.12 (0.79–1.59)	0.511

Note: A significant interaction was found between place of residence and region; the results are not presented in the table. N = sample size; CI = confidence interval; OR = odds ratio; bolded p-values = statistically significant

4.4.4 Maternal Exposure to SBC Messages and Care-Seeking Behavior Among Children Under Five

The model examining the relationship between maternal exposure to at least one care-seeking-related SBC message in the past six months and care-seeking from an appropriate provider for fever for children under five years of age is presented in Table 13. We found a borderline positive association between maternal exposure to care-seeking SBC messages and care-seeking for children with fever (OR=1.69, p=0.078). Significant associations were observed between care-seeking for children and place of residence, household wealth quintile, region of the country, number of ITNs owned by household, residence in a PMI-supported state, and household ownership of a radio. No significant relationship was found between care-seeking for fever and sex or age of the child, mother's education level, household size, malaria risk zone, or household ownership of a TV.

Children living in rural areas had 32 percent lower odds of having treatment sought for their fever, compared to children living in urban areas (OR=0.68, p<0.05). The odds of seeking treatment was around 70 percent lower among children from the bottom three wealth quintiles, compared to children from highest wealth quintiles. Children from the North East, North West, South South, and South West regions all had a lower odds of having treatment sought for their fever than children from the North Central region. Children living in households that owned one or two ITNs also had a lower odds of having treatment sought for their fever, compared to children from households that did not own an ITN (one ITN: OR=0.32, p<0.05; two ITNs: OR=0.16, p<0.01). Children residing in a PMI-supported state had 28 percent lower odds of having treatment sought for their fever, compared to children residing in a non-PMI-supported state (OR=0.72, p<0.05). Children from households that own a radio had almost 1.5 times greater odds of having treatment sought for their fever, compared to children from households that do not own a radio (OR=1.47, p<0.01).

Table 13. Maternal exposure to care-seeking or treatment-related malaria SBC messages in the past six months and care seeking for fever for children under five years of age

Background characteristic	N	ITN use (%)	Adjusted OR (95% CI)	p-value
Exposed to SBC care-seeking or treatment-related message				
No	1,146	65.4	1.00 (reference)	-
Yes	85	78.8	1.69 (0.94–3.04)	0.078
Sex of child				
Male	621	64.2	1.00 (reference)	-
Female	610	68.4	1.19 (0.93–1.53)	0.168
Age of child				
0–11 months	169	64.6	1.00 (reference)	-
12–23 months	355	70.6	1.14 (0.76–1.73)	0.525
24–35 months	335	65.0	0.95 (0.63–1.45)	0.823
36–47 months	223	62.6	1.00 (0.63–1.57)	0.997
48–59 months	149	66.3	0.92 (0.56–1.50)	0.731
Mother's education				
No formal education	607	62.9	1.00 (reference)	-
Primary education	211	66.5	0.94 (0.64–1.37)	0.747
Secondary or higher education	413	71.1	0.84 (0.57–1.24)	0.385
Place of residence				
Urban	341	72.7	1.00 (reference)	-
Rural	890	63.8	**0.68 (0.47–0.98)**	**0.041**
Wealth quintile				
Highest	187	75.1	1.00 (reference)	-
Fourth	197	68.6	0.53 (0.19–1.52)	0.240
Middle	214	69.7	**0.23 (0.08–0.69)**	**0.009**
Second	319	63.7	**0.29 (0.09–0.88)**	**0.030**
Lowest	314	59.8	**0.26 (0.07–0.96)**	**0.044**
Region				
North Central	159	79.5	1.00 (reference)	-
North East	194	69.5	**0.48 (0.29–0.77)**	**0.003**
North West	489	56.9	**0.22 (0.14–0.35)**	**<0.001**
South East	93	82.4	0.77 (0.40–1.49)	0.439
South South	162	65.0	**0.41 (0.24–0.71)**	**0.002**
South West	134	70.6	**0.36 (0.20–0.65)**	**0.001**
Number of household members				
1–4	403	63.9	1.00 (reference)	-
5–7	487	68.5	1.31 (0.96–1.78)	0.086
8+	341	65.9	1.16 (0.81–1.66)	0.416
Number of ITNs owned by household				
0	212	68.2	1.00 (reference)	-
1	221	62.3	**0.32 (0.11–0.92)**	**0.034**
2	396	63.8	**0.16 (0.06–0.45)**	**0.001**
3+	403	69.9	0.78 (0.24–2.57)	0.683
Malaria risk zone				
Low	265	67.2	1.00 (reference)	-
Medium	736	66.0	1.44 (0.99–2.09)	0.056
High	230	66.2	1.25 (0.81–1.95)	0.315
PMI-supported state				
No	841	67.4	1.00 (reference)	-
Yes	391	63.8	**0.72 (0.53–0.98)**	**0.038**
Household owns radio				
No	497	59.3	1.00 (reference)	-
Yes	734	71.0	**1.47 (1.12–1.93)**	**0.005**

Background characteristic	N	ITN use (%)	Adjusted OR (95% CI)	p-value
Household owns TV				
No	758	63.4	1.00 (reference)	-
Yes	473	70.9	1.06 (0.69–1.61)	0.801

Note: N = sample size; CI = confidence interval; OR = odds ratio; bolded p-values = statistically significant

4.4.5 Exposure to SBC Messages and IPTp Uptake Among Pregnant Women

Tables 14–15 present the case-control study results assessing the relationship between exposure to at least one malaria-related SBC message and uptake of IPTp2 (Table 14) and IPTp3 (Table 15), stratified by background characteristics. Overall, the odds of exposure to at least one malaria message among women who received IPTp2 was 1.7 times greater than the odds of exposure among women who did not receive IPTp2 ($p<0.001$). When examining the relationship between exposure and IPTp2 uptake stratified by different background characteristics, we found significant associations by age group, women's education level, place of residence, household wealth quintile, region of the country, parity, and residence in a PMI or non-PMI-supported state. For example, the odds of women 20–34 years of age who received IPTp2 of being exposed to at least one malaria-related SBC message were 1.8 times greater than women who did not receive IPTp2 (OR: 1.83, 95% CI: 1.49–2.25). We also found a significant association between the odds of exposure and IPTp uptake by education level. The odds of exposure and IPTp2 uptake was 2.2 times greater among women who had no formal education (OR=2.24, 95% CI: 1.64–3.04) and 1.3 times greater (OR=1.31, 95% CI: 1.01–1.70) among women who had a secondary or higher level of education, compared to women with the same levels of education who did not receive IPTp2. The odds of exposure among women living in a rural area who received IPTp2 was 1.8 times greater, compared to women who did not receive IPTp2; however, this significant association was not observed for women from urban areas. In general, the odds of exposure and IPTp2 uptake increased as wealth quintile decreased; with the odds of exposure among women who received IPTp2 from the poorest households 2.2 times greater (OR=2.22, 95% CI: 1.27–3.84) than women who did not receive IPTp2 from the same wealth quintile. The odds of exposure to malaria messages among women who received IPTp2 was 3.1 times greater in the North East (OR=3.14, 95% CI: 2.05–4.83) and 2.6 times greater in the North West (OR=2.58, 95% CI: 1.76–3.77) regions, compared to women who did not receive IPTp2 in those regions. The odds of exposure and receipt of IPTp2 was 2.4 times greater among women who had one child (OR=2.37, 95% CI: 1.55–3.61) and 1.6 times greater among women who had three or more children (OR=1.62, 95% CI: 1.29–2.03), when compared with women who did not receive IPTp2. The odds of exposure and receipt of IPTp2 among women who lived in a PMI-supported state was 2.1 times greater (OR=2.08, 95% CI: 1.50–2.88) than women who did not receive IPTp2 in those areas, and they were also greater when compared to women who did not live in PMI-supported areas (OR=1.55, 95% CI: 1.25–1.92).

Table 14. IPTp2 uptake (two or more doses SP) and exposure to at least one SBC malaria message

Background characteristic	Cases N (% exposed)	Controls N (% exposed)	Odds ratio (95% CI)	p-value*
Overall	951 (38.0%)	1,539 (26.5%)	**1.70 (1.43–2.03)**	<0.001
Age				
15–19	81 (30.9%)	160 (24.4%)	1.39 (0.73–2.61)	<0.001
20–34	727 (38.7%)	1,137 (25.6%)	**1.83 (1.49–2.25)**	

Background characteristic	Cases N (% exposed)	Controls N (% exposed)	Odds ratio (95% CI)	p-value*
35–49	143 (38.5%)	242 (31.8%)	1.34 (0.85–2.11)	
Education level				
None	291 (36.4%)	755 (20.4%)	**2.24 (1.64–3.04)**	0.0065
Primary	143 (28.0%)	267 (26.6%)	1.07 (0.66–1.73)	
Secondary or higher	517 (41.6%)	517 (35.2%)	**1.31 (1.01–1.70)**	
Place of residence				
Urban	446 (42.8%)	438 (36.3%)	1.31 (0.99–1.74)	<0.001
Rural	505 (33.7%)	1,101 (22.5%)	**1.75 (1.37–2.22)**	
Wealth quintile				
Highest	264 (44.3%)	221 (43.9%)	1.02 (0.70–1.48)	<0.001
Fourth	250 (37.2%)	270 (27.8%)	**1.54 (1.05–2.27)**	
Middle	185 (35.7%)	310 (27.1%)	1.49 (0.99–2.25)	
Second	159 (34.6%)	409 (22.7%_	**1.80 (1.18–2.73)**	
Lowest	93 (32.3%)	329 (17.6%)	**2.22 (1.27–3.84)**	
Region				
North Central	156 (22.4%)	321 (24.9%)	0.87 (0.54–1.40)	<0.001
North East	214 (40.7%)	285 (17.9%)	**3.14 (2.05–4.83)**	
North West	177 (48.6%)	433 (26.8%)	**2.58 (1.76–3.77)**	
South East	101 (46.5%)	146 (40.4%)	1.28 (0.74–2.21)	
South South	120 (29.2%)	193 (24.9%)	1.24 (0.72–2.14)	
South West	183 (38.8%)	161 (32.9%)	1.29 (0.81–2.06)	
Parity				
1	194 (41.2%)	271 (22.9%)	**2.37 (1.55–3.61)**	<0.001
2	187 (34.8%)	325 (26.8%)	1.46 (0.97–2.19)	
3+	570 (37.9%)	943 (27.4%)	**1.62 (1.29–2.03)**	
PMI-supported state				
No	658 (35.7%)	1,099 (26.4%)	**1.55 (1.25–1.92)**	<0.001
Yes	293 (43.0%)	440 (26.6%)	**2.08 (1.50–2.88)**	

* For results that are reported stratified by a background characteristic, the p-value reported represents the Mantel-Haenszel chi-square p-value for the test of the combined odds ratio.

Overall, the odds of exposure to at least one malaria message among women who received IPTp3 was 2 times greater than the odds of exposure among women who did not receive IPTp3 ($p<0.001$). Similar to the results with IPTp2 uptake, when we assessed the relationship between exposure and IPTp3 uptake stratified by different background characteristics, we found significant associations by age group, women's education level, place of residence, household wealth quintile, region of the country, parity, and residence in a PMI or non-PMI-supported state. The odds of women 20–34 years of age who received IPTp3 of being exposed to at least one malaria message was 2.1 times greater than women of the same age group who did not receive IPTp3 (OR: 2.11, 95% CI: 1.66–2.67). The odds of exposure was 2.8 times greater among women with no formal education who received IPTp3 (OR=2.77, 95% CI: 1.92–3.97) and 1.6 times greater among women who had a secondary or higher level of education who received IPTp3 (OR=1.56, 95% CI: 1.16–2.08), when compared to women with the same education levels who did not receive IPTp3. Among women in rural areas who received IPTp3, the odds of exposure was 2 times greater, compared to women from rural areas who did not receive IPTp3 (OR=1.96, 95% CI: 1.47–2.60). Among women from urban areas who received IPTp3, the odds of exposure was 1.6 times greater, compared to women from urban areas who did not receive IPTp3 (OR=1.64, 95% CI: 1.20–2.24). Generally, the odds of exposure to at least one malaria message among women who received IPTp3 from the middle and lower wealth quintiles (quintiles 2–4) was approximately 2 times greater than women from those wealth quintiles who did not receive IPTp3. Among women from the

North East, North West, and South East regions, the odds of exposure among those who received IPTp3 was significantly greater (between 2.0 and 2.8 times) than women from those regions who did not receive IPTp3. The odds of exposure among women who received IPTp3 and who had three or more children was 2.1 times greater (OR=2.09, 95% CI: 1.60–2.72), compared to those who did not receive IPTp3 and had three or more children. When examining the relationship between exposure and IPTp3 stratified by residence in a PMI or non-PMI-supported state, the odds of exposure was the same: 1.9 times greater (PMI: OR=1.93, 95% CI: 1.50–2.48; non-PMI: OR=1.94, 95% CI: 1.34–2.79) among women who received IPTp3, compared to those who did not receive IPTp3.

When we assessed exposure to at least one malaria in pregnancy SBC message, the odds of exposure among women who received IPTp2 was 2.6 times (OR=2.61; p<0.001) greater than the odds of exposure among women who did not receive IPTp2 (results not presented in table). When we assessed exposure to at least one malaria in pregnancy SBC message and uptake of IPTp3, no significant measure of association was found (OR=0.99, 95% CI: 0.44–2.04); however, this was likely an issue of insufficient power to detect a difference due to the low proportion of women exposed to at least one SBC malaria in pregnancy message (2.0%). We were not able to further stratify the results by background characteristics due to low exposure to malaria in pregnancy SBC messages.

Table 15. IPTp3 uptake (three or more doses of SP) and exposure to at least one SBC malaria message

Background characteristic	Cases N (% exposed)	Controls N (% exposed)	Odds ratio (95% CI)	p-value*
Overall	512 (42.8%)	1,978 (27.8%)	**1.95 (1.58–2.39)**	<0.001
Age				
15–19	41 (29.3%)	200 (26.0%)	1.18 (0.51–2.59)	<0.001
20–34	391 (44.0%)	1,473 (27.2%)	**2.11 (1.66–2.67)**	
35–49	80 (43.8%)	305 (31.8%)	1.67 (0.97–2.83)	
Education level				
None	165 (43.0%)	881 (21.5%)	**2.77 (1.92–3.97)**	<0.001
Primary	79 (30.4%)	331 (26.3%)	1.22 (0.68–2.15)	
Secondary or higher	124 (46.3%)	766 (35.6%)	**1.56 (1.16–2.08)**	
Place of residence				
Urban	242 (48.4%)	642 (36.3%)	**1.64 (1.20–2.24)**	<0.001
Rural	270 (37.8%)	1,336 (23.7%)	**1.96 (1.47–2.60)**	
Wealth quintile				
Highest	126 (47.6%)	359 (42.9%)	1.21 (0.79–1.86)	<0.001
Fourth	137 (46.7%)	383 (27.2%)	**2.35 (1.54–3.59)**	
Middle	103 (42.7%)	392 (27.0%)	**2.01 (1.25–3.23)**	
Second	98 (36.7%)	470 (23.8%)	**1.86 (1.13–3.01)**	
Lowest	48 (31.3%)	374 (19.5%)	1.87 (0.89–3.77)	
Region				
North Central	93 (23.7%)	384 (24.2%)	0.97 (0.54–1.69)	<0.001
North East	135 (43.7%)	364 (21.7%)	**2.80 (1.79–4.36)**	
North West	97 (53.6%)	513 (29.2%)	**2.80 (1.75–4.46)**	
South East	67 (55.2%)	180 (38.3%)	**1.98 (1.08–3.65)**	
South South	49 (32.7%)	264 (25.4%)	1.43 (0.69–2.86)	
South West	71 (46.5%)	273 (33.3%	1.74 (0.98–3.05)	

Background characteristic	Cases N (% exposed)	Controls N (% exposed)	Odds ratio (95% CI)	p-value*
Parity				
1	104 (40.4%)	361 (27.7%)	**1.77 (1.09–2.85)**	<0.001
2	97 (39.2%)	415 (27.5%)	**1.70 (1.04–2.76)**	
3+	311 (44.7%)	1,202 (27.9%	**2.09 (1.60–2.72)**	
PMI-supported state				
No	338 (41.7%)	1,419 (27.1%)	**1.93 (1.50–2.48)**	<0.001
Yes	174 (44.8%)	559 (29.5%)	**1.94 (1.34–2.79)**	

* For results that are reported stratified by a background characteristic, the p-value reported represents the Mantel-Haenszel chi-square p-value for the test of the combined odds ratio.

4.4.6 Summary of Objective 4

We observed a significant positive association between maternal exposure to ITN-related SBC messages and ITN use among children under five years of age; the odds of using an ITN among children whose mother was exposed to at least one ITN-related messages was 2.1 times greater, compared to children whose mother was not exposed to an ITN-related message. The odds of ITN use among pregnant women who were exposed to at least one ITN-related message was 2.4 times greater, compared to pregnant women who were not exposed to an ITN-related SBC message. A borderline significant association was also observed between maternal exposure to care-seeking and treatment SBC messages and care-seeking for children with fever; the odds of children having care sought for them when they got a fever was 1.7 times greater among children whose mother was exposed to a care-seeking message, compared to children whose mothers were not exposed to care-seeking messages.

Using a case-study approach, a positive association was observed between malaria SBC message exposure and women's uptake of IPTp2 and IPTp3. Overall, the odds of exposure to at least one malaria message among women who received IPTp2 was 1.7 times greater than the odds of exposure among women who did not receive IPTp2; and the odds of exposure to at least one malaria message among women who received IPTp3 was 2 times greater than the odds of exposure among women who did not receive IPTp3. These results demonstrate a positive effect of maternal exposure to malaria-related prevention messages and use of ITNs by children under five years of age and care-seeking behavior for children with fever, and between women's exposure to malaria-related messages and their uptake of malaria prevention behaviors in pregnancy.

4.5 Research Objective 5: Conduct a Profiling of Different Subnational Populations to Inform Where Best to Target Future Malaria Control Investment to Maximize Impact

4.5.1 Description of the Sample and Model-Building Process

A summary of the nine CHAID models is presented in Appendix 3. For each model, we present the results from the bivariate analysis assessing the relationship between the outcome of interest and various background characteristics, the CHAID tree diagram, and the CHAID gain index table that summarizes the gain, response, and index for each terminal node (refer to Section 3.3, Research Objective 5, for definitions of these measures). For the CHAID models that focused on intervention coverage (models 1–7), we set the target category of the analysis to those who did not receive the intervention to identify specific subgroups that should be the focus of future interventions to improve overall coverage. For the two models on malaria

morbidity, the target category of analysis is children who had malaria parasitemia (model 8) or severe anemia (model 9) to identify specific subgroups at higher risk of these adverse outcomes.

For each of the CHAID models, the following specifications were set: a maximum tree depth of three levels, a minimum of 100 cases per parent node, and a minimum of 50 cases in the child node.

4.5.2 Profiling of Subpopulations Based on Malaria Intervention Uptake

Model 1. CHAID model on household ownership of at least one ITN

Household ownership of at least one ITN by various background characteristics is presented in Table 16. A significant relationship was observed between household ownership of at least one ITN and the education level of the household head, place of residence, region of the country, household wealth quintile, and number of household members. All significant background variables assessed were therefore included in the CHAID model.

Table 16. Household ownership of at least one ITN by background characteristics

Background characteristic	ITN ownership (%)	N	Chi-square p-value
Education level of the household head			
None	72.0	2,764	<0.001
Primary	71.8	1,534	
Secondary or higher	64.9	3,418	
Place of residence			
Urban	63.0	3,083	<0.001
Rural	72.7	4,662	
Region			
North Central	55.4	1,311	<0.001
North East	79.6	843	
North West	90.6	1,993	
South East	64.0	876	
South South	63.9	1,154	
South West	53.0	1,567	
Household wealth quintile			
Lowest	86.1	1,237	<0.001
Second	73.5	1,423	
Middle	68.7	1,616	
Fourth	64.2	1,684	
Highest	57.7	1,784	
Number of household members			
1–4 members	62.0	3,940	<0.001
5–7 members	72.4	2,545	
8 or more members	83.2	1,260	
Total	**68.8**	**7,745**	

N=weighted number

To identify the sociodemographic profile of household ownership of at least one ITN in the country, all five predictor variables that demonstrated a significant relationship with household ITN ownership were included in the CHAID model. All included predictor variables were retained in the CHAID model. The final CHAID model contained 32 nodes, of which 19 were terminal nodes. The best predictor of household ITN ownership was region of the country ($p<0.001$), which makes up the first level of the tree (Figure 16). Region was split up into five parent nodes—the North West region (Node 1), the North East region (Node 2), the North Central and South South regions (Node 3), the South West region (Node 4), and the South East region (Node 5). The highest household ITN coverage was found in the North West region (89 percent), and the lowest coverage was found in the South West region (55 percent).

Among households in the North West region, the most significant predictor of household ITN ownership was the education level of the household head ($p<0.05$), split between those with no formal education (Node 6) and those with a primary or higher level of education (Node 7), with higher ownership among those from households in which the household head had a higher level of education (92 percent), compared to households in which the household head had no formal education (88 percent). Among the households with the household head having a primary or higher level of education; place of residence was also a significant predictor of ITN ownership ($p<0.05$), with lower coverage in households in urban areas (Node 17; 89 percent) than households in rural areas (Node 18; 94 percent).

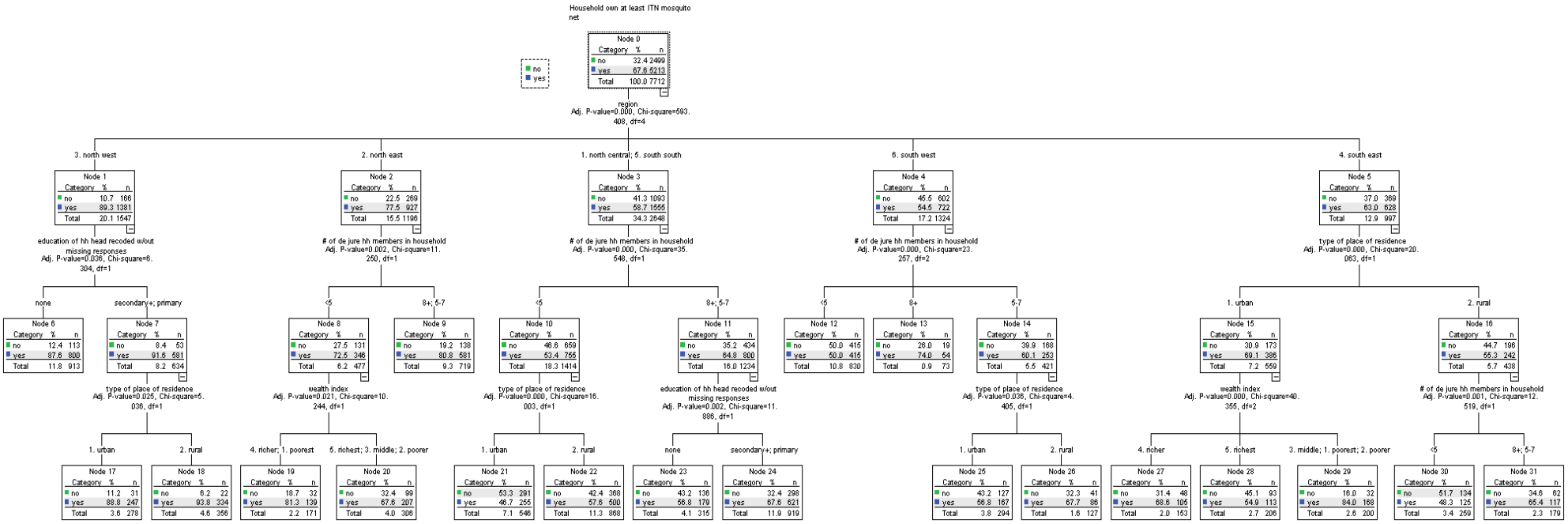
Among households in the North East region, the most significant predictor of ITN ownership was household size ($p<0.01$), split between small-size households (Node 8) and medium- and large-size households (Node 9). Coverage was higher among medium and large-size households (81 percent), compared to small households (73 percent). In small-size households, household wealth quintile was also a significant predictor of ITN ownership ($p<0.05$), split between the lowest and the fourth wealth quintiles (Node 19) and the second, middle, and highest wealth quintiles (Node 20). ITN household ownership was higher in households in Node 19 (81 percent), compared to households in Node 20 (68 percent).

In households in the South West region, the greatest predictor of ITN ownership was household size ($p<0.001$), split between small-size (Node 12), medium-size (Node 14), and large-size households (Node 13). ITN ownership was highest in large-size households (74 percent), compared to small-size (50 percent) and medium-size (60 percent) households. Among medium-size households, place of residence was another significant predictor of ITN ownership ($p<0.05$), split between urban (Node 25) and rural (Node 26) areas. ITN household ownership was higher in rural areas (68 percent), compared to urban areas (59 percent).

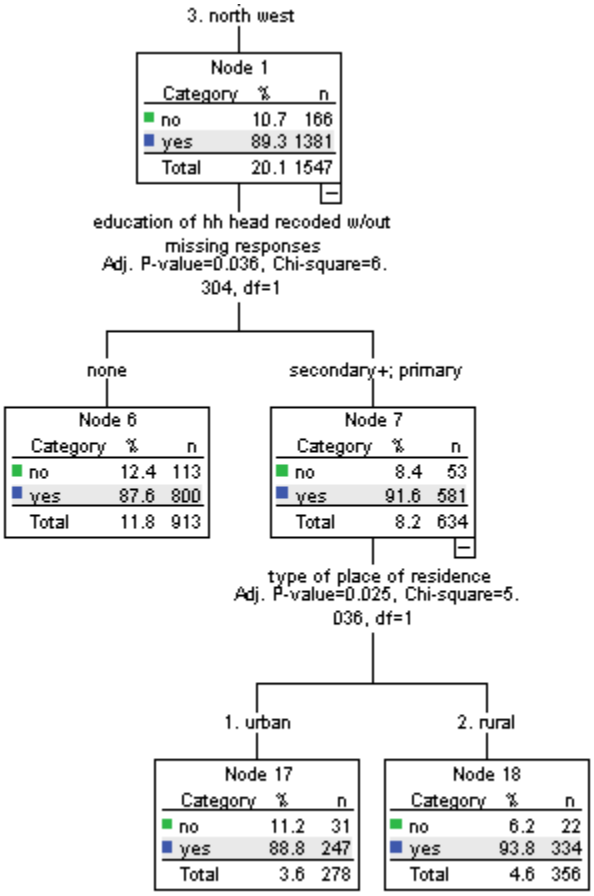
Among households in the South East region, the most significant predictor of ITN ownership was place of residence ($p<0.001$). ITN ownership coverage was higher in urban areas (Node 15; 69 percent), compared to rural areas (Node 16; 55 percent). In urban areas in the South East region, household wealth quintile was also a significant predictor of ITN ownership ($p<0.001$), split between the highest wealth quintile (Node 28), the fourth wealth quintile (Node 27), and the bottom three wealth quintiles (Node 29). ITN ownership was highest among the bottom three wealth quintiles (Node 29; 84 percent) and lowest among the wealthiest households (Node 28; 55 percent). In rural areas in the South East region, household size was also a significant predictor of ITN ownership ($p<0.01$), split between small-size households (Node 30) and medium- and large-size households (Node 31), with ITN coverage higher in medium- and large-size households (65 percent), compared to small-size households (48 percent).

Figure 16. CHAID tree for household ownership of at least one ITN

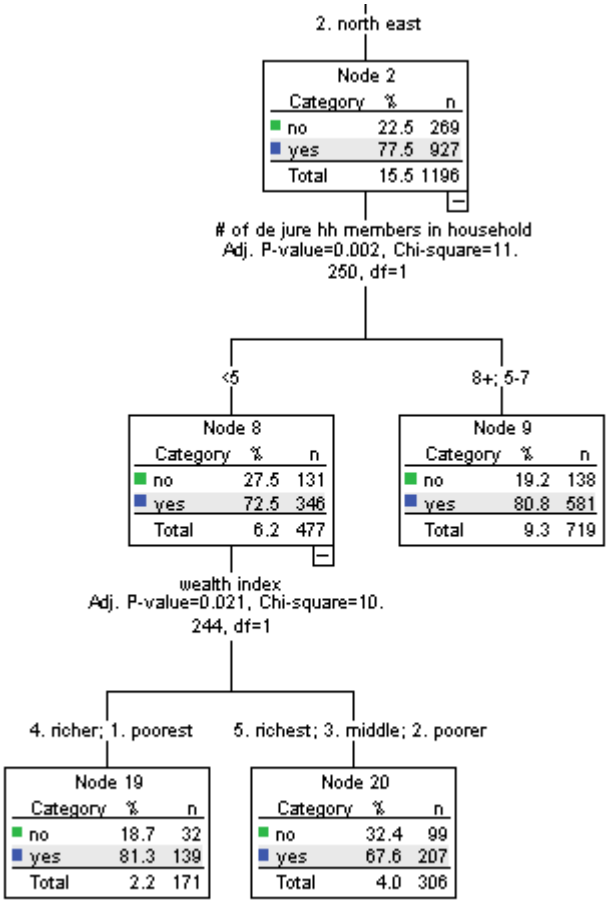
a. Full CHAID tree



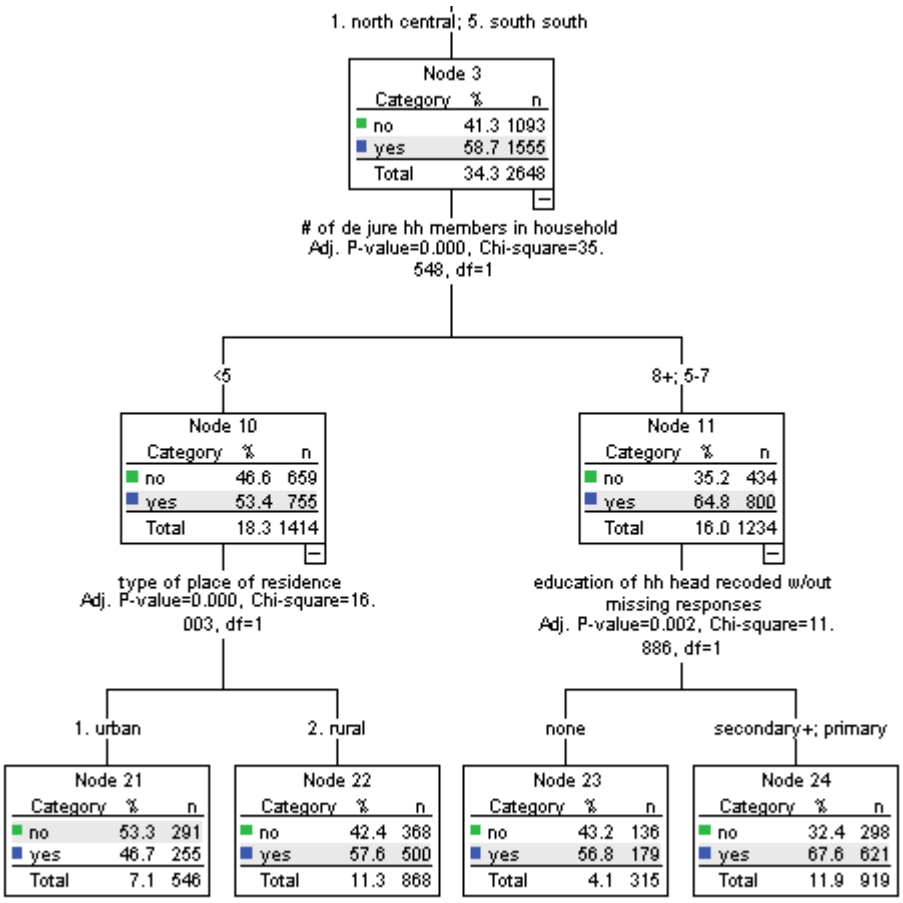
b. North West region



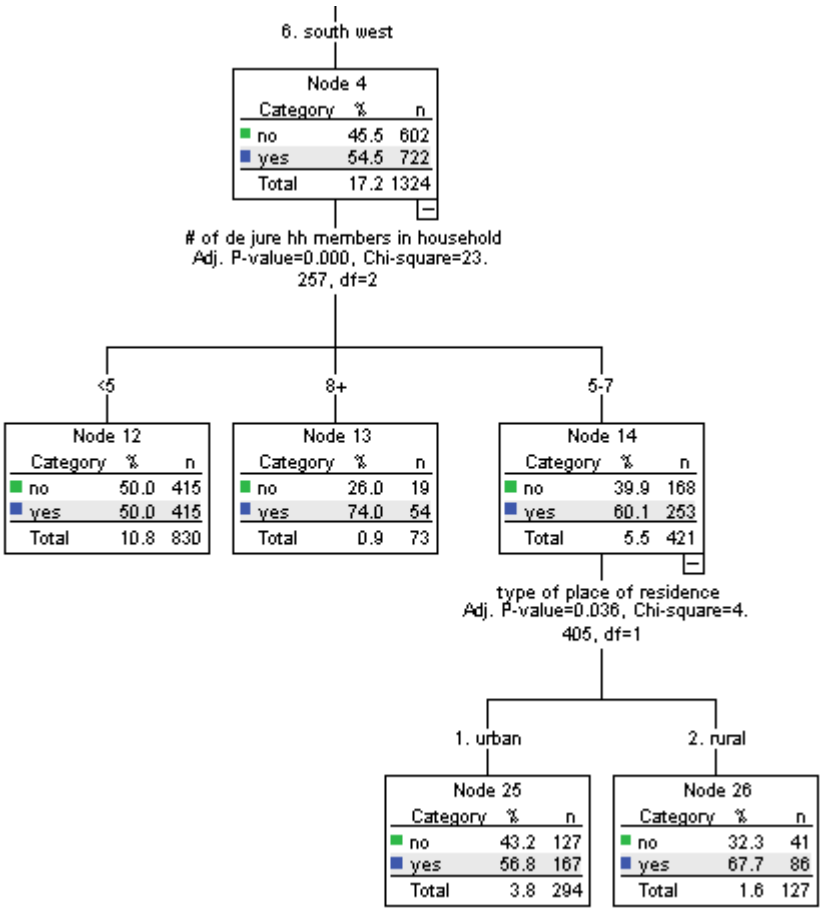
c. North East region



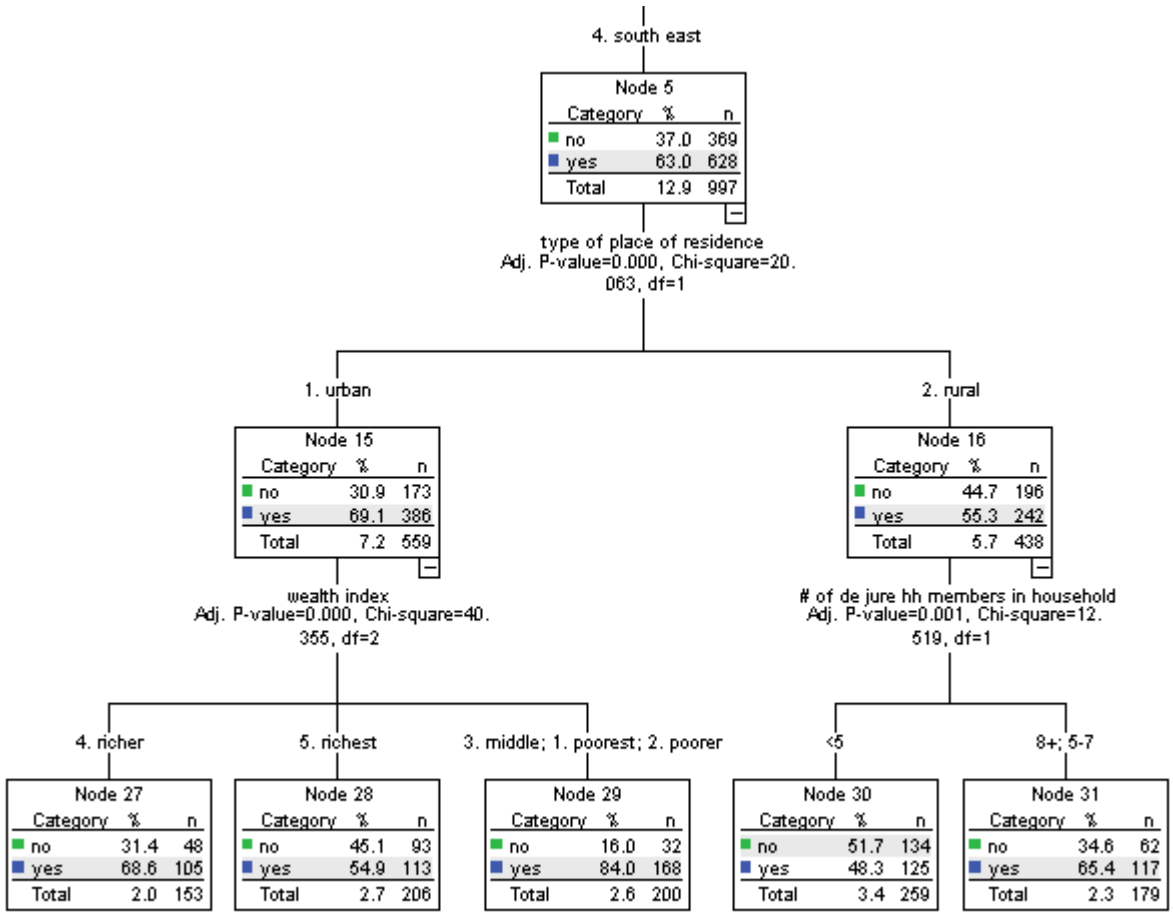
d. North Central and South South regions



e. South West region



f. South East region



The CHAID gain index for households that did not own an ITN is presented in Table 17. The table includes a description of the population in each of the 19 terminal nodes; the node percentage, which represents the demographic weight of the subgroup of households in the node in the overall sample population; the gain percentage, which represents the percentage of households that did not own an ITN out of all households in the sample; the response percentage, which represents the percentage of households that did not own an ITN in that node; and the index percentage, which represents the probability of not owning an ITN in the respective node, compared to the overall population. For example, Node 21, which comprises small-size households from the North Central and South South regions in urban areas, represents 7 percent of the overall population (node percentage). In this subgroup, 53 percent of households did not own an ITN (response percentage), which represents 12 percent of the overall population that did not own an ITN (gain percentage). The probability of not owning an ITN in this subgroup is 1.6 times higher, compared to the overall population. To increase overall national household ITN ownership coverage, these results indicate that efforts should be specifically focused on improving ITN ownership among the subgroups represented in Node 21, Node 12, Node 22, and Node 24 (highlighted in gray), which comprise approximately 55 percent of the households that did not own an ITN.

Table 17. CHAID gain index table for household ownership of at least one ITN

Node	Description of node	Node		Gain		Response (%)	Index (%)
		N	%	N	%		
21	North Central and South South regions; small-size households; urban area	546	7.1	291	11.6	53.3	164.5
30	South East region; rural area; small-size households	259	3.4	134	5.4	51.7	159.7
12	South West region; small-size households	830	10.8	415	16.6	50.0	154.3
28	South East region; urban area; highest wealth quintile	206	2.7	93	3.7	45.1	139.3
25	South West region; medium-size households; urban area	294	3.8	127	5.1	43.2	133.3
23	North Central and South South regions; medium- and large-size households; no formal education	315	4.1	136	5.4	43.2	133.2
22	North Central and South South regions; small-size households; rural area	868	11.3	368	14.7	42.4	130.8
31	South East region; rural area; medium- and large-size households	179	2.3	62	2.5	34.6	106.9
24	North Central and South South regions; medium- and large-size households; primary or higher level of education	919	11.9	298	11.9	32.4	100.1
20	North East region; small-size households; highest, middle, and second wealth quintiles	306	4.0	99	4.0	32.4	99.8
26	South West region; medium-size households; rural area	127	1.6	41	1.6	32.3	99.6
27	South East region; urban area; fourth wealth quintile	153	2.0	48	1.9	31.4	96.8
13	South West region; large-size households	73	0.9	19	0.8	26.0	80.3
9	North East region; medium- and large-size households	719	9.3	138	5.5	19.2	59.2
19	North East region; small-size households; lowest and fourth wealth quintiles	171	2.2	32	1.3	18.7	57.8
29	South East region; urban area; bottom three wealth quintiles	200	2.6	32	1.3	16.0	49.4
6	North West region; no formal education	913	11.8	113	4.5	12.4	38.2
17	North West region; primary or higher level of education; urban area	278	3.6	31	1.2	11.2	34.4
18	North West region; primary or higher level of education; rural area	356	4.6	22	0.9	6.2	19.1

Model 2. CHAID model on ITN use among children under five

ITN use among children under five by background characteristics is presented in Table 18. We found a significant association between ITN use among children under five years of age and age of the child, mother's education level, place of residence, region of the country, household wealth quintile, and number of household members. No significant relationship was observed between ITN use and sex of the child.

Table 18. ITN use among children under five by background characteristics

Background characteristic	ITN use (%)	N	Chi-square p-value
Sex			
Male	44.6	3,191	0.819
Female	44.9	3,055	
Age			
0–11 months	46.1	1,233	0.049
12–23 months	45.0	1,262	
24–35 months	48.2	1,194	
36–47 months	43.2	1,309	
48–59 months	41.5	1,249	
Mother's education level			
None	53.5	2,844	0.049
Primary	43.4	1,082	
Secondary or higher	34.6	2,321	
Place of residence			
Urban	35.8	2,124	<0.001
Rural	49.4	4,127	
Region			
North Central	40.8	1,160	<0.001
North East	50.0	894	
North West	63.0	2,031	
South East	26.3	552	
South South	34.6	671	
South West	23.2	944	
Household wealth quintile			
Lowest	59.0	1,304	<0.001
Second	52.2	1,451	
Middle	49.2	1,147	
Fourth	32.5	1,149	
Highest	27.6	1,201	
Number of household members			
1–4 members	45.7	1,509	0.004
5–7 members	41.1	2,590	
8 or more members	48.4	2,152	
Total	**44.7**	**6,252**	

To identify the sociodemographic profile of ITN use among children under five years of age in the country, the six predictor variables that demonstrated a significant relationship with ITN use among children under five years of age were included in the CHAID model. All predictor variables except child's age were retained in the CHAID model. The final CHAID model consisted of 18 nodes, 12 of which were terminal nodes. The best predictor of ITN use among children under five years of age was region of the country ($p < 0.001$), which makes up the first level of the tree (Figure 17). Region was split into five nodes, including the North West region (Node 1), the North East region (Node 2), the North Central region (Node 3), the South West and South East regions (Node 4), and the South South region (Node 5). ITN use was highest among children under five years of age from the North West region (62%) and lowest among children from the South West and South East regions (25%). In the North East and South South regions, no further significant predictors of ITN use were found.

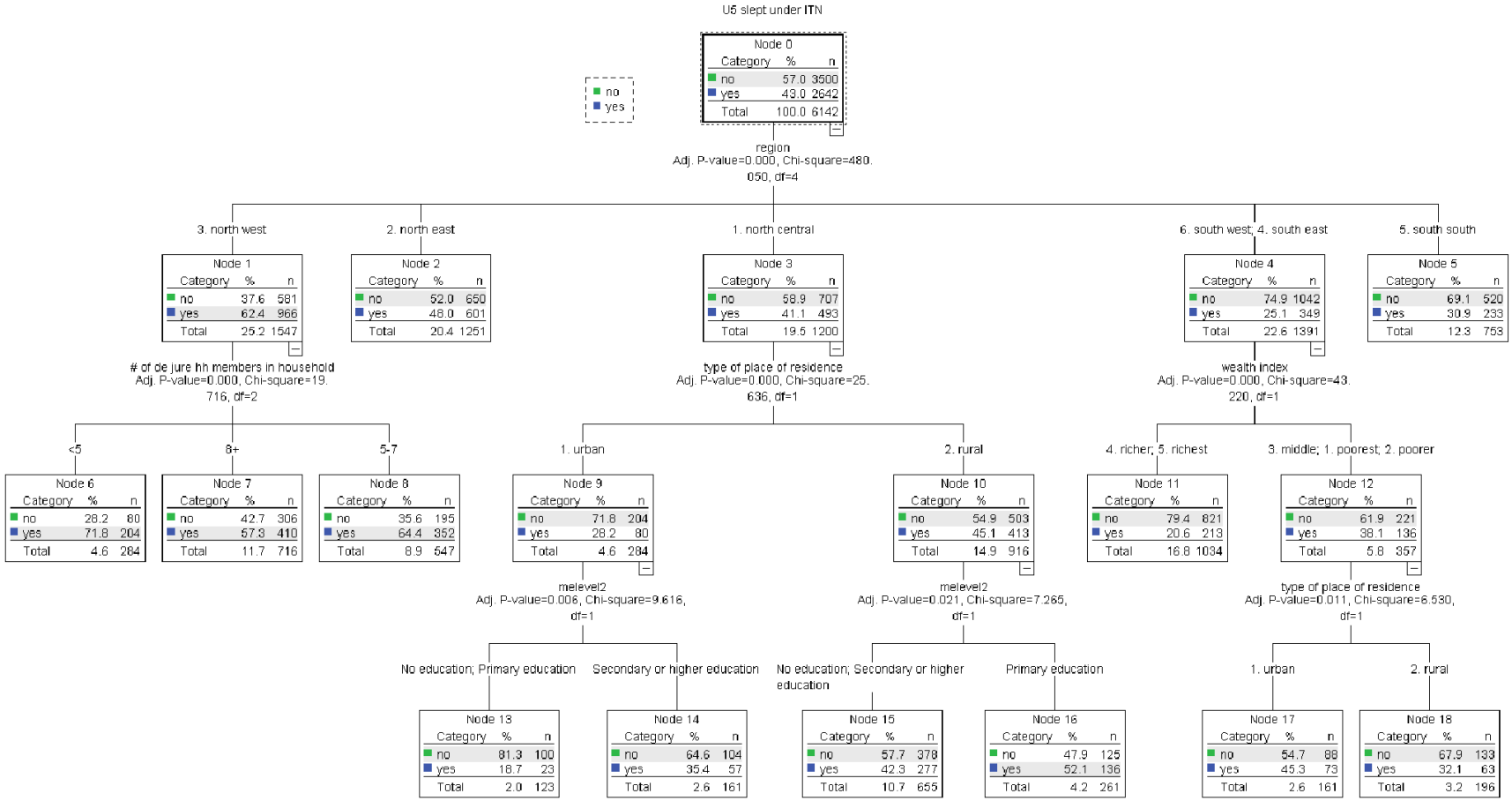
Among children under five years of age in the North West region (Node 1), the strongest predictor of ITN use was household size ($p<0.001$), which was split between small-size (Node 6), medium-size (Node 8), and large-size (Node 7) households. ITN use was highest among children from small-size households in this region (72%) and lowest among children from large-size households (57%).

Place of residence was the strongest predictor of ITN use among children under five years of age in the North Central region (Node 3) ($p<0.001$). ITN use among children under five years of age was lower in urban areas (Node 9; 28%), compared to children from rural areas (Node 10; 45%). In urban areas, mother's education level was found to be a further significant predictor of ITN use, split between children whose mother had either no formal education or a primary level of education (Node 13) and those whose mother had a secondary or higher level of education (Node 14) ($p<0.001$). ITN use was higher among children whose mother had a secondary or higher level of education (35%), compared to those whose mother had a primary level of education or no formal education (19%). Mother's education level was also a further significant predictor of ITN use in rural areas, split between children whose mother either had no formal education or a secondary or higher level of education (Node 15) and children whose mother had a primary level of education (Node 16). ITN use was higher among children from rural areas and children whose mother had a primary level of education (52 percent).

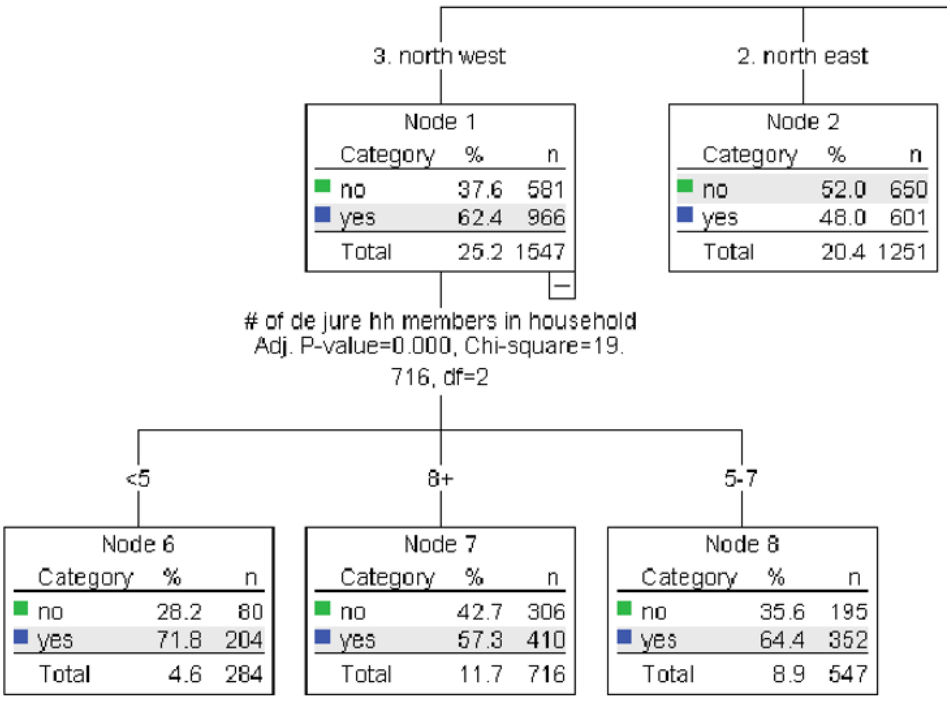
The strongest predictor of ITN use among children under five years of age in the South West and South East regions was household wealth quintile ($p<0.05$), split between children from households in the top two wealth quintiles (Node 11) and children from households in the bottom three wealth quintiles (Node 12). ITN use was higher among children from the bottom three wealth quintiles (38%), compared to children from households in the top two wealth quintiles (21%). Among children from the bottom three wealth quintiles, place of residence was another significant predictor of ITN use ($p<0.05$). Among children from the bottom three wealth quintiles, ITN use was higher among those living an urban area (45%), compared to those living in a rural area (32%).

Figure 17. CHAID tree for ITN use among children under five years of age

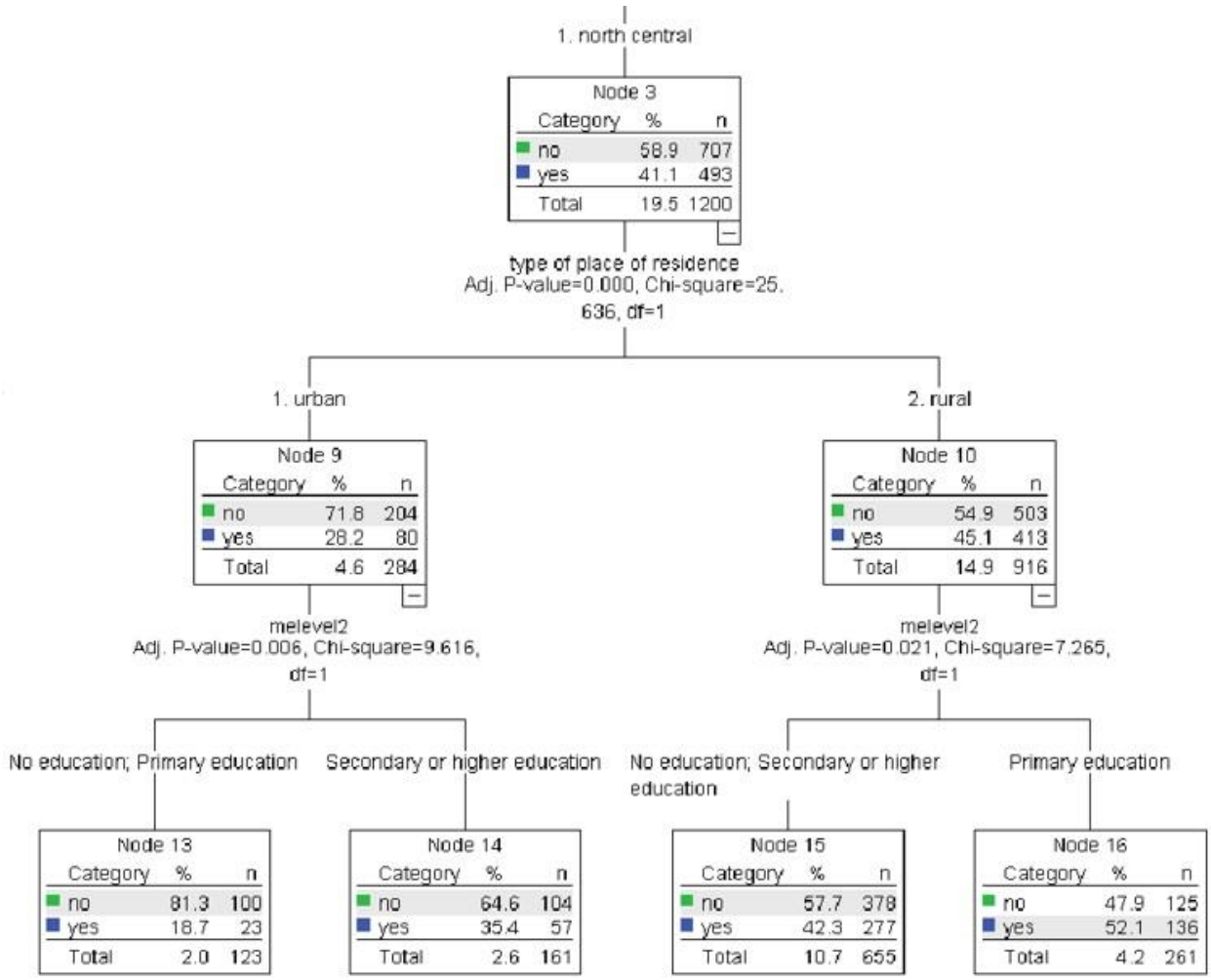
a. Full CHAID tree



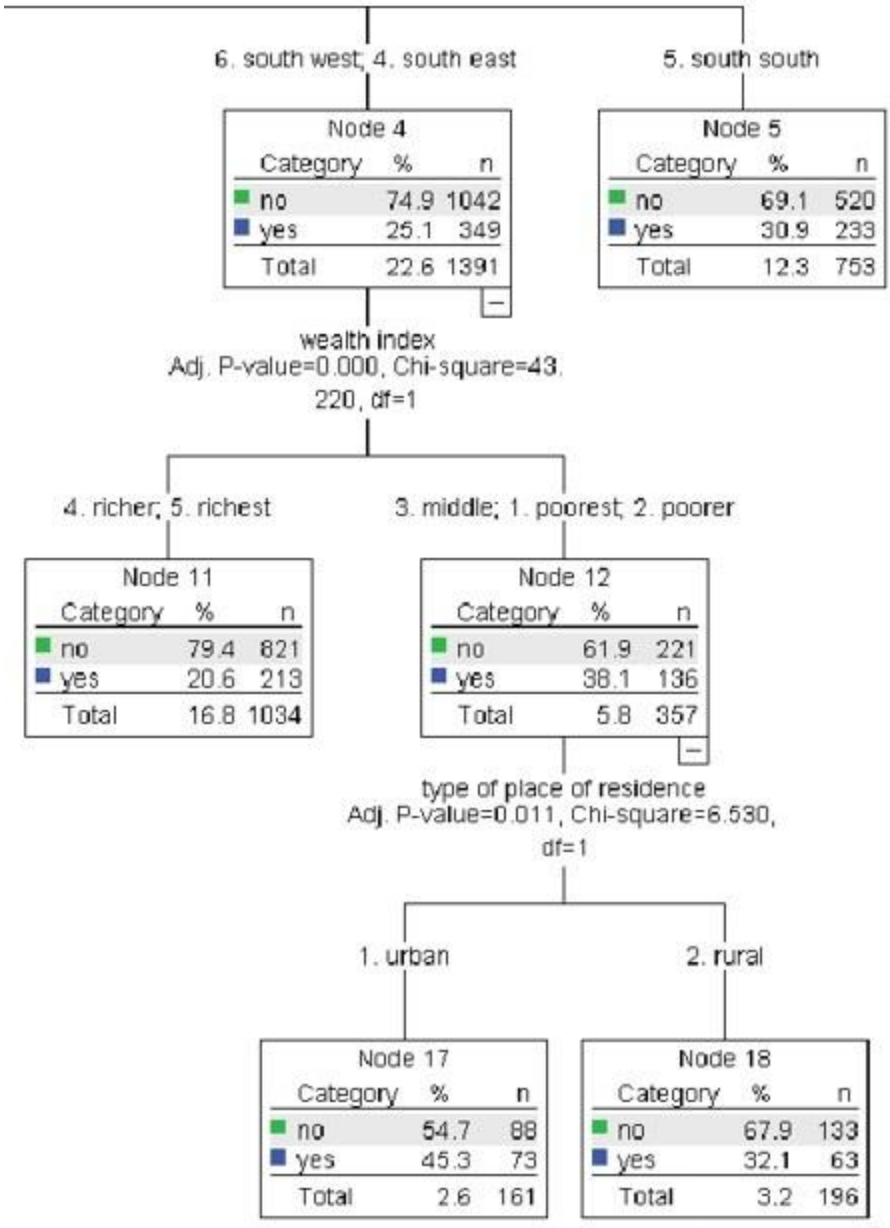
b. North West and North East nodes



c. North Central node



d. South West and South East and South South nodes



The CHAID gain index for ITN use among children under five years of age is presented in Table 19. The table includes a description of the population in each of the 12 terminal nodes; the node percentage, which represents the demographic weight of the children in that terminal node; the gain percentage, which represents the percentage of children under five years of age who did not sleep under an ITN out of all the children in the population; the response percentage, which represents the percentage of children under five years of age who did not sleep under an ITN in that specific node; and the index percentage, which represents the probability of not sleeping under an ITN in the respective node, compared to the compared to the overall population. The gain index results suggest that to improve overall national ITN use among children under five years of age, efforts should be targeted specifically to subgroups in Node 11, Node 5, Node 15, and Node 2 (highlighted in gray), which constitute close to 70 percent of children not using ITNs (gain percentage). For example, children from the South West and South East regions from households in the top two wealth quintiles represent almost a quarter of all children who are not using ITNs (gain percentage).

Table 19. CHAID gain index table for ITN use among children under five years of age

Node	Description of node	Node		Gain		Response	Index
		N	%	N	%	%	%
13	North Central region; urban area; no formal education and primary education	123	2.0	100	2.9	81.3	142.7
11	South West and South East regions; fourth and highest wealth quintiles	1034	16.8	821	23.5	79.4	139.3
5	South South region	753	12.3	520	14.9	69.1	121.2
18	South West and South East regions; bottom three wealth quintiles; rural area	196	3.2	133	3.8	67.9	119.1
14	North Central region; urban area; secondary or higher education	161	2.6	104	3.0	64.6	113.4
15	North Central region; rural area; no formal education and secondary or higher education	655	10.7	378	10.8	57.7	101.3
17	South West and South East regions; bottom three wealth quintiles; urban area	161	2.6	88	2.5	54.7	95.9
2	North East region	1251	20.4	650	18.6	52.0	91.2
16	North Central region; rural area; primary education	261	4.2	125	3.6	47.9	84.0
7	North West region; large-size households	716	11.7	306	8.7	42.7	75.0
8	North West region; medium-size households	547	8.9	195	5.6	35.6	62.6
6	North West region; small size-households	284	4.6	80	2.3	28.2	49.4

Model 3. CHAID model on ITN use among pregnant women

ITN use among pregnant women by background characteristics is presented in Table 20. We found a significant association between ITN use among pregnant women and the women's education level, household wealth quintile, place of residence, region of the country, parity, and the number of household members. No significant association was found between ITN use and women's age.

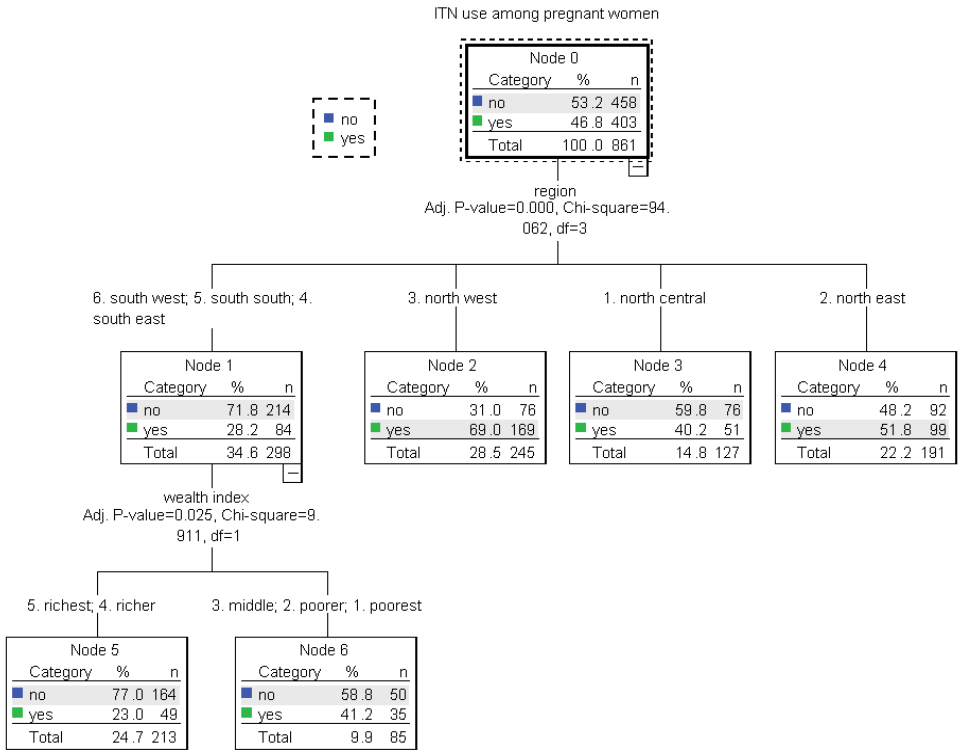
Table 20. ITN use among pregnant women by background characteristics

Background characteristic	ITN use (%)	N	Chi-square p-value
Age			
15–19	48.3	132	0.903
20–34	49.4	649	
35–49	46.8	122	
Women's education level			
None	61.9	409	<0.001
Primary	47.9	157	
Secondary or higher	33.7	338	
Place of residence			
Urban	36.0	273	<0.001
Rural	54.5	630	
Region			
North Central	37.8	132	<0.001
North East	55.5	140	
North West	67.8	326	
South East	22.7	79	
South South	33.3	108	
South West	33.2	119	
Household wealth quintile			
Lowest	66.1	232	<0.001
Second	58.5	184	
Middle	49.4	168	
Fourth	30.7	143	
Highest	30.4	176	
Number of household members			
1–4 members	43.0	393	0.016
5–7 members	50.5	263	
8 or more members	56.6	247	
Total	**48.9**	**903**	

To identify the sociodemographic profiles of pregnant women who used an ITN the previous night, the five predictor variables (women's education level, place of residence, region of the country, household wealth quintile, and household size) that demonstrated a significant relationship with ITN use were included in the CHAID model. The model retained the predictor variables region and household wealth quintile. The final CHAID model contained seven nodes, of which five were terminal nodes. The best predictor of ITN use among pregnant women was region of the country ($p < 0.001$), which makes up the first level of the tree (Figure 18). Region is split into four nodes, with Node 1 made up of the South West, South South, and South East regions; Node 2 made up of the North West region; Node 3 made up of the North Central region; and Node 4 made up of the North East region. In Node 1, which consisted of the three southern regions, the best predictor of ITN use was wealth quintile ($p<0.05$). Among pregnant women from households from the top two wealth quintiles in the three southern regions of the country, only 23 percent reported using an ITN the previous night, compared to 41 percent from households in the bottom three wealth quintiles. In the

remaining Nodes (2–4), no other significant predictor of ITN use was identified. ITN use was highest in the North West (69%) and North East (52%) regions.

Figure 18. CHAID tree for ITN use among pregnant women



The CHAID gain index for pregnant women who did not use an ITN the previous night is presented in Table 21. The table includes a description of the subgroup in each of the five terminal nodes; the node percentage, which represents the demographic weight of the subgroup of pregnant women; the gain percentage, which represents the percentage of pregnant women who did not use an ITN out of all pregnant women; the response percentage, which represents the percentage of pregnant women in that node who did not use an ITN the previous night; and the index percentage, which represents the probability of not using an ITN the previous night in the terminal node, compared to the overall population. For example, Node 5, which comprises pregnant women from the three southern regions of the country in the top two wealthier quintiles, represents 25 percent of the overall population. In this subgroup, 77 percent of pregnant women did not use an ITN the previous night (response percentage), which represents 36 percent of the overall population who are not using ITNs (gain percentage). Further, the probability of non-use (index percentage) in this subgroup was almost 1.5 times greater, compared to the overall population. To improve national coverage of ITN use among pregnant women, these results indicate that focus should be placed on improving use in the subgroups represented in Node 5, Node 3, and Node 4 (highlighted in gray)—specifically, pregnant women from the three southern regions from households in the top two wealth quintiles and pregnant women from the North Central and North East regions.

Table 21. CHAID gain index for pregnant women who do not use ITNs

Node	Description of node	Node		Gain		Response	Index
		N	%	N	%	%	%
5	South West, South South, and South East regions; top two wealth quintiles	213	24.7	164	35.8	77.0	144.7
3	North Central	127	14.8	76	16.6	59.8	112.5
6	South West, South South, and South East regions; bottom three wealth quintiles	85	9.9	50	10.9	58.8	110.6
4	North East region	191	22.2	92	20.1	48.2	90.6
2	North West region	245	28.5	76	16.6	31.0	58.3

Model 4. CHAID model on ITN use among the general population

ITN use among the general population by background characteristics is presented in Table 22. A significant association was observed between ITN use among the general population and the head of the household's education level, household wealth quintile, place of residence, region of the country, and the number of household members.

Table 22. ITN use among the general population by background characteristics

Background characteristic	ITN use (%)	N	Chi-square p-value
Education level of the household head			
None	40.8	2,702	<0.001
Primary	34.4	1,478	
Secondary or higher	27.6	3,254	
Place of residence			
Urban	29.3	14,021	<0.001
Rural	42.1	23,654	
Region			
North Central	30.2	6,467	<0.001
North East	45.4	5,062	
North West	54.4	11,823	
South East	21.2	3,660	
South South	28.9	4,563	
South West	21.1	6,100	
Household wealth quintile			
Lowest	52.7	7,532	<0.001
Second	44.7	7,535	
Middle	39.6	7,536	
Fourth	27.8	7,584	
Highest	21.9	7,487	
Number of household members			
1–4 members	35.6	10,229	<0.001
5–7 members	34.8	14,648	
8 or more members	41.7	12,797	
Total	**37.3**	**37,674**	

To identify the sociodemographic profiles of the general population who use ITNs, the five predictor variables (education level of the household head, place of residence, region of the country, household wealth quintile, and household size) that demonstrated a significant relationship with ITN use were included in the CHAID model. The model retained the five predictor variables. The final CHAID model contained 56 nodes, of which 35 were terminal nodes. The best predictor of ITN use among the general population was region ($p<0.001$), which makes up the first level of the tree (Figure 19a). This level was split into five nodes, North West region (Node 1), North East region (Node 2), North Central region (Node 3), South West and South East regions (Node 4), and South South region (Node 5). ITN use was highest in the North West region (54%) and lowest in the South West and South East regions (21%).

Among the general population in the North West region (Figure 19b), the most significant predictor of ITN use was household size ($p<0.001$), split into small-size (Node 6), medium-size (Node 8), and large-size households (Node7). ITN use was highest among those from small-size households (64%), compared to those from medium-size (55%) and large-size (49%) households. In each of these subgroups, wealth index was also a significant predictor of ITN use ($p<0.001$). In small-size households, wealth quintile was split into three further nodes—the top two wealth quintiles (Node 21), the middle and second wealth quintiles (Node 22), and the lowest wealth quintile (Node 23)—with the highest coverage among those from the poorest households (70%). In medium-size households, wealth quintile was split between the top two wealth quintiles (Node 24) and the bottom three wealth quintiles (Node 25), with coverage higher among those from the bottom wealth quintiles (51%), compared to those from the top two wealth quintiles (42%). In medium-size households, wealth was split into three nodes—the highest wealth quintile (Node 27), the fourth and middle wealth quintiles (Node 26), and the bottom two wealth quintiles (Node 28)—with the highest ITN use found among those from the bottom two wealth quintiles (57%).

Among the general population in the North East region (Figure 19c), the most significant predictor of ITN use was household wealth quintile ($p<0.001$), split into four nodes—the second and fourth wealth quintiles (Node 9), the highest wealth quintile (Node 10), the middle wealth quintile (Node 11), and the lowest wealth quintile (Node 12). ITN use was highest among those from households in the lowest wealth quintile (49%) and lowest among those from the highest wealth quintile (30%). In the fourth and second wealth quintiles, household size was another significant predictor of ITN use ($p<0.001$), which was split between those from small-size (Node 29), medium-size (Node 31), and large-size households (Node 30), with the highest ITN use in the small-size households (48%). Among those from the highest wealth quintile, education level of the household head was a significant predictor of ITN use ($p<0.01$), which was split between those with no formal education or a primary level of education (Node 32) and those with a secondary or higher level of education (Node 33). ITN use was highest among those whose household head had no formal education or a primary level of education (44%). Among those from the middle wealth quintile, household head education level was a significant predictor of ITN use ($p<0.01$), which was split between those with no formal education (Node 34) and those with a primary or higher level of education (Node 35), with ITN use highest in households whose household head had a primary or higher level of education (48%). Among those from the lowest wealth quintile, the best predictor of ITN use was household size ($p<0.001$), which was split between small-size households (Node 36) and medium- and large-size households (Node 37), with ITN use the highest in small-size households (64%).

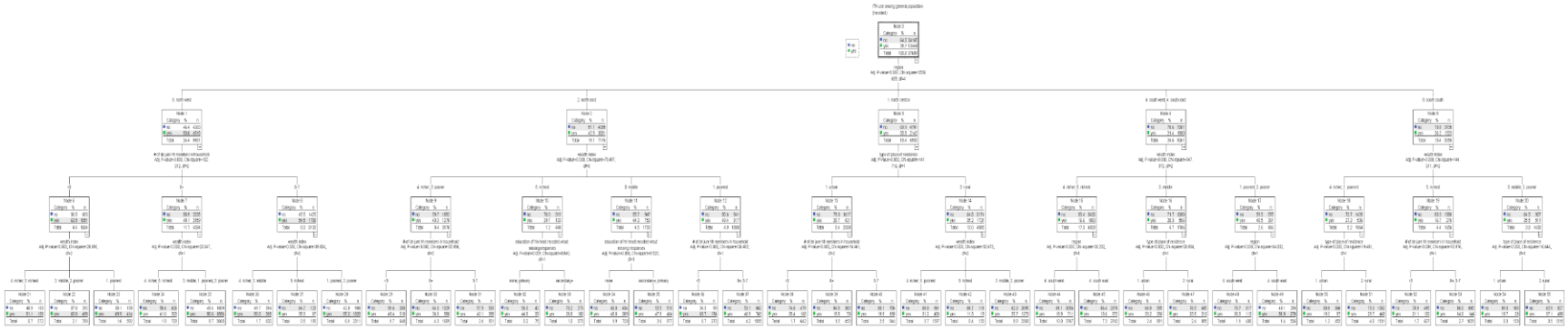
Among the general population in the North Central region (Figure 19d), place of residence was the greatest predictor of ITN use ($p<0.001$), split into urban (Node 13) and rural (Node 14) residents, with higher ITN use among rural residents (35%), compared to urban residents (21%). Among urban residents (Node 13), household size was a significant predictor of ITN use ($p<0.001$), split into small-size (Node 38), medium-size (Node 40), and large-size (Node 39) households. ITN use was highest among those from small-size households (25%) and lowest among those from large-size households (16%). Among rural residents, household wealth quintile was the greater predictor of ITN use ($p<0.001$), split into three nodes—the fourth and lowest wealth quintiles (Node 41), the highest wealth quintile (Node 42), and the middle and second wealth quintiles (Node 43). ITN use was highest among those from the middle and second wealth quintiles (38%) and lowest among those from the wealthiest households (11%).

Among residents in the South West and South East regions (Figure 19e), household wealth quintile was the most significant predictor of ITN use ($p<0.001$), split into the top two wealth quintiles (Node 15), the middle wealth quintile (Node 16), and the bottom two wealth quintiles (Node 17). ITN use was highest among those from the bottom two wealth quintiles (41%) and lowest among those from the top two wealth quintiles (17%). Among residents from the top two wealth quintiles, region of the country was a further significant predictor of ITN use ($p<0.001$), split into the South West (Node 44) and the South East (Node 45) regions, with ITN use higher in the South West region (19%). Among residents from the middle wealth quintile, place of residence was a further significant predictor of ITN use, split into urban (Node 46) and rural (Node 47) residents, with ITN use higher among urban residents (33%), compared to rural residents (24%). Among residents from the bottom two wealth quintiles, region of the country was a further significant predictor of ITN use, split into the South West region (Node 48) and the South East region (Node 49), with ITN use much higher in South East (52%), compared to South West (26%).

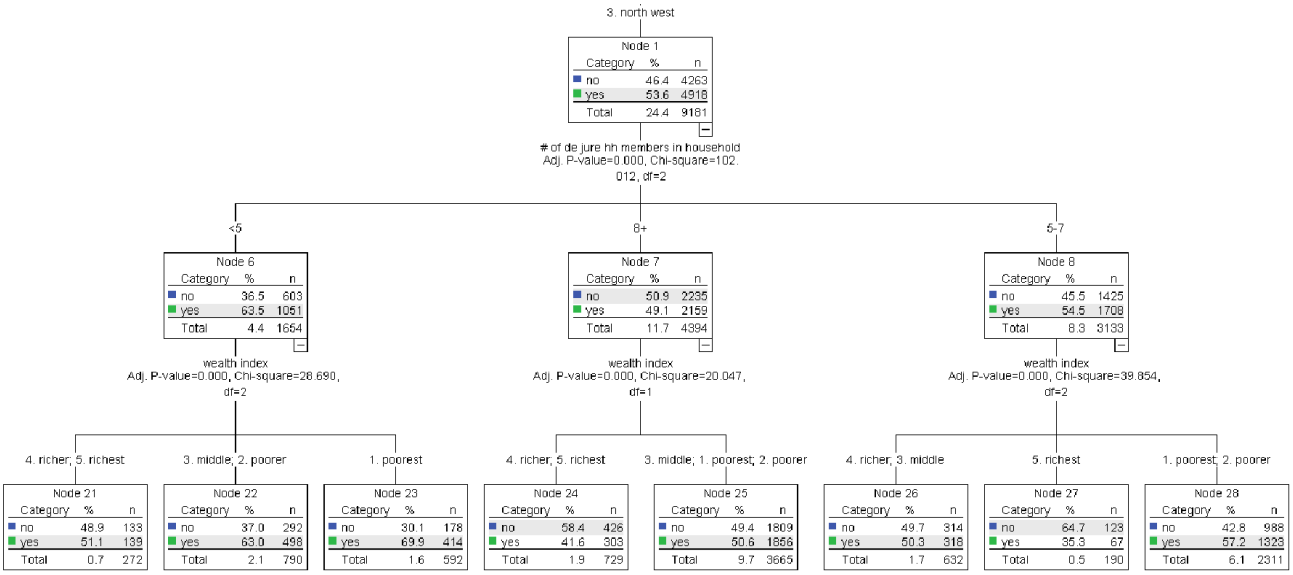
Among residents in the South South region (Figure 19f), the best predictor of ITN use was household wealth quintile ($p<0.001$), split into those from the fourth and lowest wealth quintiles (Node 18), the highest wealth quintile (Node 19), and the middle and second wealth quintiles (Node 20). ITN use was highest among those from the middle and second wealth quintiles (36%) and lowest among those from the highest wealth quintile (17%). Among residents from the fourth and lowest wealth quintiles, place of residence was a further significant predictor of ITN use ($p<0.001$), split into urban (Node 50) and rural (Node 51) residents, with higher ITN use among rural residents (30%), compared to urban residents (19%). Among residents from the highest wealth quintile, household size was a further significant predictor of ITN use, split into those from small-size households (Node 52) and those from medium- and large-size households (Node 53). ITN use among residents from small-size households was higher (21%), compared to residents from medium- and large-size households (14%). Among residents from the middle and second wealth quintiles, place of residence was a further significant predictor of ITN use ($p<0.001$), split into urban (Node 54) and rural (Node 55) residents, with ITN use higher among rural residents (37%), compared to urban residents (19%).

Figure 19. CHAID tree for ITN use among the general population

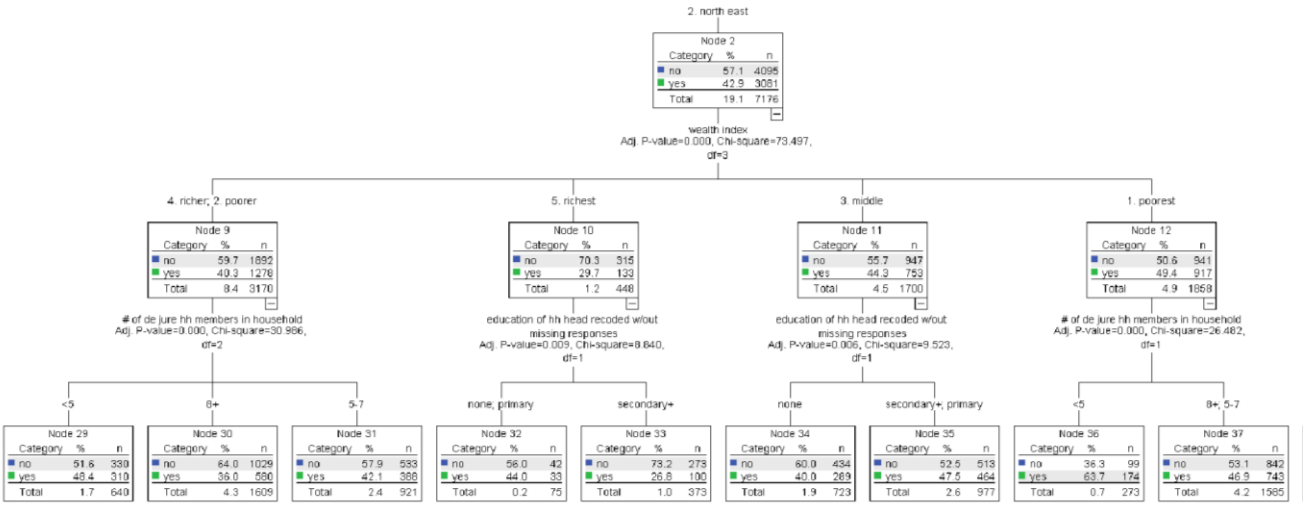
a. Full CHAID tree



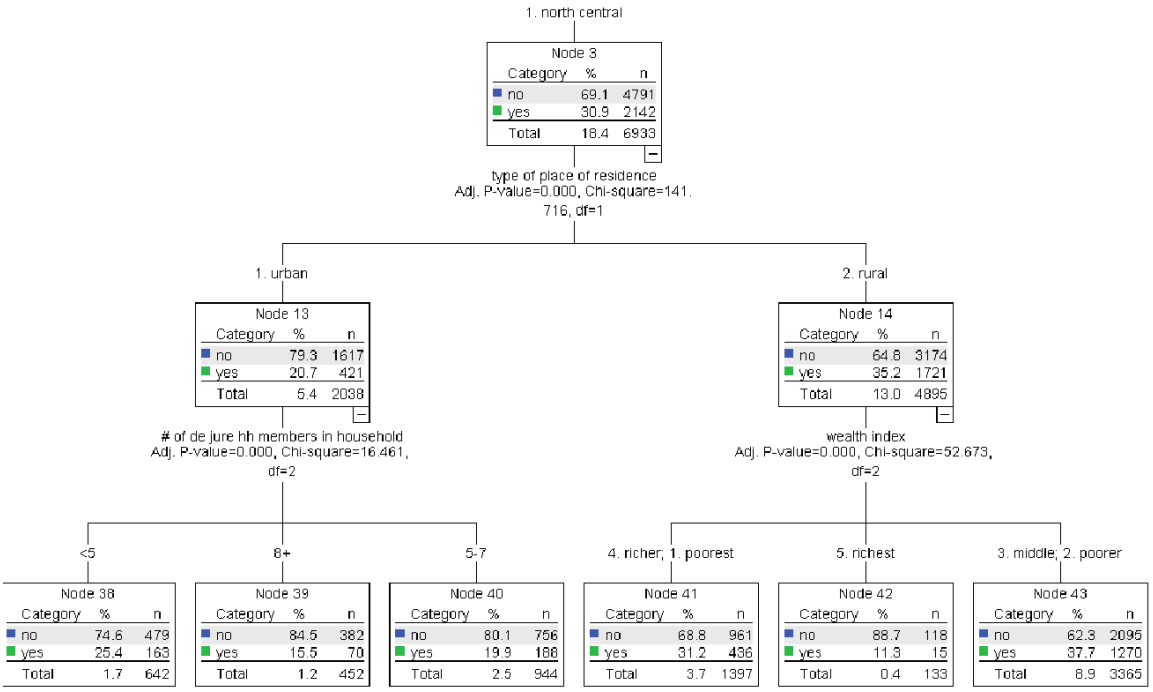
b. North West node



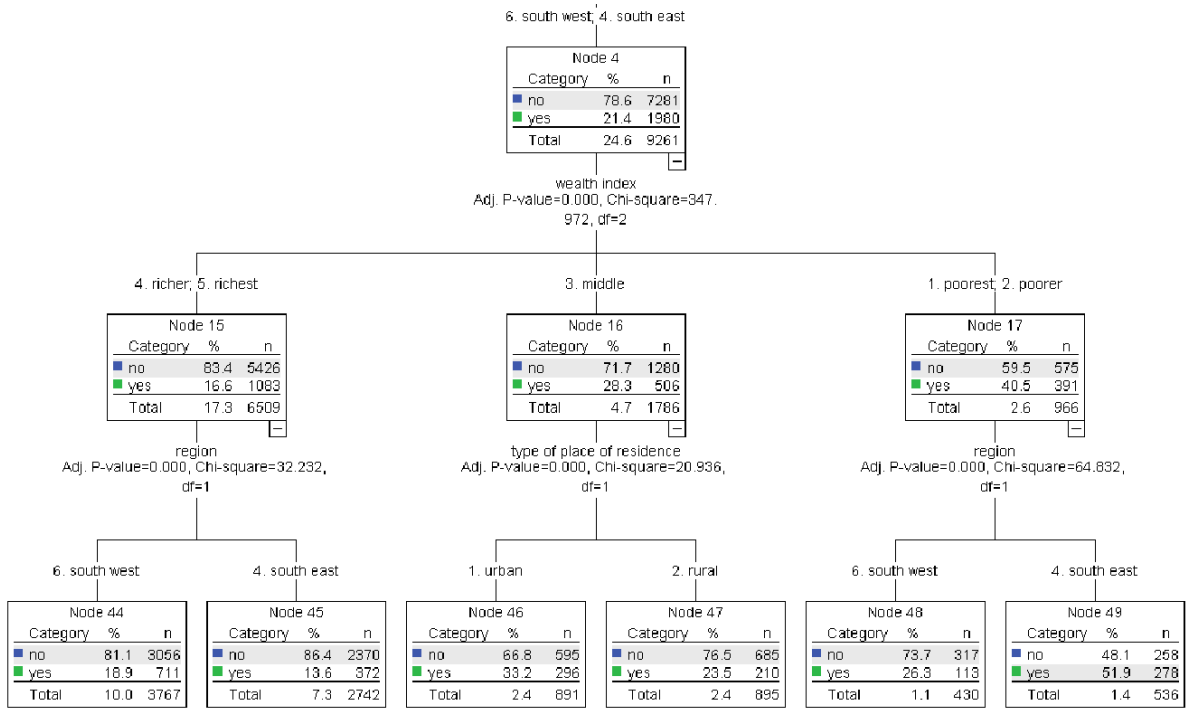
c. North East node



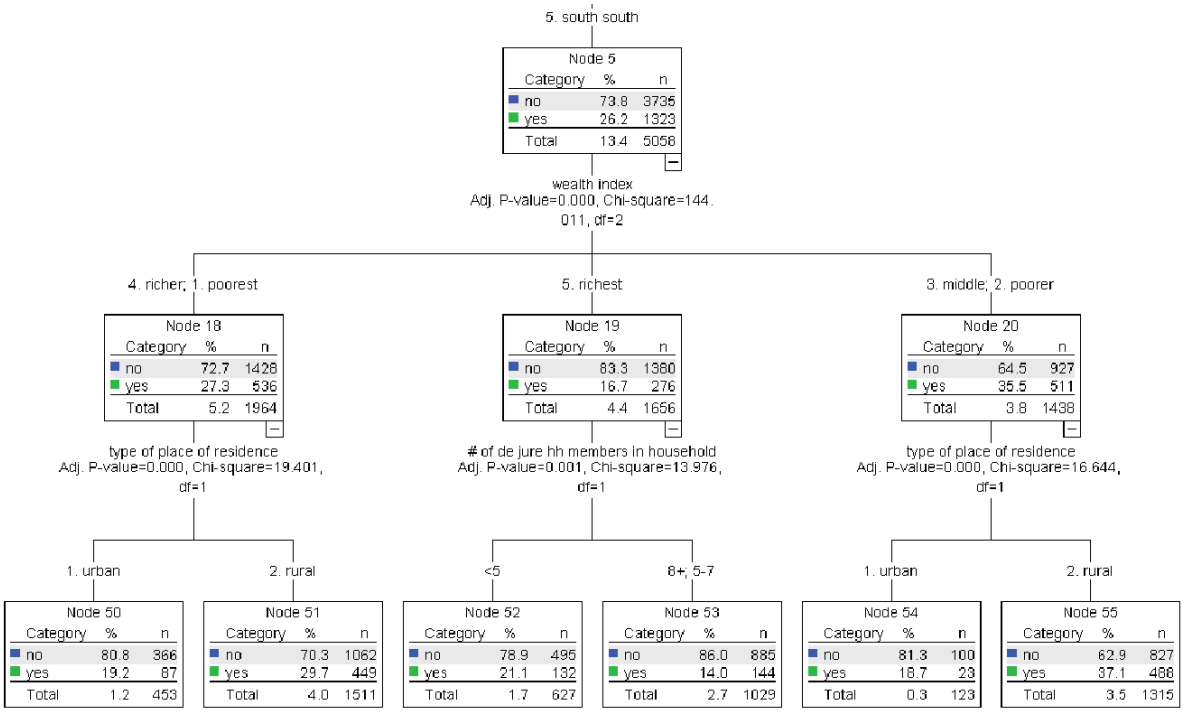
d. North Central node



e. South West and South East node



f. South South node



The CHAID gain index for the general population who did not use an ITN the previous night is presented in Table 23. The table includes a description of the population in each of the 35 terminal nodes; the node percentage, which represents the demographic weight of the subgroup in the overall population; the gain percentage, which represents the percentage of the general population who did not use an ITN in the subgroup out of the overall population; the response percentage, which represents the percentage of the general population in that node who did not use an ITN the previous night; and the index percentage, which represents the probability of not using an ITN the previous night among those in the subgroup, compared to the overall population. For instance, Node 42, which comprises the general population from the North Central region and from the highest wealth quintile, represents less than 1 percent of the overall population. In this subgroup, 89 percent did not use an ITN the previous night (response percentage), which represents less than 1 percent of the overall population who are not using ITNs. The probability of non-use (index percentage) in this subgroup is almost 1.4 times greater, compared to the overall population. To improve national ITN use coverage, the results from the gain index indicate that focus should be placed on the subgroups represented in the eight nodes highlighted in gray, with a particular focus on subgroups in Node 45 and Node 50, which represent almost 20 percent of the population who are not using ITNs.

Table 23. CHAID gain index table for ITN use among the general population

Node	Description of node	Node		Gain		Response	Index
		N	%	N	%	%	%
42	North Central region; rural area; highest wealth quintile	133	0.4	118	0.5	88.7	138.1
45	South East region; top two wealth quintiles	2,742	7.3	2,370	9.8	86.4	134.5
53	South South region; highest wealth quintile; medium- and large-size households	1029	2.7	885	3.7	86.0	133.9
39	North Central region; urban area; large-size households	452	1.2	382	1.6	84.5	131.5
44	South West region; top two wealth quintiles	123	0.3	100	0.4	81.3	126.5
50	South South region; fourth and lowest wealth quintiles; urban area	3,767	10.0	3,056	12.6	81.1	126.3
40	North Central region; urban area; medium-size households	453	1.2	366	1.5	80.8	125.7
54	South South region; middle and second wealth quintiles; urban area	944	2.5	756	3.1	80.1	124.6
52	South South region; highest wealth quintile; small-size households	627	1.7	495	2.0	78.9	122.9
47	South West and South East regions; middle wealth quintile; rural area	895	2.4	685	2.8	76.5	119.1
38	North Central region; urban area; small-size households	642	1.7	479	2.0	74.6	116.1
48	South West region; bottom two wealth quintiles	430	1.1	317	1.3	73.7	114.7
33	North East region; highest wealth quintile; secondary or higher education level	373	1.0	273	1.1	73.2	113.9
51	South South region; fourth and lowest wealth quintiles; rural area	1,511	4.0	1,062	4.4	70.3	109.4
41	North Central region; rural area; fourth and lowest wealth quintiles	1,397	3.7	961	4.0	68.8	107.1
46	South West and South East regions; middle wealth quintile, urban area	891	2.4	595	2.5	66.8	103.9
27	North West region; medium-size households; highest wealth quintile	190	0.5	123	0.5	64.7	100.8
30	North East region; fourth and second wealth quintiles; large-size households	1,609	4.3	1,029	4.3	64.0	99.5
55	South South region; middle and second wealth quintiles; rural area	1315	3.5	827	3.4	62.9	97.9
43	North Central region; rural area; middle and second wealth quintiles	3,365	8.9	2,095	8.7	62.3	96.9
34	North East region; middle wealth quintile; no formal education	723	1.9	434	1.8	60.0	93.4
24	North West region; large-size households; bottom three wealth quintiles	729	1.9	426	1.8	58.4	90.9
31	North East region; fourth and second wealth quintiles; medium-size households	921	2.4	533	2.2	57.9	90.1
32	North East region; highest wealth quintile; no or primary level of education	75	0.2	42	0.2	56.0	87.2
37	North East region; lowest wealth quintile; medium- and large-size households	1,585	4.2	842	3.5	53.1	82.7
35	North East region; middle wealth quintile; no formal education	977	2.6	513	2.1	52.5	81.7
29	North West region; large-size households; bottom three wealth quintiles	640	1.7	330	1.4	51.6	80.2
26	North West region; medium-size households; fourth and middle wealth quintiles	632	1.7	314	1.3	49.7	77.3
25	North West region; large-size households; bottom three wealth quintiles	3,665	9.7	1,809	7.5	49.4	76.8
21	North West region; small-size households; top two wealth quintiles	272	0.7	133	0.6	48.9	76.1
49	South East region; bottom two wealth quintiles	536	1.4	258	1.1	48.1	74.9
28	North West region; medium-size households; bottom two wealth quintiles	2,311	6.1	988	4.1	42.8	66.5

Node	Description of node	Node		Gain		Response	Index
		N	%	N	%	%	%
22	North West region; small-size households; middle and second wealth quintiles	790	2.1	292	1.2	37.0	57.5
36	North East region; lowest wealth quintile; small-size households	273	0.7	99	0.4	36.3	56.4
23	North West region; small-size households; lowest wealth quintile	592	1.6	178	0.7	30.1	46.8

Model 5. CHAID model on IPTp coverage of three or more doses

Uptake of IPTp (three or more doses) among women 15–49 years of age with a live birth in the past two years by background characteristics is presented in Table 24. IPTp uptake was found to be significantly associated with woman's education level, place of residence, region of the country, and household wealth quintile. No significant relationship was observed between IPTp uptake and women's age, parity, or number of household members.

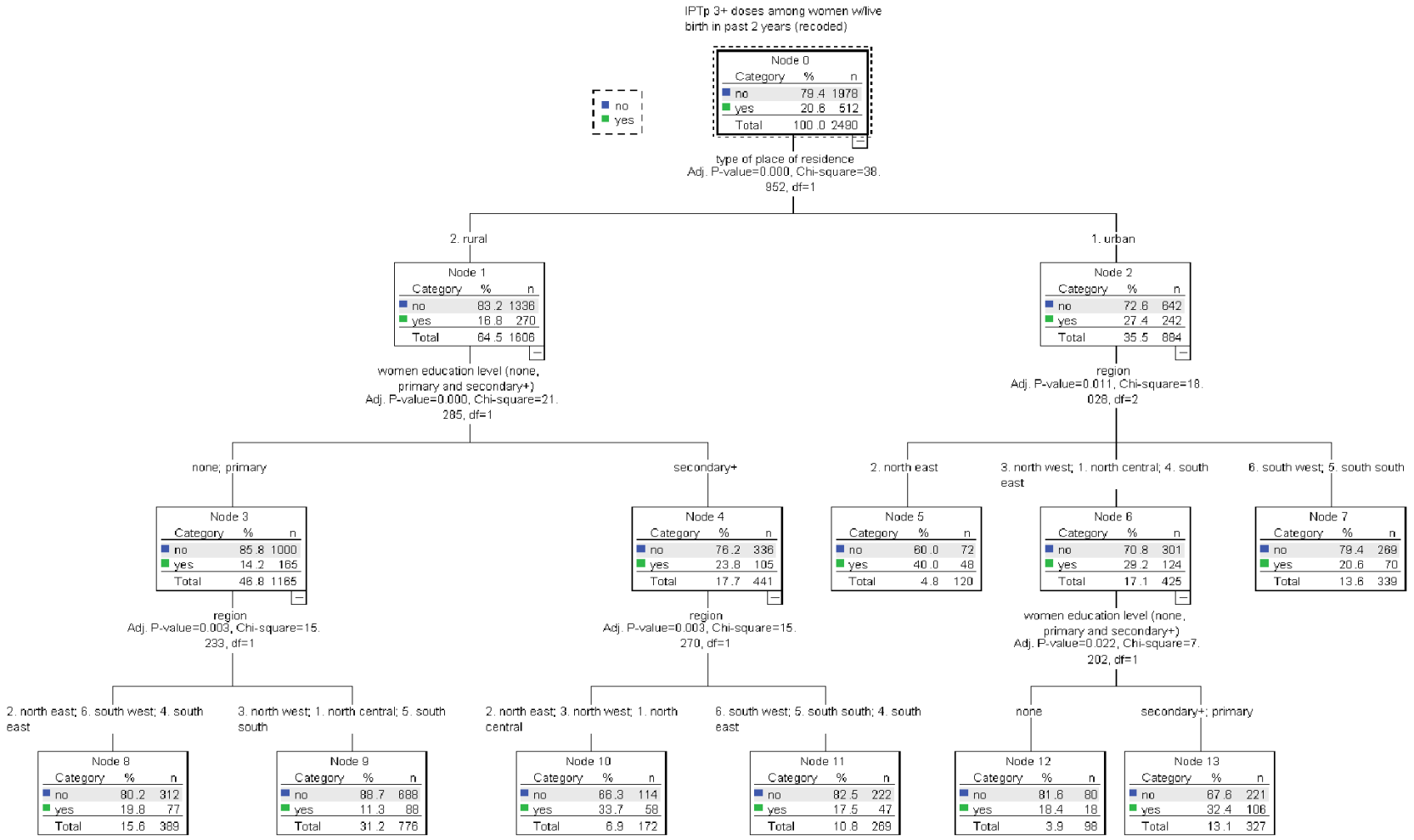
Table 24. IPTp coverage of three or more doses by background characteristics

Background characteristic	IPTp uptake (%)	N	Chi-square p-value
Age			
15–19	15.0	247	0.279
20–34	19.6	1,888	
35–49	18.6	387	
Woman's education level			
None	13.3	1,107	<0.001
Primary	18.6	402	
Secondary or higher	25.3	1,012	
Place of residence			
Urban	24.1	889	0.001
Rural	16.2	1,633	
Region			
North Central	18.0	441	0.006
North East	26.0	350	
North West	15.4	815	
South East	26.0	225	
South South	15.8	282	
South West	19.5	409	
Household wealth quintile			
Lowest	9.9	488	0.006
Second	16.9	598	
Middle	20.0	463	
Fourth	26.3	468	
Highest	22.5	506	
Parity			
1	20.5	464	
2	17.3	530	0.534
3+	19.1	1,527	
Number of household members			
1–4 members	18.3	726	0.679
5–7 members	19.8	979	
8 or more members	18.5	817	
Total	**19.0**	**2,522**	

To identify the sociodemographic profiles of women who received three or more doses of SP, the four predictor variables (woman's education level, place of residence, region of the country, and household wealth quintile) that demonstrated a significant relationship with IPTp uptake were included in the CHAID model. The model retained the predictor variables of woman's education level, place of residence, and region of the country. The final CHAID model contained 14 nodes, of which 8 were terminal nodes. The best predictor of ITN use among pregnant women was place of residence ($p<0.001$), which makes up the first level of the tree (Figure 20). Among women residing in rural areas (Node 1), the best predictor of IPTp uptake was education level ($p<0.001$), which was split into women with no education or only a primary level of education (Node 3) and those who had a secondary or higher level of education (Node 4), with higher uptake among women with a secondary or higher level of education (24%). In both of these parent nodes (Node 3 and 4), the most significant predictor of IPTp uptake was region of the country (Nodes 8–11). Among women with no education or only a primary level of education, IPTp uptake was higher in the North East, South West, and South East regions (Node 8, 20%), compared to the North West, North Central, and South South regions (Node 9, 11%). Among women with a secondary or higher level of education, those from the North East, North West, and North Central regions had higher IPTp uptake (Node 10; 34%), compared to those from the South West, South South, and South East regions (Node 11; 18%).

Among women residing in urban areas (Node 2), the most significant predictor of IPTp uptake was region of the country, which was split up into three nodes: the North East region (Node 5); the North West, North Central, and South East regions (Node 6); and the South West and South South regions (Node 7). IPTp uptake was highest in the North East region (40%) and lowest in the South West and South South regions (21%). Among women from the North West, North Central, and South East regions in urban areas, education level was a further significant predictor of IPTp uptake ($p<0.05$), with women with no formal education (Node 12) and women with a primary level or higher of education (Node 13) split into different nodes, with higher IPTp uptake among women with a primary or higher level of education (32%).

Figure 20. CHAID tree for IPTp coverage of three or more doses



The CHAID gain index for pregnant women who did not receive IPTp (three or more doses) is presented in Table 25. The table includes a description of the population in each of the eight terminal nodes; the node percentage, which represents the demographic weight of the subgroup of women for that node out of the overall population; the gain percentage, which represents the percentage of women who did not receive IPTp in that node out of all the women in the sample; the response percentage, which represents the percentage of women in that node who did not receive IPTp; and the index percentage, which represents the probability of the women in the subgroup not receiving IPTp, compared to the overall population. For example, Node 9 comprises women from rural areas who have no formal education or only a primary level of education in the North West, North Central, and South South regions. This subgroup represents 31 percent of the overall sample. In this subgroup, almost 89 percent did not receive IPTp (response percentage). The subgroup represents 35 percent of the overall sample that did not receive IPTp. The probability of not receiving IPTp was slightly more than 1.1 times greater in this subgroup, compared to the overall population. The gain index results indicate that to improve overall national coverage of IPTp (three or more doses), more resources should be specifically focused on improving coverage in the subgroup represented in Node 9 and on the subgroups represented in Nodes 7 and 7 because they comprise more than half of the proportion of women who did not receive IPTp (3 or more doses).

Table 25. CHAID gain index table for women who did not receive IPTp coverage of three or more doses

Node	Description of node	Node		Gain		Response	Index
		N	%	N	%	%	%
9	Rural area; none or primary level of education; North West, North Central, and South South regions	776	31.2	688	34.8	88.7	111.6
11	Rural area; secondary or higher education level; South West, South South, and South East regions	269	10.8	222	11.2	82.5	103.9
12	Urban area; North West, North Central, and South East regions; no formal education	98	3.9	80	4.0	81.6	102.8
8	Rural area; none or primary level of education; North East, South West, South East regions	389	15.6	312	15.8	80.2	101.0
7	Urban area; South West and South South regions	339	13.6	269	13.6	79.4	99.9
13	Urban area; North West, North Central, and South East regions; primary and secondary or higher education	327	13.1	221	11.2	67.6	85.1
10	Rural area; secondary or higher education level; North East, North West, and North Central regions	172	6.9	114	5.8	66.3	83.4
5	Urban area; North East region	120	4.8	72	3.6	60.0	75.5

Model 6. CHAID model on children under five with fever who received ACT treatment

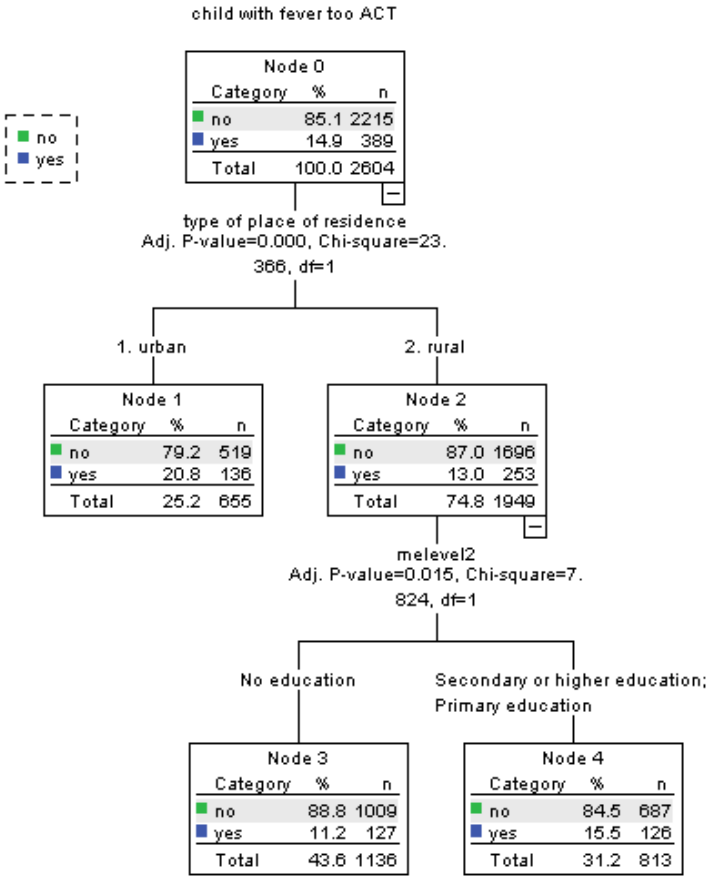
Receipt of an ACT among children under five with fever in the past two weeks by background characteristics is presented in Table 26. A significant association was found between ACT treatment for children with fever and mother's education level, place of residence, and household wealth quintile. No significant relationship was observed between receipt of ACT treatment and sex or age of the child, region of the country, number of household members, or number of ITNs owned by a household.

Table 26. ACT treatment coverage among children under five with fever by background characteristics

Background characteristic	ACT treatment (%)	N	Chi-square p-value
Sex			
Male	15.5	1,327	0.899
Female	15.3	1,255	
Age			
0–11 months	12.0	388	0.101
12–23 months	15.2	562	
24–35 months	13.8	567	
36–47 months	18.8	568	
48–59 months	16.2	498	
Mother's education level			
None	11.2	1,338	<0.001
Primary	15.5	471	
Secondary or higher	22.6	773	
Place of residence			
Urban	21.9	651	<0.001
Rural	13.2	1,932	
Region			
North Central	15.3	352	0.188
North East	14.7	432	
North West	13.1	1,065	
South East	22.4	215	
South South	18.0	296	
South West	17.7	223	
Household wealth quintile			
Lowest	11.3	672	<0.001
Second	13.7	706	
Middle	15.7	485	
Fourth	16.7	404	
Highest	25.8	315	
Number of household members			
1–4 members	16.0	604	0.899
5–7 members	15.5	1,001	
8 or more members	14.8	978	
Number of ITNs owned by household			
None	12.7	445	0.429
1 ITN	14.1	399	
2 ITNs	17.2	747	
3 or more ITNs	15.7	992	
Total	**15.4**	**2,583**	

To identify the sociodemographic profiles of children under five with fever in the past two weeks who received an ACT, the predictor variables (mother's education level, place of residence, and household wealth quintile) that demonstrated a significant relationship with receipt of an ACT were included in the CHAID model. The model retained the predictor variables woman's education level and place of residence. The final CHAID model contained four nodes, of which three were terminal nodes. The best predictor of receipt of ACT treatment was place of residence ($p<0.001$), which makes up the first level of the tree (Figure 21). ACT treatment coverage was higher in urban areas (21%), compared to rural areas (13%). Among children residing in urban areas (Node 1), no further significant predictor of ACT treatment was found. Among children residing in rural areas, the best predictor of receipt of ACT treatment was mother's education level ($p<0.05$), which was split into children whose mother had no formal education (Node 3) and children whose mother had a primary level of education or higher (Node 4). ACT treatment coverage was lower among children whose mother had no formal education (11%), compared to children whose mother had a primary level of education or higher (16%).

Figure 21. CHAID tree for ACT treatment among children under five with fever



The CHAID gain index for children who did not receive ACT treatment is presented in Table 27. The table includes a description of the population in each of the three terminal nodes; the node percentage, which represents the demographic weight of the children for that node in the overall population; the gain percentage, which represents the percentage of children who did not receive an ACT out of all the children in the sample population; the response percentage, which represents the percentage of children in that node who did not receive an ACT; and the index percentage, which represents the probability of the children in the subgroup not receiving an ACT, compared to the overall population. The gain index results indicate that to improve overall national coverage of ACT treatment, emphasis should be on improving coverage among children from rural areas (Nodes 3 and 4), particularly among children who mothers have no formal education. Children in the Node 3 subgroup represent 46 percent of all children who did not receive an ACT out of the overall population (gain percentage).

Table 27. CHAID gain index table for ACT treatment for children under five with fever

Node	Description of node	Node		Gain		Response	Index
		N	%	N	%	%	%
3	Rural area; mother has no formal education	1,136	43.6	1009	45.6	88.8	104.4
4	Rural area; mother has a primary or higher level of education	813	31.2	687	31.0	84.5	99.3
1	Urban area	655	25.2	519	23.4	79.2	93.2

Model 7. CHAID model on women's exposure to SBC malaria messages

Women's exposure to at least one SBC malaria message in the past six months by background characteristics is presented in Table 28. A significant association was observed between exposure and woman's age, woman's education level, place of residence, region of the country, and household wealth quintile. No significant relationship was observed between exposure to SBC malaria messages and number of household members.

Table 28. Women's exposure to SBC malaria messages by background characteristics

Background characteristic	Exposed to SBC malaria message (%)	N	Chi-square p-value
Age			
15–19	30.8	1,376	<0.001
20–34	35.1	4,494	
35–49	39.8	2,164	
Woman's education level			
None	27.1	3,119	<0.001
Primary	36.9	1,244	
Secondary or higher	42.5	3,671	
Place of residence			
Urban	43.8	3,129	<0.001
Rural	30.4	4,905	
Region			
North Central	25.7	1,357	<0.001
North East	31.4	1,077	
North West	34.9	2,359	

Background characteristic	Exposed to SBC malaria message (%)	N	Chi-square p-value
South East	42.0	811	
South South	38.0	1,080	
South West	44.4	1,351	
Household wealth quintile			
Lowest	23.7	1,448	
Second	28.8	1,530	
Middle	33.2	1,564	<0.001
Fourth	41.7	1,653	
Highest	47.4	1,840	
Number of household members			
1–4 members	34.9	2,467	
5–7 members	36.3	3,031	0.717
8 or more members	35.5	2,535	
Total	**35.6**	**8,034**	

To identify the sociodemographic profiles of women who were exposed to malaria SBC messages, the five predictor variables (woman's age, woman's education level, place of residence, region of the country, and household wealth quintile) that demonstrated a significant relationship with exposure were included in the CHAID model. The model retained the five predictor variables. The final CHAID model contained 28 nodes, of which 18 were terminal nodes. The best predictor of exposure to malaria SBC messages was household wealth quintile ($p<0.001$), which makes up the first level of the tree (Figure 22). Each of the wealth quintiles split into a parent node (Nodes 1–5). Among women within the middle wealth quintile (Node 1), the most significant predictor of exposure to SBC malaria messages was place of residence ($p<0.001$), with higher exposure among women residing in urban areas (40%), compared to women residing in rural areas (29%). In rural areas in this wealth quintile (Node 6), region was another significant predictor of exposure, split into the North Central region (Node 21) and the five remaining regions (Node 20). Exposure was significantly lower in the North Central region (21%), compared to the other regions of the country (32%). Among women residing in urban areas, no other significant predictors of exposure were observed.

In the lowest wealth quintile (Node 2), the most significant predictor of exposure was region ($p<0.001$), which was split into three child nodes—the North East and South East regions (Node 8), the North West and South West regions (Node 9), and the South South and North Central regions (Node 10). Exposure was lowest in the South South and North Central regions (7%) and highest in the North West and South West regions (28%).

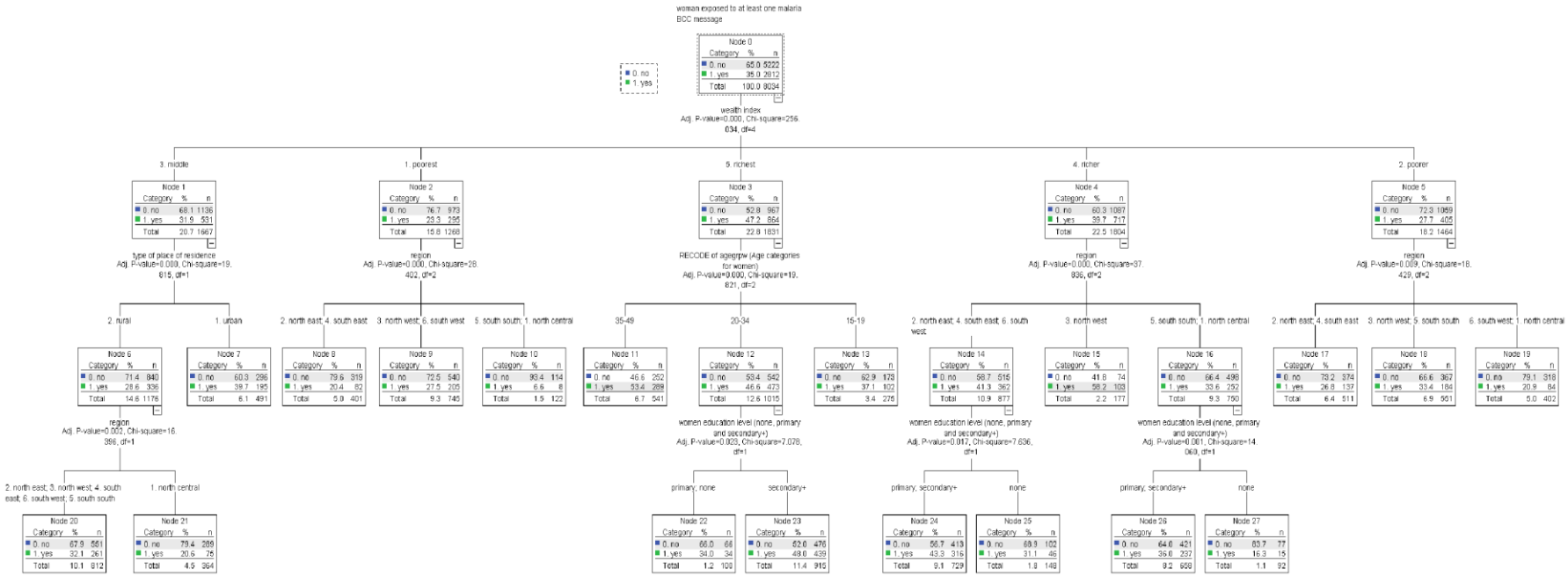
In the highest wealth quintile (Node 3), the most significant predictor of exposure was woman's age, which was split into women 15–19 years of age (Node 13), women 20–34 years of age (Node 12), and women 35–49 years of age (Node 11), with exposure levels increasing with age. Among women 20–34 years of age, education level was another significant predictor of exposure in this subgroup, which was split into women with no formal education or a primary level of education (Node 22) and women with a secondary or higher level of education (Node 23), with higher exposure among women with a secondary or higher level of education (48%), compared to women with no education or a primary level of education (34%).

In the fourth wealth quintile (Node 4), the most significant predictor of exposure was region of the country, which was split into three further nodes—the North East, South East, and South West regions (Node 14); the North West region (Node 15); and the South South and North Central regions (Node 16). Exposure to malaria SBC messages was highest in the North West region subgroup (58%) and lowest in the South South and North Central subgroup (34%). In the North East, South East, and South West regions, woman's education level was also a significant predictor of exposure, which was split into women with no formal education (Node 25) and women with a primary or higher level of education (Node 24). Exposure to malaria SBC messages was highest among the women with a primary or higher level of education subgroup (43%), compared to women with no formal education (31%). In the South South and North Central regions subgroup, woman's education level was a significant predictor of exposure ($p<0.001$), which was split into women with no formal education (Node 27) and women with a primary or higher level of education (Node 26). Exposure to SBC messages was higher among women with a primary or higher level of education (36%), compared to women with no formal education (16%).

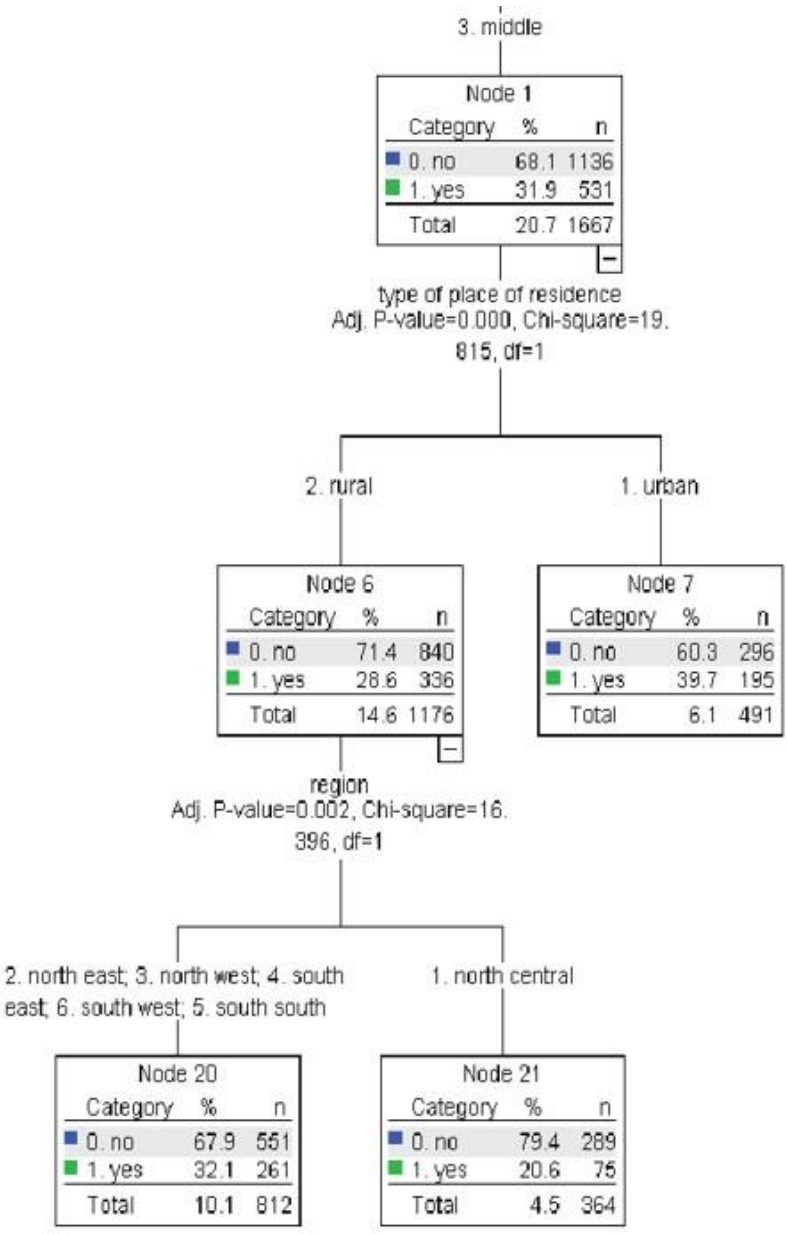
In the second wealth quintile (Node 5), the most significant predictor of exposure to malaria SBC messages was region ($p<0.01$). Region was split into three child nodes—the North East and South East regions (Node 17); the North West and South South regions (Node 18); and the South West and North Central regions (Node 19). The highest exposure was among women residing in the North West and South South regions (33%), and the lowest exposure was among women residing in the South West and North Central regions (21%).

Figure 22. CHAID tree for SBC malaria message exposure

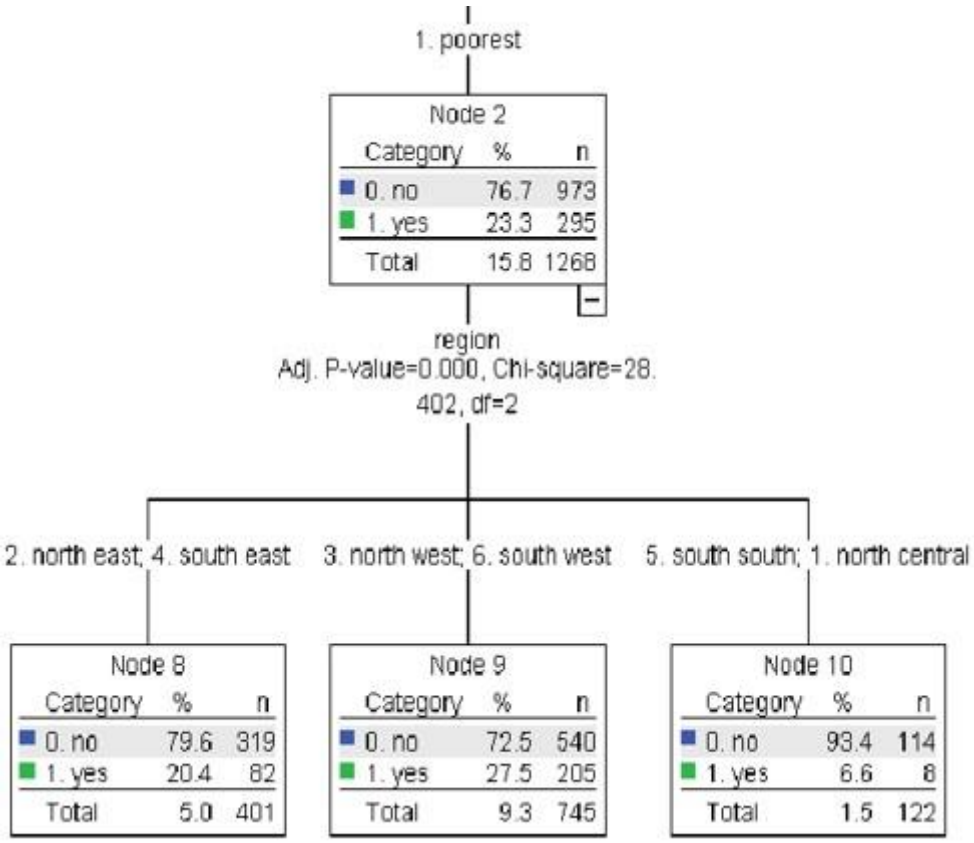
a. Full CHAID tree



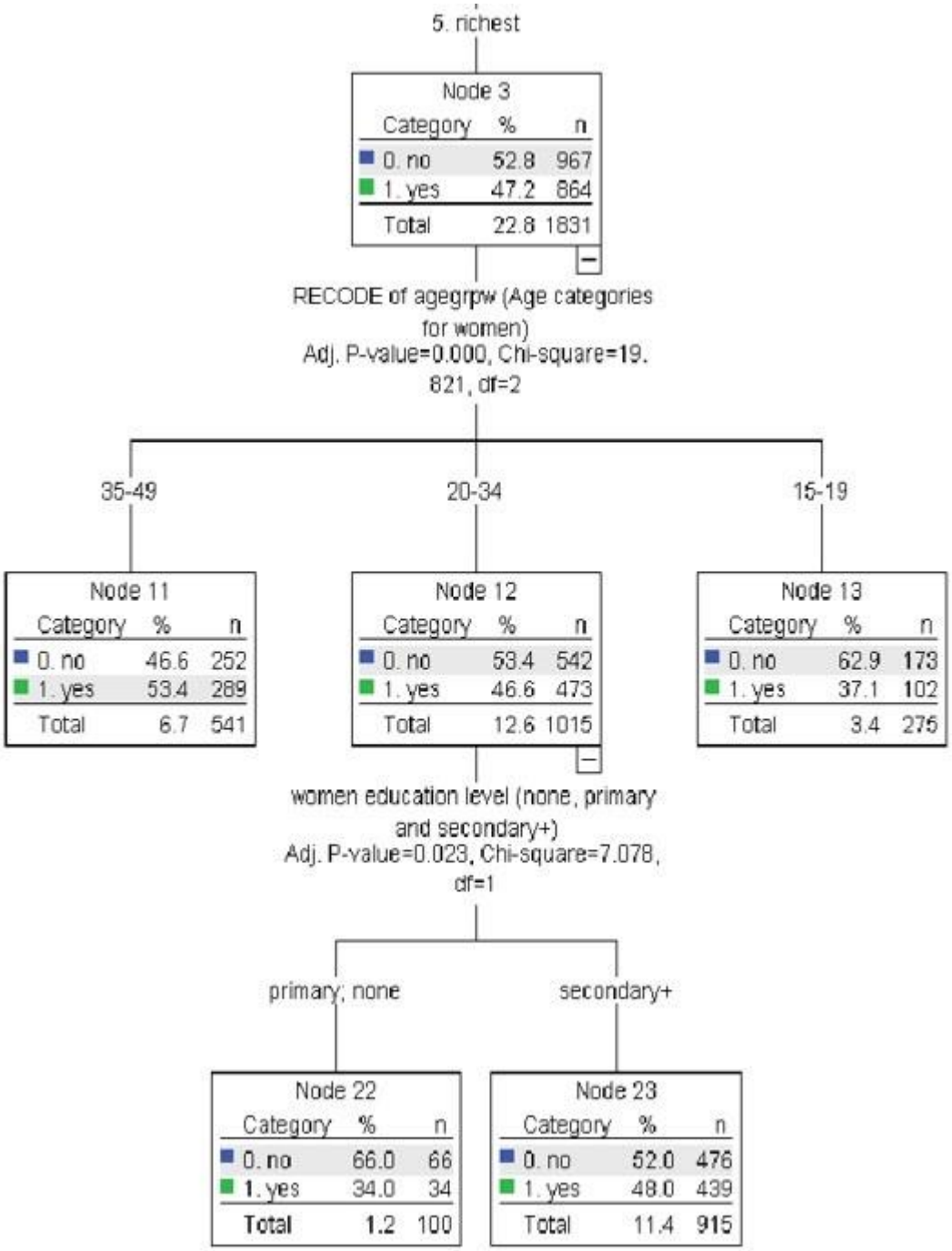
b. Middle node



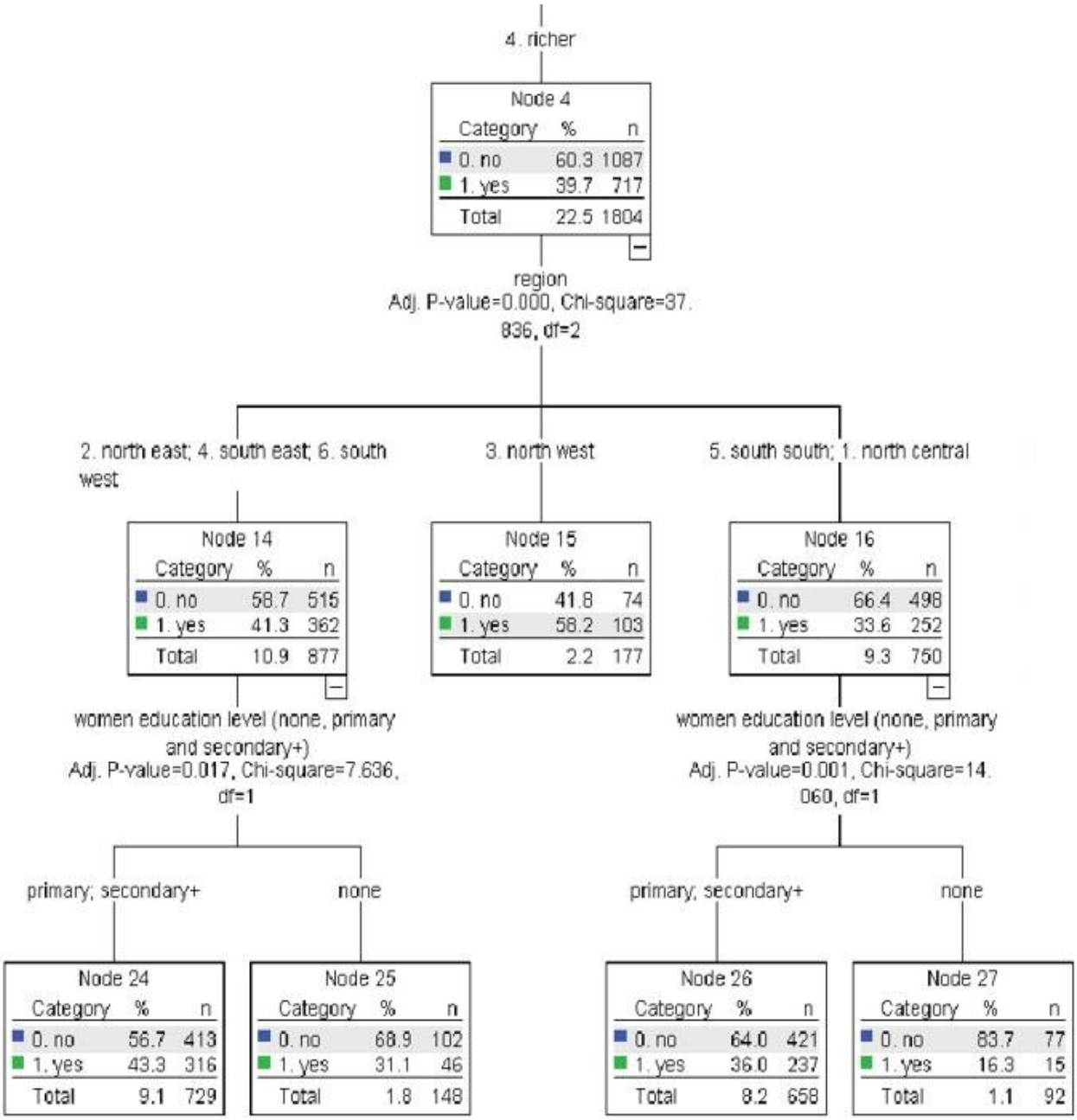
c. Poorest node



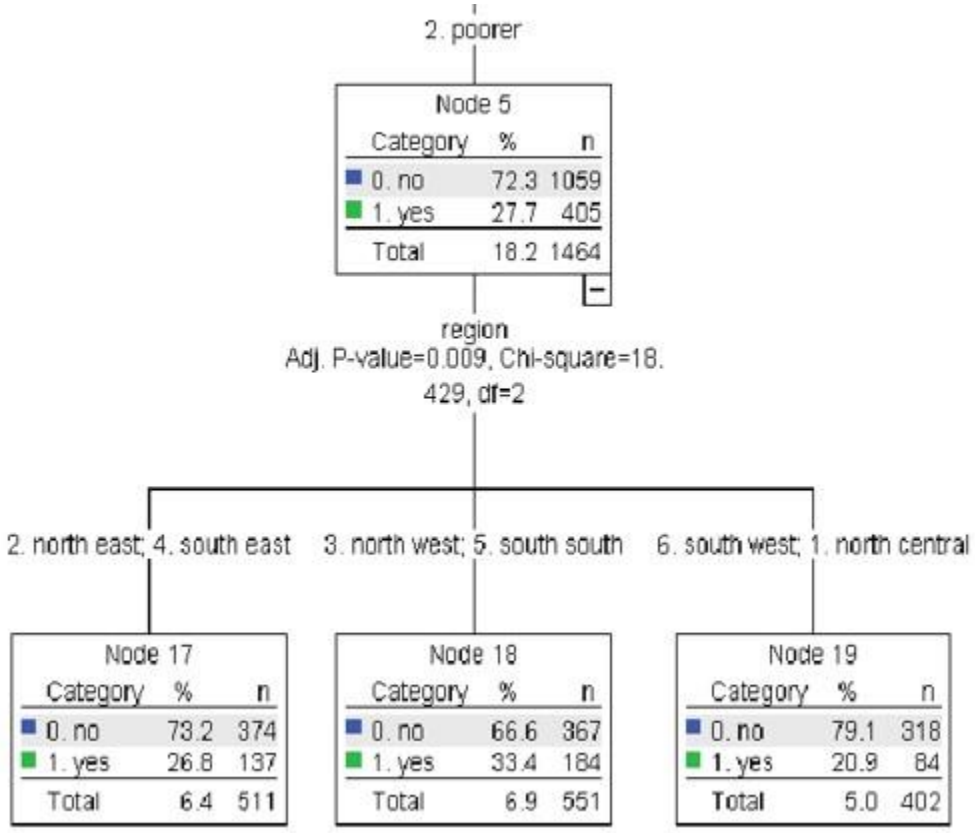
d. Richest node



e. Richer node



f. Poorer node



The CHAID gain index for women who were not exposed to malaria SBC messages is presented in Table 29. The table includes a description of the population in each of the 18 terminal nodes; the node percentage, which represents the demographic weight of the women for that node in the overall population; the gain percentage, which represents the percentage of women who were not exposed to malaria SBC messages out of all the women in the population; the response percentage, which represents the percentage of women in that node who were not exposed to a malaria SBC message; and the index percentage, which represents the probability of the women in the subgroup not being exposed to malaria SBC messages, compared to the overall population. The gain index results suggest that to improve overall national coverage of malaria SBC messages, more emphasis should be on improving exposure among women in the subgroups in Node 9, Node 17, Node 18, Node 20, Node 23, Node 24, and Node 26. Women in these subgroups represent more than half of women who were not exposed to SBC malaria messages.

Table 29. CHAID gain index table for SBC malaria message exposure

Node	Description of node	Node		Gain		Response	Index
		N	%	N	%	%	%
10	Lowest wealth quintile; South South and North Central regions	122	1.5	114	2.2	93.4	143.8
27	Fourth wealth quintile; South South and North Central regions; no formal education	92	1.1	77	1.5	83.7	128.8
8	Lowest wealth quintile; North East and South East regions	401	5.0	319	6.1	79.6	122.4
21	Middle wealth quintile; rural area; North Central region	364	4.5	289	5.5	79.4	122.1
19	Second wealth quintile; South West and North Central regions	402	5.0	318	6.1	79.1	121.7
17	Second wealth quintile; North East and South East regions	511	6.4	374	7.2	73.2	112.6
9	Lowest wealth quintiles; North West and South West regions	745	9.3	540	10.3	72.5	111.5
25	Fourth wealth quintile; North East, South East, and South West regions; no formal education	148	1.8	102	2.0	68.9	106.0
20	Middle wealth quintile; rural area; North East, North West, South East, South West, and South South regions	812	10.1	551	10.6	67.9	104.4
18	Second wealth quintile; North West and South South regions	551	6.9	367	7.0	66.6	102.5
22	Fourth wealth quintile; women 20–34 years of age; none or primary only education level	100	1.2	66	1.3	66.0	101.5
26	Fourth wealth quintile; South South and North Central regions; primary and secondary or higher education level	658	8.2	421	8.1	64.0	98.4
13	Highest wealth quintile; women 15–19 years of age	275	3.4	173	3.3	62.9	96.8
7	Middle wealth quintile; urban area	491	6.1	296	5.7	60.3	92.7
24	Fourth wealth quintile; North East, South East, and South West regions; primary and secondary or higher education level	729	9.1	413	7.9	56.7	87.2
23	Highest wealth quintile; women 20–34 years of age; secondary or higher education level	915	11.4	476	9.1	52.0	80.0
11	Highest wealth quintile; women 35–49 years of age	541	6.7	252	4.8	46.6	71.7
15	Fourth wealth quintile; North West region	177	2.2	74	1.4	41.8	64.3

4.5.3 Profiling of Subpopulations Based on Parasitemia and Severe Anemia Risk

Model 8. CHAID model on parasitemia infection in children 6–59 months of age

Parasitemia infection (measured through microscopy) in children 6–59 months of age stratified by background characteristics is presented in Table 30. A significant relationship was observed between parasitemia infection and age of the child, mother's education level, household wealth quintile, place of residence, region of the country, and number of household members. No significant association was found between parasitemia infection and the sex of the child or the number of ITNs owned by the household in which the child resided.

Table 30. Parasitemia prevalence in children 6–59 months of age by background characteristics

Background characteristic	Parasitemia prevalence (%)	N	Chi-square p-value
Sex			
Male	27.2	2,604	0.613
Female	26.4	2,532	
Age			
6–11 months	16.1	549	<0.001
12–23 months	21.7	1,175	
24–35 months	27.1	1,098	
36–47 months	29.8	1,181	
48–59 months	33.8	1,133	
Mother's education level			
None	37.8	2,301	<0.001
Primary	26.4	906	
Secondary or higher	13.8	1,929	
Place of residence			
Urban	10.9	1,773	<0.001
Rural	35.2	3,363	
Region			
North Central	31.1	968	<0.001
North East	26.4	727	
North West	37.1	1,638	
South East	12.1	455	
South South	19.0	548	
South West	14.7	799	
Household wealth quintile			
Lowest	42.7	1,063	<0.001
Second	40.2	1,166	
Middle	27.3	946	
Fourth	16.4	944	
Highest	4.2	1,016	
Number of household members			
1–4 members	20.2	1,197	<0.001
5–7 members	26.5	2,153	
8 or more members	31.6	1,785	

Background characteristic	Parasitemia prevalence (%)	N	Chi-square p-value
Number of ITNs owned by household			
None	24.3	1,164	0.177
1 ITN	25.3	873	
2 ITNs	26.7	1,399	
3 or more ITNs	29.5	1,700	
Total	**26.8**	**5,136**	

To identify the sociodemographic profiles of children with parasitemia (through microscopy), the predictor variables (child's age, mother's education level, place of residence, region of the country, household wealth quintile, and household size) that demonstrated a significant relationship with parasitemia were included in the CHAID model. The model retained child's age, mother's education level, place of residence, region of the country, and household wealth quintile. The final CHAID model contained 24 nodes, of which 14 were terminal nodes. The best predictor of parasitemia infection was household wealth quintile ($p<0.001$), which makes up the first level of the tree (Figure 23). Household wealth quintile was split into four parent nodes—the fourth quintile (Node 1), the middle quintile (Node 2), the highest quintile (Node 3), and the second and lowest quintiles (Node 4). Parasitemia prevalence was highest among children from households in the bottom two wealth quintiles (43%) and lowest among children from the wealthiest households (5%).

Among children in the fourth wealth quintile (Node 1), region of the country was a significant predictor of parasitemia ($p<0.001$), which was split into two child nodes—the North West, South West, and South South regions (Node 5); and the North East, North Central, and South East regions (Node 6). Parasitemia prevalence in children was significantly higher in children from the North West, South West, and South South regions (24%), compared to children from the North East, North Central, and South East regions (8%). In the North West, South West, and South South regions, place of residence was a further significant predictor of parasitemia ($p<0.05$), which was split into urban (Node 13) and rural (Node 14) areas. Among children residing in urban areas, parasitemia prevalence was lower (20%), compared to children residing in rural areas (28%).

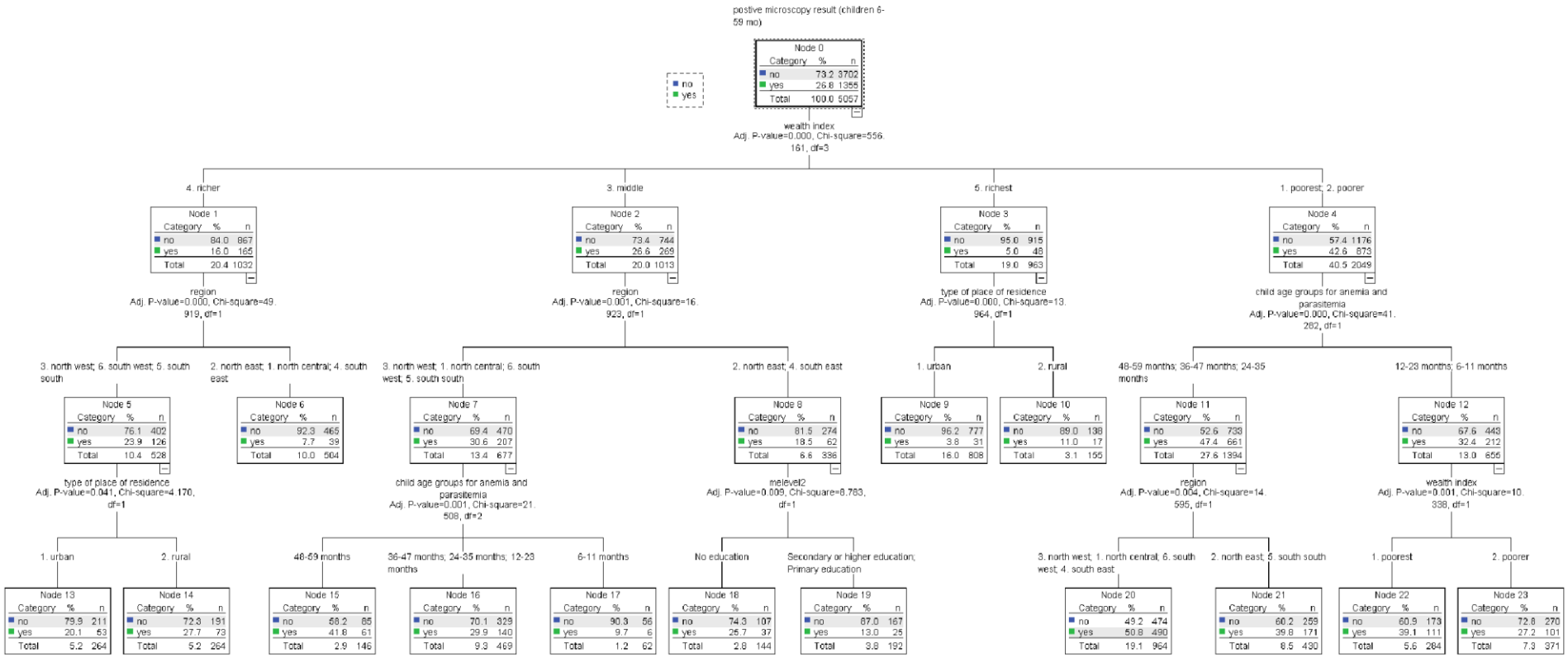
Among children in the middle wealth quintile (Node 2), region was the most significant predictor of parasitemia prevalence ($p<0.001$), which was split into two nodes—the North West, North Central, South West, and South South regions (Node 7); and the North East and South East regions (Node 8). Parasitemia prevalence was lower in the North East and South East regions (19%), compared to the other four regions of the country (31%). Among children from the North West, North Central, South West, and South South regions, age of the child was a further significant predictor of parasitemia prevalence ($p<0.01$), which was split into children 6–11 months of age (Node 17), children 12–47 months of age (Node 16), and children 48–59 months of age (Node 15). Parasitemia prevalence was highest among the oldest age group (48–59 months) at 42 percent and lowest among the youngest age group (6–11 months) at 10 percent. Among children from the North East and South East regions, mother's education level was a further significant predictor of parasitemia prevalence ($p<0.01$), which was split into children whose mothers had no formal education (Node 18) and children whose mother had a primary or higher level of education (Node 19). Parasitemia prevalence was 26 percent among children whose mother had no formal education, compared to 13 percent among children whose mother had a primary or higher level of education.

Among children in the highest wealth quintile, place of residence was the most significant predictor of parasitemia prevalence ($p<0.001$), with 11 percent parasitemia prevalence among children residing in rural areas (Node 9), compared to 4 percent parasitemia prevalence among children residing in urban areas (Node 10). No further significant predictors of parasitemia prevalence were observed in either of these subgroups.

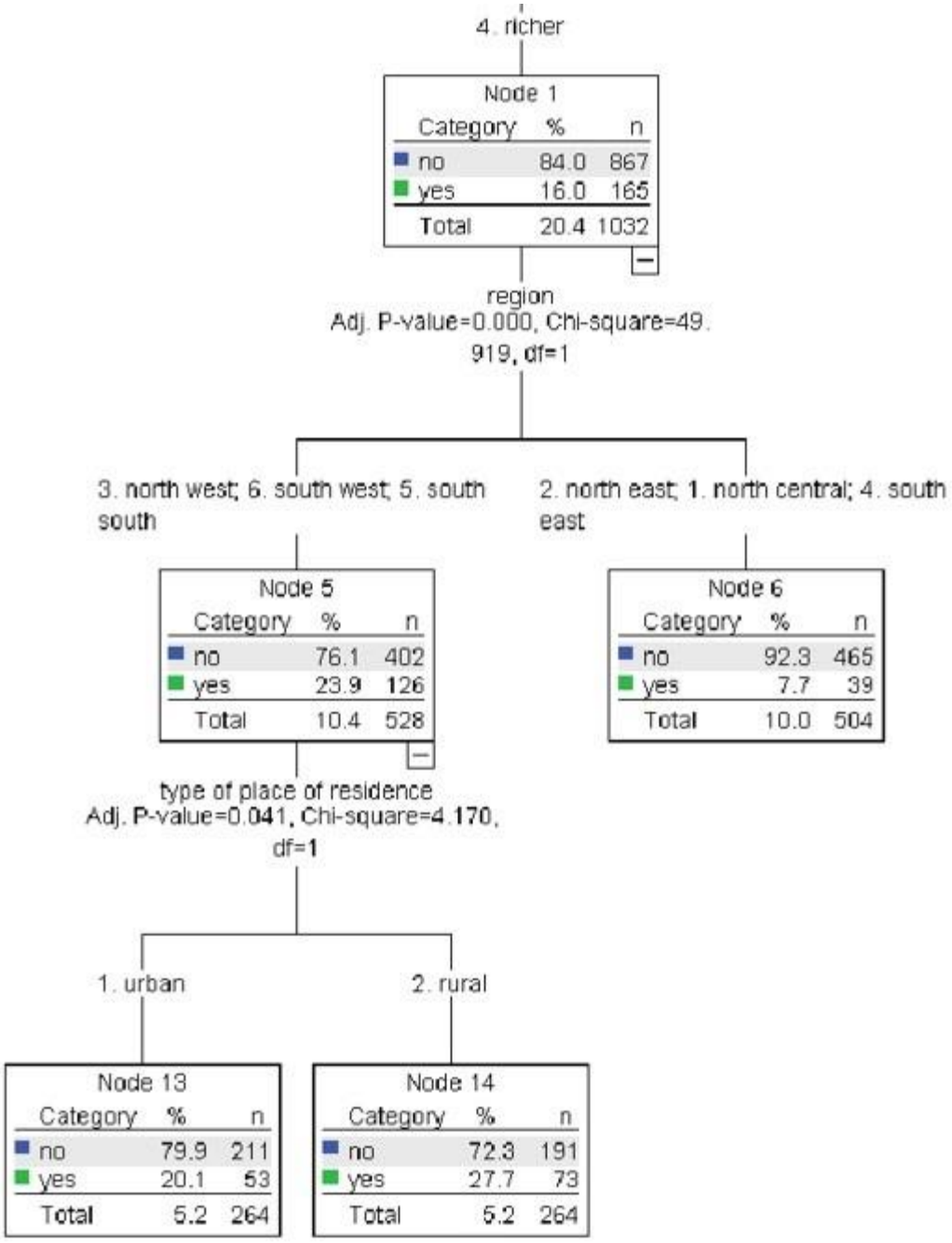
Among children in the bottom two wealth quintiles, age was the most significant predictor of parasitemia prevalence ($p<0.001$), which was split into children 6–23 months of age (Node 12) and children 24–59 months of age (Node 11). Parasitemia prevalence was highest in older children (47%), compared to younger children (32%). Among children 24–59 months of age, region of the country was a further significant predictor of parasitemia ($p<0.01$), which was split into two nodes—the North West, North Central, South West, and South East regions (Node 20); and the North East and South South regions (Node 21). Parasitemia prevalence was 40 percent among children from the North East and South South regions in this subgroup, compared to 51 percent among children from the four remaining regions of the country. Among children 6–23 months of age, household wealth quintile was a further significant predictor of parasitemia, which was split into two child nodes—the lowest wealth quintile (Node 22) and the second wealth quintile (Node 23)—with higher prevalence among young children from the lowest wealth quintile (39%), compared to young children in the second wealth quintile (27%).

Figure 23. CHAID tree for parasitemia in children 6–59 months of age

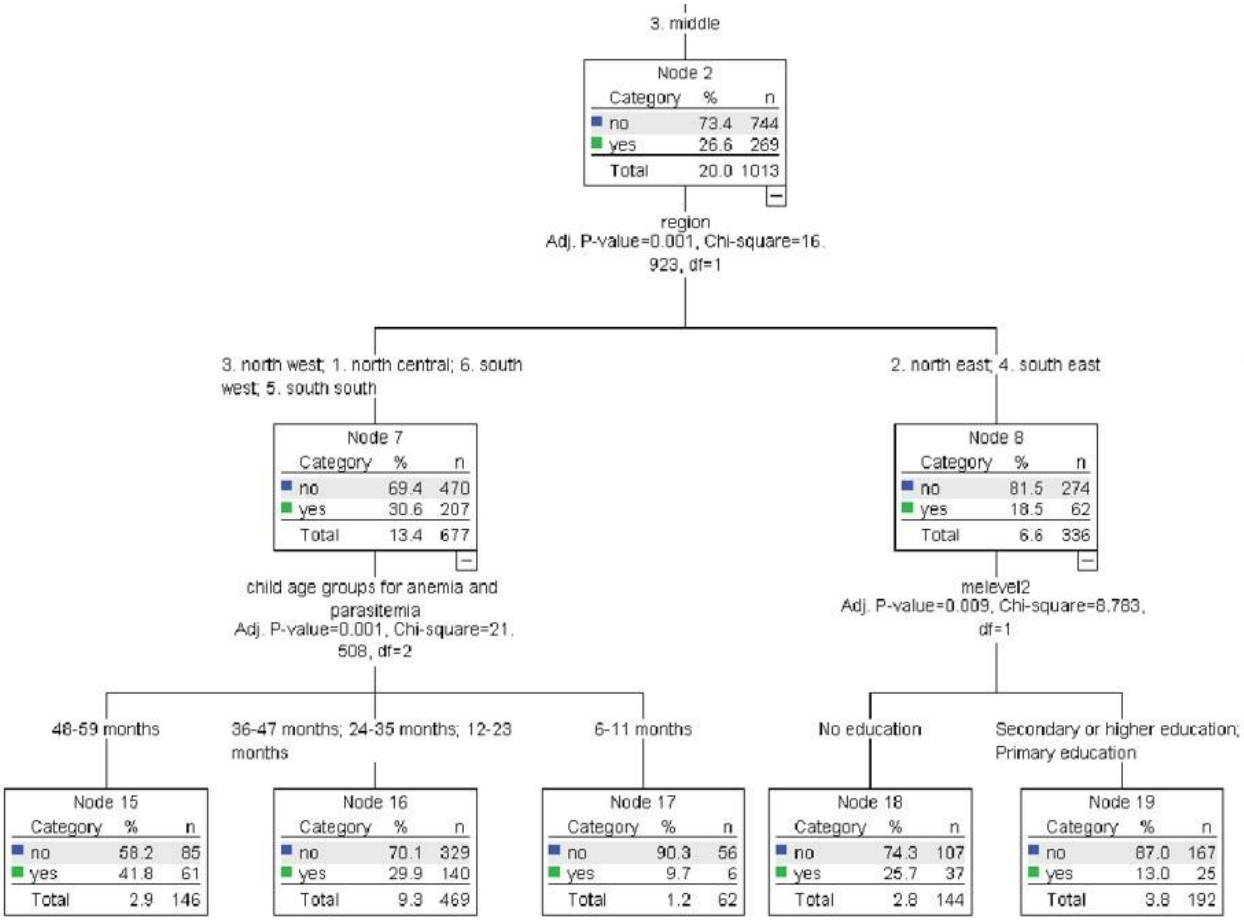
a. Full CHAID tree



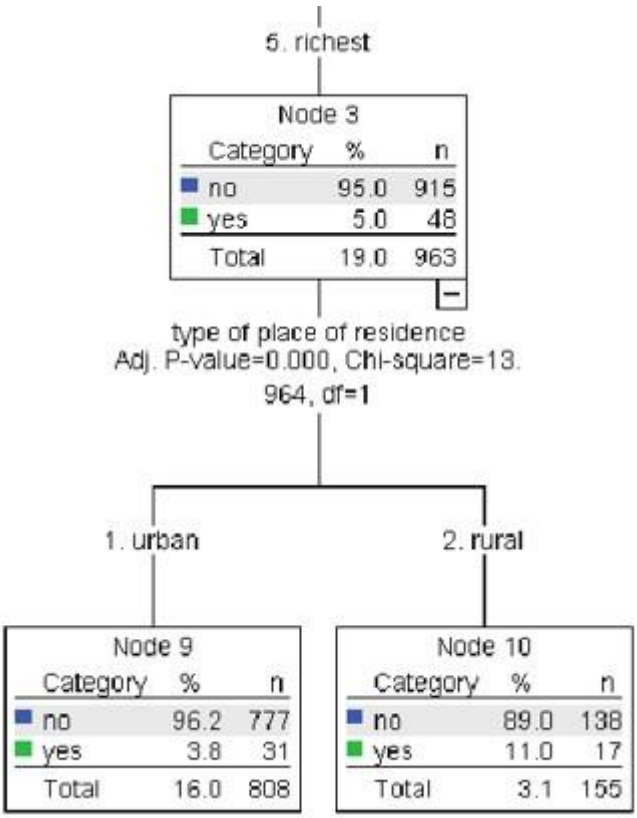
b. Richer node



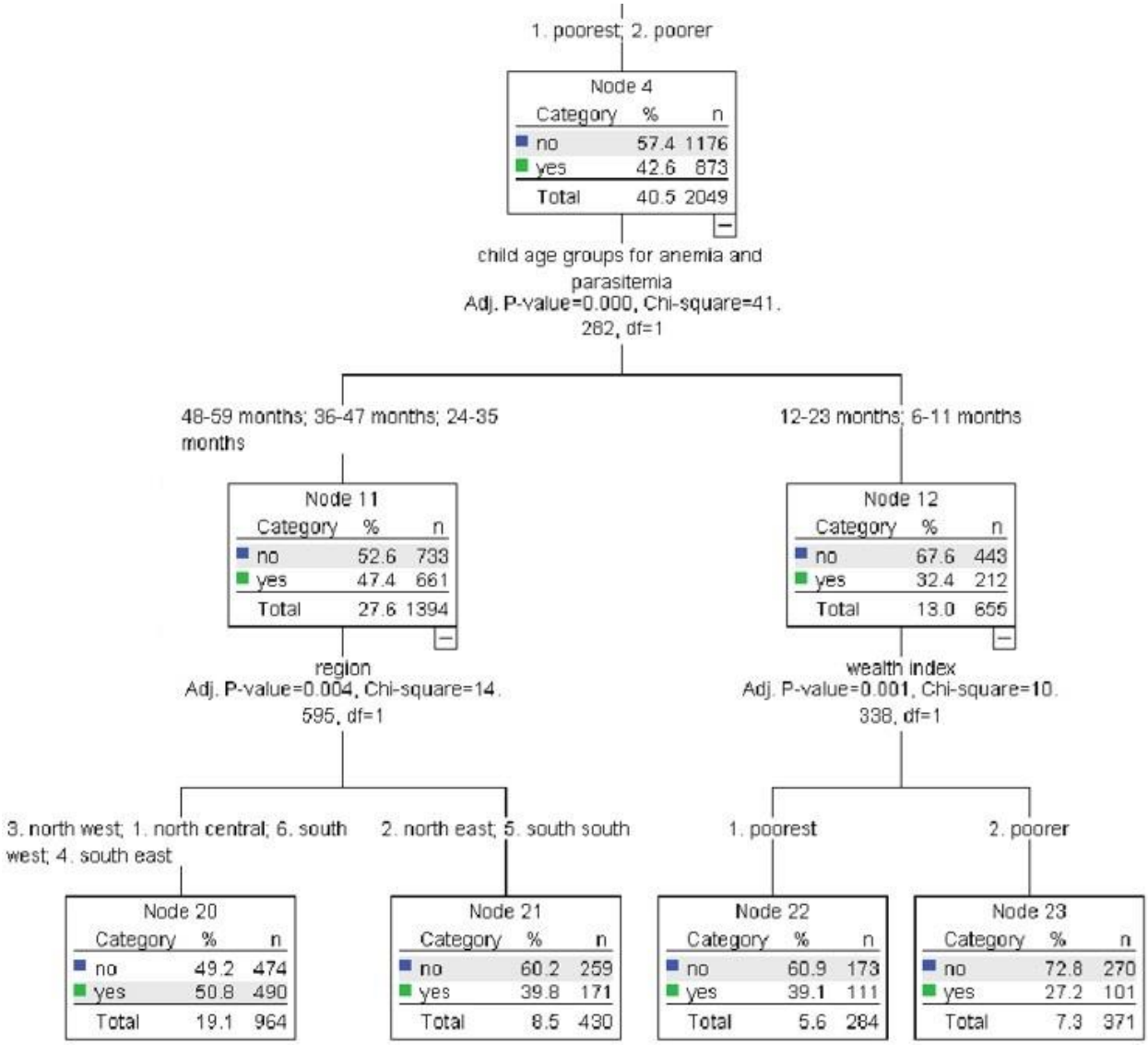
c. Middle node



d. Richest node



e. Poorest and Poorer nodes



The CHAID gain index for children with parasitemia is presented in Table 31. The table includes a description of each of the subgroups in the 14 terminal nodes; the node percentage, which represents the demographic weight of the children for that node in the overall population; the gain percentage, which represents the percentage of children with parasitemia out of all the children in the overall population; the response percentage, which represents the percentage of children in that node who had parasitemia; and the index percentage, which represents the probability of the children in that node having parasitemia, compared to the overall population. The gain index results indicate that to reduce parasitemia prevalence at the national level, interventions should be directed particularly to children in Node 20 (children from the bottom two wealth quintiles who are 24–59 months of age and from the North West, North Central, South West, and South East regions) because they comprise 36 percent of all the children with parasitemia infection in the overall population. Efforts should also be targeted to children represented in Node 16, Node 21, Node 22, and Node 23.

Table 31. CHAID gain index table for parasitemia in children 6–59 months of age

Node	Description of node	Node		Gain		Response (%)	Index (%)
		N	%	N	%		
20	Bottom two wealth quintiles; children 24–59 months of age; North West, North Central, South West, and South East regions	964	19.1	490	36.2	50.8	189.7
15	Middle wealth quintile; North West, North Central, South West, and South South regions; children 48–59 months of age	146	2.9	61	4.5	41.8	155.9
21	Bottom two wealth quintiles; children 24–59 months of age; North East and South South regions	430	8.5	171	12.6	39.8	148.4
22	Lowest wealth quintile; children 6–23 months of age	284	5.6	111	8.2	39.1	145.9
16	Middle wealth quintile; North West, North Central, South West, and South South regions; children 12–47 months of age	469	9.3	140	10.3	29.9	111.4
14	Fourth wealth quintile; North West, South West, and South South regions; rural area	264	5.2	73	5.4	27.7	103.2
23	Second wealth quintiles; children 6–23 months of age	371	7.3	101	7.5	27.2	101.6
18	Middle wealth quintile; North East and South East regions; mother with no formal education	144	2.8	37	2.7	25.7	95.9
13	Fourth wealth quintile; North West, South West, and South South regions; urban area	264	5.2	53	3.9	20.1	74.9
19	Middle wealth quintile; North East and South East regions; mother with a primary or higher level of education	192	3.8	25	1.8	13.0	48.6
10	Highest wealth quintile; rural area	155	3.1	17	1.3	11.0	40.9
17	Middle wealth quintile; North West, North Central, South West, and South South regions; children 6–11 months of age	62	1.2	6	0.4	9.7	36.1
6	Fourth wealth quintile; North East, North Central, and South East regions	504	10.0	39	2.9	7.7	28.9
9	Highest wealth quintile; urban area	808	16.0	31	2.3	3.8	14.3

Model 9. CHAID model on severe anemia prevalence in children 6–59 months of age

Severe anemia prevalence in children 6–59 months of age stratified by background characteristics is presented in Table 32. A significant association was observed between severe anemia prevalence and age of the child, mother's education level, place of residence, region of the country, and household wealth quintile. No significant relationship was found between severe anemia prevalence and household size or the number of ITNs owned by a household.

Table 32. Severe anemia prevalence in children 6–59 months of age by background characteristics

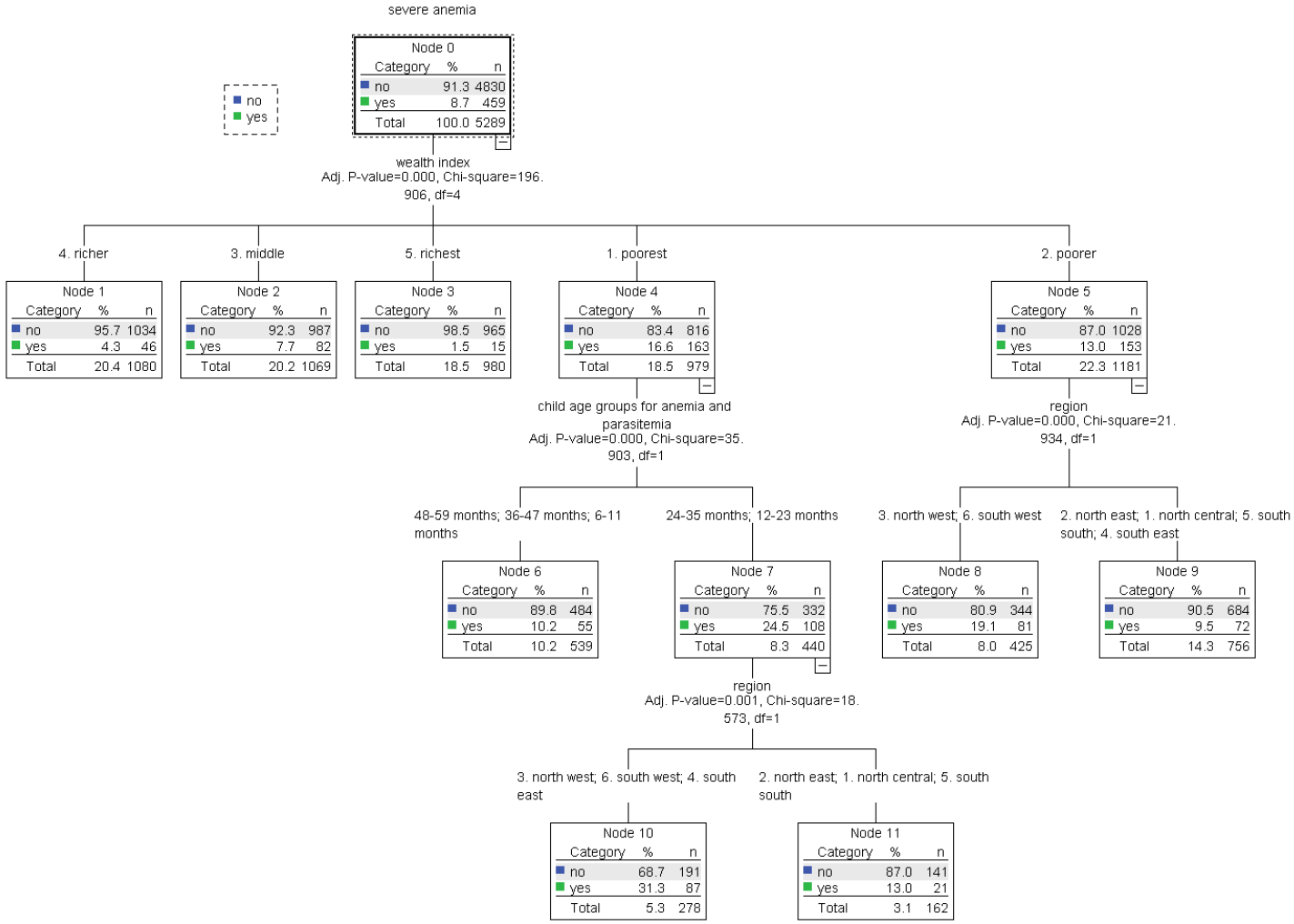
Background characteristic	Severe anemia prevalence (%)	N	Chi-square p-value
Sex			
Male	9.9	2,741	0.508
Female	9.3	2,644	
Age			
6–11 months	10.5	577	<0.001
12–23 months	12.9	1,209	
24–35 months	11.9	1,140	
36–47 months	8.3	1,259	
48–59 months	5.1	1,200	
Mother's education level			
None	14.8	2,436	<0.001
Primary	7.0	953	
Secondary or higher	4.5	1,996	
Place of residence			
Urban	4.8	1,823	<0.001
Rural	12.1	3,562	
Region			
North Central	4.7	1,007	<0.001
North East	7.1	753	
North West	18.3	1,736	
South East	5.6	471	
South South	5.7	567	
South West	4.7	851	
Household wealth quintile			
Lowest	17.5	1,109	<0.001
Second	14.2	1,260	
Middle	8.1	1,001	
Fourth	4.6	986	
Highest	1.9	1,029	
Number of household members			
1–4 members	8.4	1,249	0.270
5–7 members	9.2	2,252	
8 or more members	10.9	1,884	
Number of ITNs owned by household			
None	6.0	1,223	0.004
1 ITN	8.6	905	
2 ITNs	11.3	1,466	
3 or more ITNs	11.2	1,791	
Total	**9.6**	**5,385**	

To identify the sociodemographic profiles of children with severe anemia, the predictor variables (child's age, mother's education level, place of residence, region of the country, and household wealth quintile) that demonstrated a significant relationship with severe anemia were included in the CHAID model. The model retained child's age, region of the country, and household wealth quintile. The final CHAID model contained 12 nodes, of which 8 were terminal nodes. The best predictor of severe anemia was household wealth quintile ($p<0.001$), which makes up the first level of the tree (Figure 24). Each of the wealth quintiles split into a parent node, with the highest severe anemia prevalence found among children from households in the lowest wealth quintile (17%) and the lowest severe anemia prevalence found among children from households in the highest wealth quintile (2%). No further significant predictor variables were found to be associated with severe anemia in the top three wealth quintiles (Nodes 1–3).

Among children in the lowest wealth quintile, child's age was a significant predictor of severe anemia, which was split into children 6–11 months of age and children 36–59 months of age (Node 6), and children 12–35 months of age (Node 7). Severe anemia prevalence was significantly higher in children 12–35 months of age (25%), compared to severe anemia prevalence among children 6–11 months of age and children 36–59 months of age (10%). For children 12–35 months of age, region of the country was another significant predictor of severe anemia—split into the North West, South West, and South East regions (Node 10); and the North East, North Central, and South South regions (Node 11). Severe anemia prevalence among children in this age group from the North West, South West, and South East regions was significantly higher (31%), compared to severe anemia prevalence among children from the North East, North Central, and South South regions (13%).

Among children in the second wealth quintile (Node 5), region of the country was a significant predictor of severe anemia. The parent node was split into two child nodes—the North West and South West regions (Node 8); and the North East, North Central, South South, and South East regions (Node 9). Severe anemia prevalence was significantly higher in children from the North West and South West regions (19%), compared to severe anemia prevalence among children from the other four regions of the country (10%).

Figure 24. CHAID tree for severe anemia prevalence in children 6–59 months of age



The CHAID gain index for children with severe anemia is presented in Table 33. The table includes a description of the population in each of the eight terminal nodes; the node percentage, which represents the demographic weight of the children for that node in the overall population; the gain percentage, which represents the percentage of children with severe anemia out of all the children in the overall population; the response percentage, which represents the percentage of children in that node who had severe anemia; and the index percentage, which represents the probability of the children in that node having severe anemia, compared to the overall population. The gain index results suggest that to reduce severe anemia prevalence at the national level, resources should be focused on reducing severe anemia among children from Node 10, Node 8, Node 6, and Node 9.

Table 33. CHAID gain index table for severe anemia in children 6–59 months of age

Node	Description of node	Node		Gain		Response (%)	Index (%)
		N	%	N	%		
10	Lowest wealth quintile; children 12–35 months of age; North East, North Central, and South South regions	278	5.3	87	19.0	31.3	360.6
8	Second wealth quintile; North West and South West regions	425	8.0	81	17.6	19.1	219.6
11	Lowest wealth quintile; children 12–35 months of age; North West, South West, and South East regions	162	3.1	21	4.6	13.0	149.4
6	Lowest wealth quintile; children 6–11 months and 36–59 months of age	539	10.2	55	12.0	10.2	117.6
9	Second wealth quintile; North East, North Central, South South, and South East regions	756	14.3	72	15.7	9.5	109.7
2	Middle wealth quintile	1069	20.2	82	17.9	7.7	88.4
1	Fourth wealth quintile	1080	20.4	46	10.0	4.3	49.1
3	Highest wealth quintile	980	18.5	15	3.3	1.5	17.6

4.5.4 Summary of Objective 5

A summary of the CHAID model results is presented in Table 34, which contains the most significant predictor of the outcome of interest, the other significant predictor variables selected by the model, and the recommended subgroups that should be targeted for future interventions. Across the ITN ownership and use outcome indicators, the best predictor of the outcome of interest was region of the country. For household ITN ownership and ITN use, more efforts should be focused on targeting interventions and resources to improve ownership and use among the different subgroups in the three southern regions of the country, which make up the largest gain percentage across each of the four outcome indicators. For IPTp (more than three doses), the greatest predictor of uptake was place of residence. The results indicate that efforts should be focused on improving coverage among women from rural areas across all six regions who had no formal education or a primary level of education only. For ACT treatment for children under five with fever, place of residence was the most significant predictor of receipt of treatment. The gain index results indicate that efforts should be targeted to improving treatment coverage among children residing in rural areas and specifically among children whose mother had no formal education. The best predictor of exposure to at least one malaria SBC message among women 15–49 years of age was household wealth quintile. There was greater variation in terms of subgroups to target to improve message exposure. The subgroups with the highest gain percentage and for which interventions to improve exposure should be targeted, were (1) women from rural areas across all regions of the country, except the North Central region, and from households in

the middle wealth quintile; and (2) women from the North West and South West regions from households in the lowest wealth quintile.

Household wealth quintile was the most significant predictor of parasitemia and severe anemia in children 6–59 months of age. To have the greatest impact on parasitemia prevalence, resources should be targeted to help reduce prevalence among children 24–59 months of age across all regions of the country from households in the bottom two wealth quintiles because they comprise almost half of all children with parasitemia infection. To reduce severe anemia prevalence, emphasis should be placed on interventions for children 12–35 months of age from the North East, North Central, and South South regions, from households in the lowest wealth quintiles, and from households in the second wealth quintile across all regions of the country.

Table 34. Summary of CHAID model results

Outcome of interest	Most significant predictor of outcome	Other significant predictors of outcome	Subgroups to target and their gain percentage
Household ownership of at least one ITN	Region	Education level of household head, place of residence, household wealth quintile, number of household members	• Small-size households in the South West region ***(17%)*** • Small-size households in the North Central and South Central regions of the country in rural areas ***(15%)*** • Small-size households in the North Central and South Central regions of the country in urban areas ***(12%)*** • Medium- and large-size households in the North Central and South South regions among households whose head of household has a primary or higher level of education ***(12%)***
ITN use among children under five	Region	Place of residence, mother's education level, household wealth quintile, number of household members	• Children from the South West and South East regions and from households in the top two wealth quintiles ***(24%)*** • Children from the North East region ***(19%)*** • Children from the South South region ***(15%)*** • Children from rural areas in the North Central region and whose mother has no formal education or a secondary or higher level of education ***(11%)***
ITN use among pregnant women	Region	Household wealth quintile	• Pregnant women from the three southern regions of the country from households in the top two wealth quintiles ***(36%)*** • Pregnant women from the North East region ***(20%)*** • Pregnant women from the North Central region ***(17%)***
ITN use among the general population	Region	Education level of household head, place of residence, household wealth quintile, number of household members	• General population from the South South region from households in the lowest and fourth wealth quintiles in urban areas **(13%)** • General population from the South East region from households in the top two wealth quintiles ***(10%)*** • General population from the North Central region from households in the middle and second wealth quintiles in rural areas ***(9%)*** • General population from the South South region from households in the fourth and lowest wealth quintiles in rural areas ***(4%)*** • General population from the North East region from large-size households in the fourth and second wealth quintiles ***(4%)*** • General population from the North Central region from households in the fourth and lowest wealth quintiles in rural areas ***(4%)***

Outcome of interest	Most significant predictor of outcome	Other significant predictors of outcome	Subgroups to target and their gain percentage
IPTp (three or more doses) uptake among women who had a live birth in the past two years	Place of residence	Women's education level, region	• Pregnant women and women of reproductive age from rural areas in the North West, North Central, and South South regions, with no formal education or a primary level of education ***(35%)*** • Pregnant women and women of reproductive age from rural areas in the North East, South West, and South East regions, with no formal education or a primary level of education ***(16%)*** • Pregnant women and women of reproductive age from urban areas in the South West and South South regions ***(14%)***
Children under five with fever in the two weeks preceding the survey who received ACT treatment	Place of residence	Mother's education level	• Children under five from rural areas and whose mother has no formal education ***(46%)*** • Children under five from rural areas and whose mother has a primary or higher level of education ***(31%)***
Exposure to at least one malaria SBC message in the past six months	Household wealth quintile	Place of residence, region, age of woman, women's education level	• Women from rural areas in the North East, North West, South East, South West, and South South regions from households in the middle wealth quintile ***(11%)*** • Women from the North West and South West regions from households in the lowest wealth quintile ***(10%)*** • Women 20–34 years of age from households in the highest wealth quintile with a secondary or higher level of education ***(9%)*** • Women from the South South and North Central regions from households in the fourth wealth quintile with a primary or higher level of education ***(8%)*** • Women from the North East, South East, and South West regions from households in the fourth wealth quintile with a primary or higher level of education ***(8%)*** • Women from the North East and South East regions from households in the second wealth quintile ***(7%)*** • Women from the North West and South South regions from households in the second wealth quintile ***(7%)***

Outcome of interest	Most significant predictor of outcome	Other significant predictors of outcome	Subgroups to target and their gain percentage
Parasitemia prevalence (through microscopy) among children 6–59 months of age	Household wealth quintile	Age of child, place of residence, region, mother's education level	• Children 24–59 months of age from the North West, North Central, South West, and South East regions from households in the bottom two wealth quintiles ***(36%)*** • Children 24–59 months of age from the North East and South South regions from households in the bottom two wealth quintiles ***(13%)*** • Children 12–47 months of age from the North West, North Central, South West, and South South regions from households in the middle wealth quintile ***(10%)*** • Children 6–23 months of age from households in the lowest wealth quintile ***(8%)*** • Children 6–23 months of age from households in the second wealth quintile ***(8%)***
Severe anemia prevalence among children 6–59 months of age	Household wealth quintile	Age of child, region	• Children 12–35 months of age from the North East, North Central, and South South regions from households in the lowest wealth quintile ***(19%)*** • Children from the North West and South West regions from households in the second wealth quintile ***(18%)*** • Children from the North East, North Central, South South, and South East regions from households in the second wealth quintile ***(16%)*** • Children 6–11 months of age and 36–59 months of age from households in the lowest wealth quintile ***(12%)***

5. DISCUSSION

5.1 State and National-Level Malaria Intervention Coverage and Malaria Morbidity in 2015

The 2015 NMIS results showed that vector control coverage varied widely across the different states in Nigeria, with states in the North East and North West regions generally performing better, and states in the three southern regions performing at or significantly below the national average across the different indicators examined. There was less variation in coverage of IPTp across the states, with the majority performing similar to the national average. A number of states in the North Central and the three southern regions, however, had higher IPTp coverage than the national average. Diagnostic testing coverage for children with fever was generally low across all states; most states did not vary significantly from the national average. Care-seeking from a health provider varied more across the states, with a number of states in the North Central, North East, and South East regions performing better than the national average. The majority of states had similar or significantly worse ACT treatment coverage than the national average, with only two exceptions in FCT Abuja and Cross River, which performed significantly better than the national average.

Although vector control coverage was generally higher in the North West region, a number of states in that region had significantly higher levels of parasitemia and severe anemia prevalence. In the three southern regions, where vector control coverage was generally lower, parasitemia and severe anemia prevalence were generally lower than the national average. These results are reflective of the targeting of vector control interventions in areas with higher parasitemia prevalence. The results also suggest that vector control coverage levels have not reached high enough levels for a sustained period of time to have shown a dramatic reduction in malaria morbidity.

Intervention coverage targets set for 2015 for vector control, IPTp, and case management were not achieved at the national level and in the majority of the states. The 2015 targets for parasitemia and severe anemia were close to being achieved at the national level and were achieved by many states. Large gaps remain at the national and individual state level to achieve the set targets for vector control, IPTp, diagnostic testing and treatment coverage, and malaria morbidity by 2020.

5.2 Comparative Performance Between PMI- and Non-PMI-Supported States

The pooled analysis results demonstrated improvements in malaria knowledge, vector control coverage, IPTp, case management, and malaria morbidity between 2008/2010 and 2015 in both PMI- and non-PMI-supported states. Significant improvements in knowledge of malaria and malaria prevention methods were observed in PMI-supported states between 2010 and 2015. In non-PMI-supported states, knowledge of malaria remained relatively stable during this time period, although improvements were observed in knowledge of ITNs as a prevention method. Generally, knowledge levels were similar in PMI- and non-PMI states by 2015. There was greater improvement in exposure to malaria SBC messages in PMI-supported states between 2010 and 2015, compared to non-PMI-supported states; with recall of specific malaria messages higher overall in PMI-supported states in 2015.

Coverage of vector control interventions (ITNs and IRS) generally improved between 2008 and 2015 in both PMI- and non-PMI-supported states; however, ITN use across all populations was significantly higher in PMI-supported states by 2015. IPTp coverage improved between 2008 and 2015, but overall coverage remained low in both PMI- and non-PMI-supported states in 2015, with only slightly higher coverage in PMI-supported states. Timely care-seeking for fever and diagnostic testing coverage showed only slight improvements between 2008/2010 and 2015, with overall coverage remaining low in 2015 in both PMI- and non-PMI-supported states. ACT treatment coverage improved significantly between 2008 and 2015 and was slightly higher in PMI-supported states in 2015. Malaria morbidity decreased significantly in both PMI- and non-PMI-supported states between 2010 and 2015. In 2015, however, parasitemia prevalence was significantly lower in non-PMI-supported states, and severe anemia prevalence was similar in both PMI- and non-PMI-supported states. In general, there were improvements in malaria intervention coverage across both PMI- and non-PMI-supported states between 2008/2010 and 2015, but PMI-supported states showed greater improvements across a number of key malaria indicators, compared to non-PMI-supported states.

5.3 Relationship Between ITN Ownership and ITN Use and Parasitemia and Severe Anemia Prevalence

The results from the multiple regression analysis exploring the relationship between ITN ownership and use and parasitemia prevalence demonstrated a significant protective effect for ITNs acquired by households in the past 2–12 months. ITNs that were newly acquired (owned for less than two months) or had been acquired more than a year ago did not demonstrate a significant protective effect. Lack of a protective effect for newly acquired ITNs may reflect that nets may not have been in use when a child first got malaria, given the incubation period of the disease. In addition, for ITNs owned for more than a year, this could be an indication that the nets were no longer in good condition (for example, they have more holes) or an indication of a decrease in the novelty factor; with interest in use waning over time. No significant association was observed between household ITN access or ITN use and parasitemia prevalence. The absence of a protective effect for household ITN access could be due to lower overall coverage in the sampled population (35 percent), or a diluted effect if many of the ITNs owned by the household were either newly acquired (less than two months ago) after a child had already been infected or were acquired more than a year ago and were no longer in good condition. The lack of a significant protective effect for ITN use is likely because the indicator assesses use the night before the survey and not for a longer period of time.

The multiple regression analysis examining the relationship between moderate anemia prevalence and household ITN ownership and use did not show a protective effect. This is most likely due to other factors having a greater influence on moderate anemia, such as iron deficiency, deficiencies in other nutrients, and other diseases that cause anemia (Florey, 2012). The results from the analyses assessing the relationship between ITN ownership and ITN use demonstrated a significant protective effect between severe anemia prevalence and ITN use among children 6–59 months of age. Although no significant association was found between the three models assessing ITN ownership (ownership of at least one ITN, ITN ownership by age of net, and household ITN access) and severe anemia prevalence, the results suggest a trend toward a protective effect of these interventions.

5.4 Relationship Between Maternal Malaria SBC Exposure and Key Malaria Behavioral Outcomes

The results from the multiple regression analyses and the case-control study examining the relationship between maternal exposure to malaria-related SBC messages and ITN use (among children under five years of age and among pregnant women), care-seeking from a health provider for children with fever, and IPTp uptake all showed positive effects between maternal exposure to malaria messages and uptake of these key malaria preventive behaviors. These results indicate the positive effect that SBC interventions can have on improving key malaria prevention behaviors in higher-risk populations, specifically among young children and pregnant women.

5.5 Subnational Profiling of Malaria Interventions and Malaria Morbidity Outcomes

The subnational profiling using the CHAID analyses revealed that the greatest predictor of ITN ownership and use in Nigeria is region of the country, highlighting the substantial variation in coverage of this intervention across the country, with greater overall coverage in the Northern regions and lower coverage in the southern regions. Other important predictors of ITN ownership and use in the models were education level of either the mother or household head, place of residence, household wealth quintile, and household size. Overall, the results indicate that there is generally lower ownership and use of ITNs among those living in urban areas and from the wealthier households. Education level of the mother or household head has a more nuanced relationship with ITN ownership and use. In poorer households, a higher education level is typically associated with greater ITN ownership and use; in wealthier households, there is generally lower ITN ownership and use among those with a higher education level. Household size also plays an important role, with greater use observed in smaller households, suggesting that there are likely insufficient numbers of ITNs at the household level in larger homes to cover all the people in the household. To improve overall ITN ownership and coverage at the national level, efforts will need to focus on targeting the subnational populations identified in the CHAID models—which generally are representative of those from the southern regions, households in the wealthier quintiles, and medium-size and large-size households in which there are insufficient ITNs to cover household members.

For IPTp, place of residence was the greatest predictor of uptake, with lower coverage among women residing in rural areas and higher coverage among women residing in urban areas. Education level and region of the country were also important predictors of IPTp uptake. IPTp was generally lower in urban areas in the three southern regions of the country, but coverage was more variable between the North and South regions in rural areas. A higher education level was associated with higher IPTp coverage in rural and urban areas. Similar to IPTp, the most significant predictor of ACT treatment coverage was place of residence, with lower treatment coverage observed in rural areas. Mother's education level was also a significant predictor, with lower levels of treatment coverage associated with a lower level of education. These results suggest that one of the key barriers to uptake of IPTp and ACT treatment coverage is likely access to health facilities in rural areas. Thus, to increase overall coverage at the national level, resources will need to be targeted to improve uptake of these interventions in rural areas and among women with lower education levels.

The CHAID results revealed that the most significant predictor of exposure to malaria SBC messages was household wealth quintile; with greater levels of exposure associated with increasing household wealth. In each of the wealth quintiles, the best predictor of exposure varied—from region, to place of residence, to women's age group—indicating a more complex and nuanced relationship between household wealth and other factors on women's exposure to SBC messages. The gain index results indicate that more precise targeting of SBC interventions across different subgroups will be needed to improve overall national exposure to malaria risk and prevention messages.

The best predictor of parasitemia and severe anemia in children 6–59 months of age was household wealth quintile, with increasing household wealth associated with lower levels of malaria morbidity. Age of the child was also a significant predictor of both parasitemia and severe anemia, with generally greater morbidity in older children, compared to younger children. Region of the country also was a significant predictor, but morbidity levels across the regions varied based on household wealth quintile. The results overall indicate that to achieve significant reductions in malaria morbidity, more emphasis will need to be made on improving intervention coverage and access for children and households in the poorer wealth quintiles across the different regions of the country.

6. CONCLUSION AND RECOMMENDATIONS

The results from this research study highlight the substantial improvements in malaria intervention coverage and reductions in malaria morbidity between 2008 and 2015. There have been some greater gains in intervention coverage in PMI-supported states, specifically in vector control and IPTp coverage. Despite the significant gains experienced, however, large gaps remain to be filled to attain the set 2020 national targets for malaria intervention coverage and malaria morbidity reduction. The subnational profiling results provide important guidance on where the scale-up of malaria control interventions should be targeted to have the greatest impact—both in terms of targeting those at greatest risk for malaria and making the greatest gains in coverage to achieve the 2020 national targets.

Table 35. Summary of recommendations by thematic area

	Thematic area	Key issues	Recommendations
1	Coverage of vector control interventions (ITNs/LLINs)	• Coverage of household ITN ownership, access, and use has improved between 2008 and 2015, with generally greater improvements in PMI-supported states; however, coverage levels are far below the national targets. • Household ITN ownership and use was substantially lower in the southern regions and among several subpopulations identified.	• Continue carrying out ITN distribution using mass campaigns and targeted distribution through ANC and schools, with a focus on targeted distribution among the identified subgroups with lower coverage and uptake. • Consider use of rapid surveys to track ITN ownership, access, and use among identified subgroups with lower ownership coverage and use of ITNs, and identify barriers to ownership and use.
2	Coverage of IPTp	• IPTp coverage has improved between 2008 and 2015, in both PMI- and non-PMI-supported states; however, coverage levels are far below the national targets. • IPTp coverage was substantially lower among pregnant women from rural areas across all regions of the country, with low levels of education, and among pregnant women from urban areas in the South West and South South regions.	• Integrate routine monitoring of quality of ANC into supervisory visits at primary healthcare (PHC) facilities, to identify and address issues related low administration of IPTp. Prioritize routine monitoring, mentoring, and refresher trainings for health providers on malaria in pregnancy care from identified subpopulations with substantially lower IPTp coverage. • Consider conducting operational research to understand health providers' perspectives on low uptake of IPTp at PHCs; target this research to the locations of subgroups identified with lower IPTp coverage.
3	Malaria case management	• Small improvements in diagnostic testing coverage have been made between 2010 and 2015; however, coverage levels remain far below national targets. • Trends in care-seeking for children under five with fever have fluctuated between 2008 and 2015, with overall small improvements during this time period. Prompt care-seeking for children with fever has also improved over the same time period; however, coverage levels overall are low. • Substantial improvements have been observed in ACT treatment coverage among children with fever between 2008 and 2015; however, coverage levels remain far below national targets. ACT treatment coverage was substantially lower among children from	• Integrate routine monitoring of quality of care into supervisory visits at PHC facilities, to identify and address issues related to proper malaria case management. Prioritize routine monitoring, mentoring, and refresher trainings for health providers in rural PHC facilities. • Tailor SBC communication interventions and messages to reinforce timely care-seeking for fever, to demand diagnostic testing for fever at PHC facilities, and to improve knowledge of ACT treatment for malaria. Prioritize SBC communication messages in rural areas among women of reproductive age who have less formal education.

	Thematic area	Key issues	Recommendations
		rural areas, with the lowest coverage among those whose mother had no formal education.	
4	SBC intervention coverage	• Study findings suggest a positive association between maternal exposure to malaria SBC messages and ITN use among children under five years of age, ITN use among pregnant women, and uptake of IPTp. However, maternal exposure to malaria messages nationally was low overall, and coverage is uneven, with large differences by place of residence, region, and wealth quintile.	• Consider conducting operational research to understand which sources or messages are the most effective in positively influencing uptake or use of malaria preventions interventions to inform future SBC programming. • Prioritize and target SBC communication interventions to the following subpopulations to improve overall coverage and equity of coverage: women from rural areas across all regions except the North Central region, women from households in the middle wealth quintile, and women from the North West and South West regions from households in the lowest wealth quintile.
5	Malaria morbidity burden	• National parasitemia and severe anemia levels have shown significant reductions between 2010 and 2015 and are close to or at national target levels. However, reductions have been very uneven and unequitable across the country, with children from households in the lowest wealth quintiles experiencing the highest malaria burden.	• Integrate routine monitoring of quality of malaria case management care into supervisory visits at PHC facilities to identify and address issues related to proper malaria case management, particularly among subpopulations in the lowest wealth quintiles. • Ensure optimal coverage of malaria prevention interventions, such as ITN ownership and use, among subpopulations from the lowest wealth quintiles.

7. REFERENCES

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APPENDIX A. KEY OUTCOME INDICATORS ASSESSED IN THIS RESEARCH STUDY

Outcome indicators	Indicator description
Knowledge and behavior change communication	Percentage of women 15–49 years of age with knowledge of correct cause of malaria
	Percentage of women 15–49 years of age with knowledge of correct treatment of malaria
	Percentage of women 15–49 years of age with knowledge of symptoms of malaria
	Percentage of women 15–49 years of age with knowledge of how to prevent malaria
	Percentage of women 15-49 years of age who have been exposed to malaria behavior change communication messages
Vector control: Insecticide-treated nets (ITNs) and indoor residual spraying (IRS)	Percentage of households with at least one ITN
	Percentage of households with at least one ITN for every two people
	Percentage of households that own less than one ITN for every two household members
	Percentage of population with access to an ITN within their household
	Percentage of population who slept under an ITN the previous night
	Percentage of population who slept under an ITN the previous night among those with access to an ITN
	Percentage of children under five years of age who slept under an ITN the previous night
	Percentage of existing ITNs used the previous night
	Percentage of households with at least one ITN or sprayed by IRS in the last 12 months
	Percentage of households with at least one ITN for every two people or sprayed by IRS within the last 12 months
Prevention and control of malaria in pregnant women	Percentage of pregnant women who slept under an ITN the previous night
	Percentage of women who received intermittent preventive treatment (at least three doses of sulfadoxine-pyrimethamine) for malaria during antenatal care visits during their last pregnancy
Diagnosis	Percentage of children under five years of age with fever in the last two weeks who had a finger or heel stick
Treatment	Percentage of children under five years of age with fever in the last two weeks for whom advice or treatment was sought from a health provider
	Percentage of children under five years of age with fever in last two weeks who received first-line treatment according to national policy, among the children who received any antimalarial
Morbidity indicators	Malaria parasitemia prevalence: Percentage of children 6–59 months of age with malaria infection (measured via microscopy and rapid diagnostic tests)
	Moderate anemia prevalence: Percentage of children 6–59 months of age with a hemoglobin measurement of 8–9.9 g/dL
	Severe anemia prevalence: Percentage of children 6–59 months of age with a hemoglobin measurement of <8 g/dL

APPENDIX B. RESULTS TABLES FOR RESEARCH OBJECTIVES 1–4

Research Objective 1 Tables

Table 1. Household ownership of at least one ITN, by state (2015)

Zone/state	Indicator: Percentage of households that own at least one ITN					% point difference between state and national estimate	Indicator: Percentage of households that do not own any ITNs					% point difference between state and national estimate
	%	LCI	UCI	SE	N		%	LCI	UCI	SE	N	
North Central												
Benue	41.7	34.7	49.1	3.7	313	-27.1	58.3	50.9	65.3	3.7	313	27.1
FCT Abuja	45.1	34.5	56.2	5.6	41	-23.7	54.9	43.8	65.5	5.6	41	23.7
Kogi	54.7	44.5	64.5	5.2	174	-14.1	45.3	35.5	55.5	5.2	174	14.1
Kwara	37.7	28.6	47.9	5	195	-31.1	62.3	52.1	71.4	5	195	31.1
Nassarawa	76.4	70.6	81.4	2.8	92	7.6	23.6	18.6	29.4	2.8	92	-7.6
Niger	61.2	46.1	74.4	7.4	293	-7.6	38.8	25.6	53.9	7.4	293	7.6
Plateau	78.3	60.5	89.4	7.4	202	9.5	21.7	10.6	39.5	7.4	202	-9.5
North East												
Adamawa	70.6	50.6	84.9	9	150	1.8	29.4	15.1	49.4	9	150	-1.8
Bauchi	97.3	92.3	99.1	1.5	235	28.5	2.7	0.9	7.7	1.5	235	-28.5
Borno	64.1	48	77.5	7.7	48	-4.7	35.9	22.5	52	7.7	48	4.7
Gombe	86.9	81.9	90.6	2.2	122	18.1	13.1	9.4	18.1	2.2	122	-18.1
Taraba	52.9	41.9	63.6	5.6	128	-15.9	47.1	36.4	58.1	5.6	128	15.9
Yobe	82.6	53.8	95.1	10.2	161	13.8	17.4	4.9	46.2	10.2	161	-13.8
North West												
Jigawa	95.4	89.6	98	2	301	26.6	4.6	2	10.4	2	301	-26.6
Kaduna	91.6	80.9	96.6	3.7	274	22.8	8.4	3.4	19.1	3.7	274	-22.8
Kano	88	80	93.1	3.3	423	19.2	12	6.9	20	3.3	423	-19.2
Katsina	97.1	94.5	98.5	1	409	28.3	2.9	1.5	5.5	1	409	-28.3
Kebbi	86.7	72.6	94.1	5.3	200	17.9	13.3	5.9	27.4	5.3	200	-17.9
Sokoto	77.3	67.3	84.9	4.5	157	8.5	22.7	15.1	32.7	4.5	157	-8.5
Zamfara	88.6	76.1	95	4.6	229	19.8	11.4	5	23.9	4.6	229	-19.8

Zone/state	Indicator: Percentage of households that own at least one ITN					% point difference between state and national estimate	Indicator: Percentage of households that do not own any ITNs					% point difference between state and national estimate
	%	LCI	UCI	SE	N		%	LCI	UCI	SE	N	
South East												
Abia	51.9	41.4	62.1	5.3	134	-16.9	48.1	37.9	58.6	5.3	134	16.9
Anambra	74.8	60.8	85	6.2	234	6	25.2	15	39.2	6.2	234	-6
Ebonyi	88.9	78.9	94.5	3.8	151	20.1	11.1	5.5	21.1	3.8	151	-20.1
Enugu	56.6	41.7	70.3	7.5	165	-12.2	43.4	29.7	58.3	7.5	165	12.2
Imo	45.9	39.1	52.8	3.5	192	-22.9	54.1	47.2	60.9	3.5	192	22.9
South South												
Akwa Ibom	74.2	58.7	85.3	6.8	204	5.4	25.8	14.7	41.3	6.8	204	-5.4
Bayelsa	45.4	36.3	54.7	4.7	120	-23.4	54.6	45.3	63.7	4.7	120	23.4
Cross River	82.7	62	93.4	7.8	180	13.9	17.3	6.6	38	7.8	180	-13.9
Delta	43.2	31.6	55.6	6.2	160	-25.6	56.8	44.4	68.4	6.2	160	25.6
Edo	38.7	31.7	46.2	3.7	153	-30.1	61.3	53.8	68.3	3.7	153	30.1
Rivers	75.4	61.5	85.5	6.1	337	6.6	24.6	14.5	38.5	6.1	337	-6.6
South West												
Ekiti	73.4	67.6	78.4	2.8	138	4.6	26.6	21.6	32.4	2.8	138	-4.6
Lagos	44.3	36.5	52.3	4	314	-24.5	55.7	47.7	63.5	4	314	24.5
Ogun	39.1	27.6	51.9	6.3	172	-29.7	60.9	48.1	72.4	6.3	172	29.7
Ondo	50.1	39.3	60.8	5.5	248	-18.7	49.9	39.2	60.7	5.5	248	18.7
Osun	65.7	54.8	75.1	5.2	300	-3.1	34.3	24.9	45.2	5.2	300	3.1
Oyo	51.3	43.7	58.8	3.8	396	-17.5	48.7	41.2	56.3	3.8	396	17.5
Total (national)	**68.8**	**66.9**	**70.7**	**1**	**7,745**		**31.2**	**29.3**	**33.1**	**1**	**7,745**	

Table 2. Household access to ITNs, by state (2015)

Indicator: Percentage of households with at least one ITN for every two people

Zone/state	%	LCI	UCI	SE	N	% point difference between state and national estimate
North Central						
Benue	15.6	10.5	22.5	3.0	313	-19.3
FCT Abuja	23.4	15	34.7	5.0	41	-11.5
Kogi	20.2	13.2	29.6	4.2	174	-14.7
Kwara	13.6	8.8	20.6	3.0	195	-21.3
Nassarawa	33	23.7	43.8	5.2	92	-1.9
Niger	36.3	22.5	52.8	7.9	293	1.4
Plateau	33.6	23.8	45.2	5.5	202	-1.3
North East						
Adamawa	31.1	19.3	46.1	7.0	150	-3.8
Bauchi	53	43.2	62.5	4.9	235	18.1
Borno	11.3	3.1	33.3	7.0	47	-23.6
Gombe	37.7	30.8	45.1	3.7	122	2.8
Taraba	16.5	12.1	22.1	2.5	128	-18.4
Yobe	41.8	25.5	60.2	9.2	161	6.9
North West						
Jigawa	55.7	48.1	63.2	3.9	301	20.8
Kaduna	52.9	39.9	65.5	6.7	274	18
Kano	40.2	30.5	50.8	5.2	423	5.3
Katsina	53.7	44.9	62.3	4.4	405	18.8
Kebbi	22.1	15.2	30.9	4.0	200	-12.8
Sokoto	24	16.1	34.3	4.7	157	-10.9
Zamfara	47.3	37.6	57.1	5.0	229	12.4
South East						
Abia	29.9	21	40.6	5.0	132	-5
Anambra	47.9	35.8	60.3	6.4	234	13
Ebonyi	62.7	48.5	75	6.9	151	27.8
Enugu	19.8	13.1	28.8	4.0	165	-15.1
Imo	20.4	11.6	33.5	5.6	192	-14.5
South South						
Akwa Ibom	54.8	42.7	66.3	6.1	203	19.9
Bayelsa	22.7	18.1	28.1	2.6	120	-12.2
Cross River	55.2	37.2	71.9	9.2	179	20.3
Delta	24.3	15.4	36.2	5.3	160	-10.6
Edo	18.3	13.8	24	2.6	153	-16.6
Rivers	46.8	35.7	58.2	5.8	335	11.9
South West						
Ekiti	50.2	46.5	53.9	1.9	137	15.3
Lagos	11.8	7	19	3.0	312	-23.1
Ogun	19.2	11.4	30.4	4.8	169	-15.7
Ondo	25.7	18.8	34.1	3.9	248	-9.2
Osun	38.1	31.7	45.1	3.4	299	3.2
Oyo	18.6	11.8	28.1	4.1	396	-16.3
Total (national)	**34.9**	**33**	**36.8**	**1.0**	**7,727**	

Table 3. Gap in household access to ITNs, by state (2015)

Indicator: Percentage of households that own less than one ITN for every two household members

Zone/state	%	LCI	UCI	SE	N	% point difference between state and national estimate
North Central						
Benue	84.4	77.5	89.5	3	313	19.3
FCT Abuja	76.6	65.3	85	5	41	11.5
Kogi	79.8	70.4	86.8	4.2	174	14.7
Kwara	86.4	79.4	91.2	3	195	21.3
Nassarawa	67	56.2	76.3	5.2	92	1.9
Niger	63.7	47.2	77.5	7.9	293	-1.4
Plateau	66.4	54.8	76.2	5.5	202	1.3
North East						
Adamawa	68.9	53.9	80.7	7	150	3.8
Bauchi	47	37.5	56.8	4.9	235	-18.1
Borno	88.7	66.7	96.9	7	47	23.6
Gombe	62.3	54.9	69.2	3.7	122	-2.8
Taraba	83.5	77.9	87.9	2.5	128	18.4
Yobe	58.2	39.8	74.5	9.2	161	-6.9
North West						
Jigawa	44.3	36.8	51.9	3.9	301	-20.8
Kaduna	47.1	34.5	60.1	6.7	274	-18
Kano	59.8	49.2	69.5	5.2	423	-5.3
Katsina	46.3	37.7	55.1	4.4	405	-18.8
Kebbi	77.9	69.1	84.8	4	200	12.8
Sokoto	76	65.7	83.9	4.7	157	10.9
Zamfara	52.7	42.9	62.4	5	229	-12.4
South East						
Abia	70.1	59.4	79	5	132	5
Anambra	52.1	39.7	64.2	6.4	234	-13
Ebonyi	37.3	25	51.5	6.9	151	-27.8
Enugu	80.2	71.2	86.9	4	165	15.1
Imo	79.6	66.5	88.4	5.6	192	14.5
South South						
Akwa Ibom	45.2	33.7	57.3	6.1	203	-19.9
Bayelsa	77.3	71.9	81.9	2.6	120	12.2
Cross River	44.8	28.1	62.8	9.2	179	-20.3
Delta	75.7	63.8	84.6	5.3	160	10.6
Edo	81.7	76	86.2	2.6	153	16.6
Rivers	53.2	41.8	64.3	5.8	335	-11.9
South West						
Ekiti	49.8	46.1	53.5	1.9	137	-15.3
Lagos	88.2	81	93	3	312	23.1
Ogun	80.8	69.6	88.6	4.8	169	15.7
Ondo	74.3	65.9	81.2	3.9	248	9.2
Osun	61.9	54.9	68.3	3.4	299	-3.2
Oyo	81.4	71.9	88.2	4.1	396	16.3
Total (national)	**65.1**	**63.2**	**67**	**1**	**7,727**	

Table 4. Population access to ITNs by state (2015)

Indicator: Percentage of population with access to an ITN within their household

Zone/state	%	LCI	UCI	SE	N	% point difference between state and national estimate
North Central						
Benue	30.1	23.0	37.3	3.6	1,397	-24.6
FCT Abuja	34.1	19.9	48.4	7.2	191	-20.6
Kogi	37.7	26.5	49.0	5.7	831	-17.0
Kwara	26.4	17.9	35.0	4.3	872	-28.3
Nassarawa	56.8	53.2	60.3	1.8	580	2.1
Niger	44.4	30.4	58.4	7.1	1,406	-10.3
Plateau	57.7	44.6	70.8	6.6	1,189	3.0
North East						
Adamawa	48.8	29.3	68.4	9.9	904	-5.9
Bauchi	75.2	70.2	80.3	2.6	1,457	20.5
Borno	41.6	30.3	52.9	5.7	271	-13.1
Gombe	68.8	63.9	73.7	2.5	761	14.1
Taraba	32.8	23.9	41.8	4.5	684	-21.9
Yobe	66.5	52.7	80.2	7.0	986	11.8
North West						
Jigawa	75.9	73.0	78.8	1.5	1,793	21.2
Kaduna	74.6	62.9	86.3	5.9	1,596	19.9
Kano	67.3	60.2	74.3	3.6	2,386	12.6
Katsina	73.7	68.2	79.2	2.8	2,601	19.0
Kebbi	49.5	38.3	60.8	5.7	1,214	-5.2
Sokoto	46.7	40.1	53.3	3.3	816	-8.0
Zamfara	69.3	62.8	75.9	3.3	1,417	14.6
South East						
Abia	40.1	30.0	50.2	5.1	516	-14.6
Anambra	61.5	49.3	73.7	6.2	915	6.8
Ebonyi	76.6	66.8	86.5	5.0	755	21.9
Enugu	41.4	31.6	51.2	5.0	655	-13.3
Imo	31.9	23.7	40.1	4.2	819	-22.8
South South						
Akwa Ibom	68.1	56.5	79.7	5.9	796	13.4
Bayelsa	35.1	26.9	43.4	4.2	535	-19.6
Cross River	72.3	59.0	85.6	6.7	662	17.6
Delta	33.6	23.8	43.4	5.0	634	-21.1
Edo	31.7	25.1	38.4	3.4	602	-23.0
Rivers	64.4	52.9	75.9	5.8	1,334	9.7
South West						
Ekiti	62.9	57.9	68.0	2.6	496	8.2
Lagos	28.0	22.6	33.4	2.7	1,402	-26.7
Ogun	29.7	18.7	40.8	5.6	637	-25.0
Ondo	36.5	24.8	48.1	5.9	806	-18.2
Osun	53.9	45.8	62.0	4.1	1,074	-0.8
Oyo	43.7	36.5	50.9	3.7	1,685	-11.0
Total (national)	**54.7**	**52.9**	**56.5**	**0.9**	**3,7675**	

Table 5. Population use of ITNs by state (2015)

Zone/state	Indicator: Percentage of population that slept under an ITN the previous night					% point difference between state and national estimate	Indicator: Percentage of population that did not sleep under an ITN the previous night					% point difference between state and national estimate
	%	LCI	UCI	SE	N		%	LCI	UCI	SE	N	
North Central												
Benue	24.6	19.4	30.7	2.9	1,397	-12.7	75.4	69.3	80.6	2.9	1,397	12.7
FCT Abuja	17.4	8.6	32	5.9	191	-19.9	82.6	68	91.4	5.9	191	19.9
Kogi	22.3	13.1	35.4	5.7	831	-15	77.7	64.6	86.9	5.7	831	15
Kwara	16.6	9	28.5	4.9	872	-20.7	83.4	71.5	91	4.9	872	20.7
Nassarawa	44.4	39.6	49.3	2.5	580	7.1	55.6	50.7	60.4	2.5	580	-7.1
Niger	38	26.7	50.7	6.2	1,406	0.7	62	49.3	73.3	6.2	1,406	-0.7
Plateau	38.4	23.1	56.4	8.8	1,189	1.1	61.6	43.6	76.9	8.8	1,189	-1.1
North East												
Adamawa	31.6	19	47.8	7.5	904	-5.7	68.4	52.2	81	7.5	904	5.7
Bauchi	59.2	49.7	68.1	4.7	1,457	21.9	40.8	31.9	50.3	4.7	1,457	-21.9
Borno	57.5	46.9	67.5	5.3	271	20.2	42.5	32.5	53.1	5.3	271	-20.2
Gombe	33.6	26.6	41.4	3.8	761	-3.7	66.4	58.6	73.4	3.8	761	3.7
Taraba	27.3	19.3	37.2	4.6	684	-10	72.7	62.8	80.7	4.6	684	10
Yobe	55.9	43.7	67.4	6.1	986	18.6	44.1	32.6	56.3	6.1	986	-18.6
North West												
Jigawa	75.5	68	81.7	3.5	1,793	38.2	24.5	18.3	32	3.5	1,793	-38.2
Kaduna	61.6	50.4	71.6	5.5	1,596	24.3	38.4	28.4	49.6	5.5	1,596	-24.3
Kano	43.8	33.8	54.4	5.3	2,386	6.5	56.2	45.6	66.2	5.3	2,386	-6.5
Katsina	53.6	43.4	63.6	5.2	2,601	16.3	46.4	36.4	56.6	5.2	2,601	-16.3
Kebbi	37.6	26.8	49.8	6	1,214	0.3	62.4	50.2	73.2	6	1,214	-0.3
Sokoto	48.7	35.7	62	6.8	816	11.4	51.3	38	64.3	6.8	816	-11.4
Zamfara	56.6	49.8	63.2	3.4	1,417	19.3	43.4	36.8	50.2	3.4	1,417	-19.3
South East												
Abia	7	3.9	12.3	2.1	516	-30.3	93	87.7	96.1	2.1	516	30.3
Anambra	24.1	17.8	31.7	3.5	915	-13.2	75.9	68.3	82.2	3.5	915	13.2
Ebonyi	50	32.2	67.8	9.5	755	12.7	50	32.2	67.8	9.5	755	-12.7
Enugu	14.1	9.1	21.2	3	655	-23.2	85.9	78.8	90.9	3	655	23.2
Imo	5.9	3.9	8.9	1.2	819	-31.4	94.1	91.1	96.1	1.2	819	31.4
South South												
Akwa Ibom	36.8	25	50.5	6.6	796	-0.5	63.2	49.5	75	6.6	796	0.5
Bayelsa	18.2	12.5	25.9	3.4	535	-19.1	81.8	74.1	87.5	3.4	535	19.1
Cross River	49.6	36.7	62.5	6.7	662	12.3	50.4	37.5	63.3	6.7	662	-12.3
Delta	18.1	13.4	24	2.7	634	-19.2	81.9	76	86.6	2.7	634	19.2

Zone/state	Indicator: Percentage of population that slept under an ITN the previous night					% point difference between state and national estimate	Indicator: Percentage of population that did not sleep under an ITN the previous night					% point difference between state and national estimate
	%	LCI	UCI	SE	N		%	LCI	UCI	SE	N	
Edo	10.7	6.1	18	3	602	-26.6	89.3	82	93.9	3	602	26.6
Rivers	31.7	18.4	49	8	1,334	-5.6	68.3	51	81.6	8	1,334	5.6
South West												
Ekiti	27.3	19.9	36.3	4.2	496	-10	72.7	63.7	80.1	4.2	496	10
Lagos	11.1	8.2	14.7	1.6	1,402	-26.2	88.9	85.3	91.8	1.6	1,402	26.2
Ogun	12.2	5.2	26.1	5.1	637	-25.1	87.8	73.9	94.8	5.1	637	25.1
Ondo	20.1	10.8	34.3	6	806	-17.2	79.9	65.7	89.2	6	806	17.2
Osun	21.4	13.8	31.6	4.5	1,074	-15.9	78.6	68.4	86.2	4.5	1,074	15.9
Oyo	31.4	28	35	1.8	1,685	-5.9	68.6	65	72	1.8	1,685	5.9
Total (national)	**37.3**	**35.4**	**39.3**	**1**	**37,674**		**62.7**	**60.7**	**64.6**	**1**	**37,674**	

Table 6. Population use of ITNs among those with access to an ITN, by state (2015)
Indicator: Percentage of population that slept under an ITN the previous night among those with access to an ITN

Zone/state	%	LCI	UCI	SE	N	% point difference between state and national estimate
North Central						
Benue	67.7	45.2	84.2	10.4	181	3.2
FCT Abuja	53.2	39	66.9	7.3	37	-11.3
Kogi	58.1	38.6	75.4	9.8	138	-6.4
Kwara	57.8	28.4	82.5	15.3	86	-6.7
Nassarawa	70.9	61	79.2	4.7	150	6.4
Niger	79.6	65.6	88.9	5.9	356	15.1
Plateau	58.7	36.3	77.9	11.2	299	-5.8
North East						
Adamawa	59	50.2	67.2	4.3	203	-5.5
Bauchi	81.7	72.7	88.2	3.9	549	17.2
Borno	93.6	83.4	97.7	3.3	17	29.1
Gombe	53.4	41.4	65	6.1	247	-11.1
Taraba	73.8	66.4	80.1	3.5	67	9.3
Yobe	75.9	69	81.7	3.2	289	11.4
North West						
Jigawa	89.7	82.2	94.2	3	744	25.2
Kaduna	83.3	71	91.1	5.1	704	18.8
Kano	60.7	42.7	76.2	8.8	686	-3.8
Katsina	78	69.6	84.6	3.8	979	13.5
Kebbi	66.3	55.4	75.6	5.2	151	1.8
Sokoto	84.6	69.3	93	5.9	110	20.1
Zamfara	74.2	66.8	80.4	3.5	505	9.7
South East						
Abia	16.1	9.7	25.5	4	119	-48.4
Anambra	36.7	27.4	47.1	5.1	366	-27.8
Ebonyi	62.9	44	78.5	9.1	404	-1.6
Enugu	36.2	27.4	46.1	4.8	88	-28.3
Imo	10.7	3.6	27.3	5.5	108	-53.8
South South						
Akwa Ibom	54.2	43.2	64.8	5.6	395	-10.3
Bayelsa	50.4	39.4	61.3	5.7	104	-14.1
Cross River	65.6	54.8	74.9	5.2	314	1.1
Delta	52.7	37.6	67.3	7.8	128	-11.8
Edo	21.9	13.7	33	4.9	79	-42.6
Rivers	49.3	30.9	68	9.9	511	-15.2
South West						
Ekiti	39.1	26.9	52.9	6.8	206	-25.4
Lagos	46.1	25.9	67.7	11.3	113	-18.4
Ogun	29.9	13	54.9	11.2	98	-34.6
Ondo	54.4	38.4	69.5	8.2	153	-10.1
Osun	39	29.9	49	4.9	313	-25.5
Oyo	62.1	50.8	72.1	5.5	299	-2.4
Total (national)	**64.5**	**61.6**	**67.2**	**1.4**	**10,297**	

Note: "Access" is defined as having at least one ITN for every two people.

Table 7. Children under five use of ITNs by state (2015)

Zone/state	Indicator: Percentage of children under five years of age who slept under an ITN the previous night					% point difference between state and national estimate	Indicator: Percentage of children under five years of age who did not sleep under an ITN the previous night					% point difference between state and national estimate
	%	LCI	UCI	SE	N		%	LCI	UCI	SE	N	
North Central												
Benue	37.2	27.7	47.8	5.2	268	-6.4	62.8	52.2	72.3	5.2	268	6.4
FCT Abuja	18.5	10.1	31.5	5.4	30	-25.1	81.5	68.5	89.9	5.4	30	25.1
Kogi	32	22.6	43.1	5.3	156	-11.6	68	56.9	77.4	5.3	156	11.6
Kwara	20.6	11.2	34.8	6	160	-23	79.4	65.2	88.8	6	160	23
Nassarawa	47.9	37.3	58.7	5.5	122	4.3	52.1	41.3	62.7	5.5	122	-4.3
Niger	39.1	27.3	52.3	6.5	295	-4.5	60.9	47.7	72.7	6.5	295	4.5
Plateau	54.1	33.9	73	10.5	273	10.5	45.9	27	66.1	10.5	273	-10.5
North East												
Adamawa	32.4	17.6	51.8	9	170	-11.2	67.6	48.2	82.4	9	170	11.2
Bauchi	67.2	54.5	77.8	6	299	23.6	32.8	22.2	45.5	6	299	-23.6
Borno	57	46.7	66.8	5.2	40	13.4	43	33.2	53.3	5.2	40	-13.4
Gombe	40.2	32.6	48.3	4	131	-3.4	59.8	51.7	67.4	4	131	3.4
Taraba	33.1	20.6	48.6	7.3	147	-10.5	66.9	51.4	79.4	7.3	147	10.5
Yobe	56	45.3	66.2	5.4	200	12.4	44	33.8	54.7	5.4	200	-12.4
North West												
Jigawa	76.8	68	83.7	4	386	33.2	23.2	16.3	32	4	386	-33.2
Kaduna	66.6	53.4	77.6	6.3	282	23	33.4	22.4	46.6	6.3	282	-23
Kano	58.5	43.1	72.3	7.6	451	14.9	41.5	27.7	56.9	7.6	451	-14.9
Katsina	58.3	44.9	70.7	6.7	563	14.7	41.7	29.3	55.1	6.7	563	-14.7
Kebbi	38.8	27.7	51.1	6	197	-4.8	61.2	48.9	72.3	6	197	4.8
Sokoto	61.3	45.4	75.1	7.8	187	17.7	38.7	24.9	54.6	7.8	187	-17.7
Zamfara	67.2	60.1	73.5	3.4	215	23.6	32.8	26.5	39.9	3.4	215	-23.6
South East												
Abia	8.2	3.8	17	3.2	77	-35.4	91.8	83	96.2	3.2	77	35.4
Anambra	26.2	16.7	38.6	5.6	159	-17.4	73.8	61.4	83.3	5.6	159	17.4
Ebonyi	52	34.2	69.3	9.3	148	8.4	48	30.7	65.8	9.3	148	-8.4
Enugu	18.2	10.4	29.8	4.9	99	-25.4	81.8	70.2	89.6	4.9	99	25.4
Imo	7.1	2.9	16.2	3.1	119	-36.5	92.9	83.8	97.1	3.1	119	36.5
South South												
Akwa Ibom	39.8	28.3	52.7	6.3	117	-3.8	60.2	47.3	71.7	6.3	117	3.8
Bayelsa	18.6	11.7	28.5	4.3	125	-25	81.4	71.5	88.3	4.3	125	25
Cross River	46.7	36.6	57.1	5.3	103	3.1	53.3	42.9	63.4	5.3	103	-3.1
Delta	21.3	11.8	35.5	6	134	-22.3	78.7	64.5	88.2	6	134	22.3

Zone/state	Indicator: Percentage of children under five years of age who slept under an ITN the previous night					% point difference between state and national estimate	Indicator: Percentage of children under five years of age who did not sleep under an ITN the previous night					% point difference between state and national estimate
	%	LCI	UCI	SE	N		%	LCI	UCI	SE	N	
Edo	19.8	11.9	31.1	4.9	69	-23.8	80.2	68.9	88.1	4.9	69	23.8
Rivers	40.9	30.1	52.7	5.8	229	-2.7	59.1	47.3	69.9	5.8	229	2.7
South West												
Ekiti	31.1	20.4	44.4	6.2	92	-12.5	68.9	55.6	79.6	6.2	92	12.5
Lagos	12.5	9.5	16.3	1.7	295	-31.1	87.5	83.7	90.5	1.7	295	31.1
Ogun	18.3	7.9	37.1	7.4	120	-25.3	81.7	62.9	92.1	7.4	120	25.3
Ondo	21.1	11.8	34.8	5.9	137	-22.5	78.9	65.2	88.2	5.9	137	22.5
Osun	23	13.4	36.6	5.9	166	-20.6	77	63.4	86.6	5.9	166	20.6
Oyo	33.5	25.2	43	4.6	246	-10.1	66.5	57	74.8	4.6	246	10.1
Total (national)	**43.6**	**41.1**	**46.2**	**1.3**	**7,008**		**56.4**	**53.8**	**58.9**	**1.3**	**7,008**	

Table 8. Pregnant women use of ITNs by state (2015)

Zone/state	Indicator: Percentage of pregnant women who slept under an ITN the previous night					% point difference between state and national estimate	Indicator: Percentage of pregnant women who did not sleep under an ITN the previous night					% point difference between state and national estimate
	%	LCI	UCI	SE	N		%	LCI	UCI	SE	N	
North Central												
Benue	38.2	17.8	63.9	12.6	24	-10.8	61.8	36.1	82.2	12.6	24	10.8
FCT Abuja	19.3	3.2	63.6	15.7	1	-29.7	80.7	36.4	96.8	15.7	1	29.7
Kogi	34.6	12.3	66.7	15.3	13	-14.4	65.4	33.3	87.7	15.3	13	14.4
Kwara	16.6	4.8	44	9.7	18	-32.4	83.4	56	95.2	9.7	18	32.4
Nassarawa	51.9	41.1	62.5	5.5	13	2.9	48.1	37.5	58.9	5.5	13	-2.9
Niger	43.1	26.7	61.1	9.1	34	-5.9	56.9	38.9	73.3	9.1	34	5.9
Plateau	41	19.8	66.2	12.7	26	-8	59	33.8	80.2	12.7	26	8
North East												
Adamawa	35.7	20.2	54.8	9.1	20	-13.3	64.3	45.2	79.8	9.1	20	13.3
Bauchi	64.6	47.9	78.3	7.9	46	15.6	35.4	21.7	52.1	7.9	46	-15.6
Borno	57.6	42.1	71.7	7.7	7	8.6	42.4	28.3	57.9	7.7	7	-8.6
Gombe	52.4	43.5	61.2	4.6	19	3.4	47.6	38.8	56.5	4.6	19	-3.4
Taraba	33.3	19.3	51	8.3	18	-15.7	66.7	49	80.7	8.3	18	15.7
Yobe	70.1	53.4	82.8	7.6	29	21.1	29.9	17.2	46.6	7.6	29	-21.1
North West												
Jigawa	85.7	71.6	93.5	5.4	71	36.7	14.3	6.5	28.4	5.4	71	-36.7
Kaduna	79.3	59.1	91	8.1	31	30.3	20.7	9	40.9	8.1	31	-30.3
Kano	54.9	32.3	75.6	11.8	67	5.9	45.1	24.4	67.7	11.8	67	-5.9
Katsina	51.7	30.8	72	11.1	62	2.7	48.3	28	69.2	11.1	62	-2.7
Kebbi	77.8	35.3	95.8	16.3	19	28.8	22.2	4.2	64.7	16.3	19	-28.8
Sokoto	59.2	45.4	71.8	6.9	24	10.2	40.8	28.2	54.6	6.9	24	-10.2
Zamfara	72.5	58.9	83	6.2	51	23.5	27.5	17	41.1	6.2	51	-23.5
South East												
Abia	9.4	3.9	20.8	4	14	-39.6	90.6	79.2	96.1	4	14	39.6
Anambra	20.2	5.7	51.7	11.8	17	-28.8	79.8	48.3	94.3	11.8	17	28.8
Ebonyi	49.4	33.6	65.4	8.4	23	0.4	50.6	34.6	66.4	8.4	23	-0.4
Enugu	18.5	7.2	39.9	8.2	8	-30.5	81.5	60.1	92.8	8.2	8	30.5

Zone/state	Indicator: Percentage of pregnant women who slept under an ITN the previous night					% point difference between state and national estimate	Indicator: Percentage of pregnant women who did not sleep under an ITN the previous night					% point difference between state and national estimate
	%	LCI	UCI	SE	N		%	LCI	UCI	SE	N	
Imo	0			0	15	-49	100			0	15	49
South South												
Akwa Ibom	62	43.1	77.9	9.2	25	13	38	22.1	56.9	9.2	25	-13
Bayelsa	10.3	3.6	26.4	5.3	16	-38.7	89.7	73.6	96.4	5.3	16	38.7
Cross River	61.1	21.6	89.9	21	11	12.1	38.9	10.1	78.4	21	11	-12.1
Delta	22.8	9.5	45.4	9.3	18	-26.2	77.2	54.6	90.5	9.3	18	26.2
Edo	0			0	5	-49	100			0	5	49
Rivers	23.2	14.3	35.4	5.4	32	-25.8	76.8	64.6	85.7	5.4	32	25.8
South West												
Ekiti	27.4	7.2	64.6	15.9	8	-21.6	72.6	35.4	92.8	15.9	8	21.6
Lagos	6.5	0.9	34.8	6.3	22	-42.5	93.5	65.2	99.1	6.3	22	42.5
Ogun	7.3	1.7	26.9	5.3	17	-41.7	92.7	73.1	98.3	5.3	17	41.7
Ondo	48	19.9	77.5	16.7	12	-1	52	22.5	80.1	16.7	12	1
Osun	32.3	10.7	65.5	15.4	14	-16.7	67.7	34.5	89.3	15.4	14	16.7
Oyo	52.5	35.3	69.2	9	47	3.5	47.5	30.8	64.7	9	47	-3.5
Total (national)	49	44.7	53.3	2.2	897		51	46.7	55.3	2.2	897	

Table 9. Use of existing ITNs by state (2015)

Indicator: Percentage of existing ITNs used the previous night

Zone/state	%	LCI	UCI	SE	N	% point difference between state and national estimate
North Central						
Benue	69.2	47.8	84.7	8.3	243	8.4
FCT Abuja	59.9	35.5	80.3	10.4	39	-0.9
Kogi	56.5	34.3	76.5	9.7	179	-4.3
Kwara	61.0	41.2	77.8	8.3	127	0.2
Nassarawa	65.2	53.1	75.7	5	189	4.4
Niger	79.5	60.5	90.7	6.5	385	18.7
Plateau	56.3	39.5	71.7	7	387	-4.5
North East						
Adamawa	70.7	59.6	79.8	4.4	246	9.9
Bauchi	76.4	63	86.1	5	639	15.6
Borno	91.2	77.6	96.9	2	58	30.4
Gombe	45.0	36.3	53.9	3.9	299	-15.8
Taraba	77.0	69.4	83.1	3	120	16.2
Yobe	88.7	82.7	92.7	2.1	370	27.9
North West						
Jigawa	83.6	71.1	91.4	4.3	834	22.8
Kaduna	88.0	74.6	94.8	4.2	703	27.2
Kano	69.1	51.6	82.5	6.9	874	8.3
Katsina	66.3	57.7	73.9	3.5	1,153	5.5
Kebbi	73.2	55.1	85.9	6.8	325	12.4
Sokoto	84.7	73.1	91.9	4	200	23.9
Zamfara	77.9	73.5	81.7	1.8	593	17.1
South East						
Abia	17.4	10.3	27.8	3.7	136	-43.4
Anambra	28.8	21.6	37.3	3.4	401	-32.0
Ebonyi	44.2	29.1	60.4	7	413	-16.6
Enugu	35.3	24.5	47.9	5.2	149	-25.5
Imo	14.4	7.4	26.3	4	163	-46.4
South South						
Akwa Ibom	37.4	28.6	47.1	4	445	-23.4
Bayelsa	34.5	24.2	46.6	4.9	116	-26.3
Cross River	57.0	43.8	69.4	5.7	335	-3.8
Delta	36.7	24.7	50.7	5.8	145	-24.1
Edo	24.7	12.8	42.3	6.5	113	-36.1
Rivers	38.4	21.7	58.3	8.3	620	-22.4
South West						
Ekiti	35.4	24.4	48.3	5.3	204	-25.4
Lagos	32.1	23.3	42.3	4.2	215	-28.7
Ogun	29.3	15.6	48.2	7.3	126	-31.5
Ondo	52.1	33.8	69.9	8.2	176	-8.7
Osun	31.7	20.7	45.3	5.4	375	-29.1
Oyo	62.5	53.2	70.9	3.9	403	1.7
Total (national)	**60.8**	**58.5**	**63.1**	**1.2**	**12,496**	

Table 10. Households covered by vector control, by state (2015)

Indicator: Percentage of households with at least one ITN or sprayed by IRS* in the last 12 months

Zone/state	%	LCI	UCI	SE	N	% point difference between state and national estimate
North Central						
Benue	41.7	34.7	49.1	3.7	313	-27.3
FCT Abuja	47.9	36.9	59.2	5.7	41	-21.1
Kogi	54.7	44.5	64.5	5.2	174	-14.3
Kwara	37.7	28.6	47.9	5	195	-31.3
Nassarawa	77	71.9	81.4	2.4	92	8
Niger	61.2	46.1	74.4	7.4	293	-7.8
Plateau	78.3	60.5	89.4	7.4	202	9.3
North East						
Adamawa	70.6	50.6	84.9	9	150	1.6
Bauchi	97.3	92.3	99.1	1.5	235	28.3
Borno	64.1	48	77.5	7.7	48	-4.9
Gombe	88.1	83	91.8	2.2	122	19.1
Taraba	53.9	44.1	63.5	5	128	-15.1
Yobe	83.1	55.5	95.1	9.8	161	14.1
North West						
Jigawa	95.4	89.6	98	2	301	26.4
Kaduna	91.6	80.9	96.6	3.7	274	22.6
Kano	88	80	93.1	3.3	423	19
Katsina	97.1	94.5	98.5	1	409	28.1
Kebbi	86.7	72.6	94.1	5.3	200	17.7
Sokoto	77.3	67.3	84.9	4.5	157	8.3
Zamfara	89.1	76.7	95.3	4.5	229	20.1
South East						
Abia	52.6	41.8	63.2	5.5	134	-16.4
Anambra	74.8	60.8	85	6.2	234	5.8
Ebonyi	88.9	78.9	94.5	3.8	151	19.9
Enugu	56.6	41.7	70.3	7.5	165	-12.4
Imo	45.9	39.1	52.8	3.5	192	-23.1
South South						
Akwa Ibom	74.3	58.9	85.4	6.8	204	5.3
Bayelsa	46.3	37.5	55.2	4.5	120	-22.7
Cross River	82.7	62	93.4	7.8	180	13.7
Delta	44.2	31.8	57.4	6.7	160	-24.8
Edo	39.2	32.2	46.6	3.7	153	-29.8
Rivers	75.4	61.5	85.5	6.1	337	6.4
South West						
Ekiti	73.4	67.6	78.4	2.8	138	4.4
Lagos	44.7	37.3	52.4	3.9	314	-24.3
Ogun	39.5	27.9	52.5	6.4	172	-29.5
Ondo	50.1	39.3	60.8	5.5	248	-18.9
Osun	66	55.2	75.3	5.1	300	-3
Oyo	51.3	43.7	58.8	3.8	396	-17.7
Total (national)	**69**	**67.1**	**70.9**	**0.9**	**7,745**	

*Indoor residual spraying is limited to spraying conducted by a government, private, or nongovernmental organization.

Table 11. ITN household access or IRS in last 12 months, by state (2015)
Indicator: Percentage of households with at least one ITN for every two people or sprayed by IRS in the last 12 months

Zone/state	%	LCI	UCI	SE	N	% point difference between state and national estimate
North Central						
Benue	16.1	10.8	23.2	3.1	313	-19.4
FCT Abuja	28.2	17.4	42.1	6.4	41	-7.3
Kogi	20.2	13.2	29.6	4.2	174	-15.3
Kwara	13.6	8.8	20.6	3	195	-21.9
Nassarawa	35.7	26.6	46	5	92	0.2
Niger	36.3	22.5	52.8	7.9	293	0.8
Plateau	33.6	23.8	45.2	5.5	202	-1.9
North East						
Adamawa	31.1	19.3	46.1	7	150	-4.4
Bauchi	54.8	45.2	64.2	4.9	235	19.3
Borno	11	3	33.2	6.9	48	-24.5
Gombe	40.8	33.5	48.5	3.8	122	5.3
Taraba	17.5	13.2	22.9	2.5	128	-18
Yobe	44.2	28	61.8	8.9	161	8.7
North West						
Jigawa	55.7	48.1	63.2	3.9	301	20.2
Kaduna	52.9	39.9	65.5	6.7	274	17.4
Kano	40.7	31.3	50.7	5	423	5.2
Katsina	53.6	44.2	62.8	4.8	409	18.1
Kebbi	24	17.9	31.3	3.4	200	-11.5
Sokoto	24	16.1	34.3	4.7	157	-11.5
Zamfara	48.2	38.6	58	5	229	12.7
South East						
Abia	30.4	21.5	41	5	134	-5.1
Anambra	50.4	38	62.7	6.4	234	14.9
Ebonyi	62.9	48.6	75.3	6.9	151	27.4
Enugu	19.8	13.1	28.8	4	165	-15.7
Imo	20.4	11.6	33.5	5.6	192	-15.1
South South						
Akwa Ibom	54.7	42.2	66.6	6.3	204	19.2
Bayelsa	24.1	19.2	29.8	2.7	120	-11.4
Cross River	55	37	71.8	9.2	180	19.5
Delta	25.3	15.9	37.8	5.6	160	-10.2
Edo	19.3	14.4	25.4	2.8	153	-16.2
Rivers	46.9	35.4	58.8	6.1	337	11.4
South West						
Ekiti	49.8	46	53.6	1.9	138	14.3
Lagos	14.1	8.4	22.8	3.6	314	-21.4
Ogun	19.3	11.6	30.3	4.7	172	-16.2
Ondo	25.7	18.8	34.1	3.9	248	-9.8
Osun	38.3	31.9	45.2	3.4	300	2.8
Oyo	18.6	11.8	28.1	4.1	396	-16.9
Total (national)	35.5	33.6	37.4	1	7,745	

Table 12. Intermittent preventive treatment in pregnancy (2+ and 3+ doses) by state (2015)

Indicator: Percentage of women who received 2+ and 3+ doses of IPTp for malaria during ANC visits during their last pregnancy

	Received 2 or more doses of IPTp						Received 3 or more doses of IPTp					
Zone/state	%	LCI	UCI	SE	N	% point difference between state and national estimate	%	LCI	UCI	SE	N	% point difference between state and national estimate
North Central												
Benue	36.8	19.4	58.5	10.5	81	-0.4	21	9.3	40.6	8	81	2
FCT Abuja	60.7	48.7	71.6	5.9	11	23.5	35.6	23.3	50	6.9	11	16.6
Kogi	58.5	47	69.1	5.7	59	21.3	38.3	26.5	51.6	6.5	59	19.3
Kwara	20	9.9	36.4	6.7	63	-17.2	14.9	6.5	30.5	5.9	63	-4.1
Nassarawa	33.3	24	44	5.1	47	-3.9	17.6	11.4	26	3.7	47	-1.4
Niger	9.5	3.4	23.4	4.7	83	-27.7	8.1	2.4	23.8	4.8	83	-10.9
Plateau	19	9.9	33.4	5.9	98	-18.2	12	5.1	25.8	5	98	-7
North East												
Adamawa	31.3	19.6	45.9	6.8	57	-5.9	21.6	14.8	30.6	4	57	2.6
Bauchi	41.7	25.3	60.1	9.2	108	4.5	18.3	8.4	35.6	6.8	108	-0.7
Borno	76.5	71.9	80.6	2.2	14	39.3	45.2	32.9	58.1	6.5	14	26.2
Gombe	50.8	37.8	63.8	6.8	49	13.6	37.7	26.6	50.4	6.2	49	18.7
Taraba	26.8	16.6	40.3	6.1	60	-10.4	20.5	11.9	32.9	5.3	60	1.5
Yobe	60.4	39.5	78.1	10.3	62	23.2	34.9	20.7	52.3	8.3	62	15.9
North West												
Jigawa	29.1	20	40.4	5.2	121	-8.1	8.2	4	16.2	2.9	121	-10.8
Kaduna	20.9	12.4	33.2	5.3	116	-16.3	16.1	8.1	29.4	5.3	116	-2.9
Kano	25.6	12.5	45.3	8.5	162	-11.6	5.9	2.9	11.5	2.1	162	-13.1
Katsina	33.9	23.1	46.7	6.1	230	-3.3	24	17.1	32.5	3.9	230	5
Kebbi	32.2	15.5	55.3	10.6	54	-5	27.6	12.2	51	10.2	54	8.6
Sokoto	28	10.8	55.5	12	52	-9.2	16.2	6.1	36.3	7.5	52	-2.8
Zamfara	28.4	17.7	42.3	6.3	80	-8.8	10.8	5.9	18.9	3.2	80	-8.2
South East												
Abia	36	20	55.8	9.5	26	-1.2	24.2	15.3	36	5.3	26	5.2
Anambra	42.9	28.9	58.1	7.6	60	5.7	20.2	12.4	31.3	4.8	60	1.2
Ebonyi	43.8	26.5	62.7	9.6	54	6.6	41	23.5	61.2	10.1	54	22
Enugu	41.9	27.1	58.5	8.2	39	4.7	35.9	22.8	51.6	7.5	39	16.9
Imo	44.8	31.7	58.6	7	46	7.6	8.5	2.8	23.2	4.7	46	-10.5
South South												
Akwa Ibom	26.1	16	39.6	6.1	40	-11.1	11.6	3.3	33.4	7	40	-7.4
Bayelsa	28	15	46.3	8.1	43	-9.2	8.7	4.8	15.3	2.6	43	-10.3
Cross River	55.5	42	68.3	6.8	37	18.3	31.2	22.5	41.4	4.8	37	12.2
Delta	13.7	5.2	31.2	6.3	51	-23.5	3.7	1.1	11.8	2.3	51	-15.3

Zone/state	Received 2 or more doses of IPTp						Received 3 or more doses of IPTp					
	%	LCI	UCI	SE	N	% point difference between state and national estimate	%	LCI	UCI	SE	N	% point difference between state and national estimate
Edo	75	60.3	85.5	6.5	25	37.8	35.9	21.3	53.6	8.5	25	16.9
Rivers	49.2	38.2	60.4	5.7	86	12	16.3	8.2	29.8	5.4	86	-2.7
South West												
Ekiti	59.1	45.3	71.5	6.8	32	21.9	45.4	27.3	64.8	10	32	26.4
Lagos	70.5	60.6	78.8	4.7	122	33.3	9.6	4.2	20.7	4	122	-9.4
Ogun	53	41.5	64.2	5.9	52	15.8	19.1	10.2	32.8	5.7	52	0.1
Ondo	35.6	20.8	53.8	8.7	54	-1.6	9.2	5.2	16	2.7	54	-9.8
Osun	30.6	20.4	43.1	5.8	70	-6.6	12.1	7.3	19.6	3.1	70	-6.9
Oyo	59.1	44.3	72.4	7.3	79	21.9	38.2	29	48.3	5	79	19.2
Total (national)	**37.2**	**34.3**	**40.2**	**1.5**	**2,522**		**19**	**17**	**21.1**	**1.1**	**2,522**	

Table 13. Diagnostic testing among children under five years of age by state (2015)
Indicator: Percentage of children under five years of age with fever in the last two weeks who had a finger or heel stick

Zone/state	%	LCI	UCI	SE	N	% point difference between state and national estimate
North Central						
Benue	9.1	1.9	34	6.9	41	-3.5
FCT Abuja	18	7.8	36.5	7.2	8	5.4
Kogi	9.8	2.3	33.7	6.9	27	-2.8
Kwara	9.1	2.9	25.1	5.1	44	-3.5
Nassarawa	25.4	20.4	31	2.7	68	12.8
Niger	11.8	3.4	33.8	7.1	84	-0.8
Plateau	19.6	12.1	30.2	4.6	81	7
North East						
Adamawa	10.2	5.6	17.7	3	74	-2.4
Bauchi	7.1	1.2	32.6	6.2	117	-5.5
Borno	0			0	6	-12.6
Gombe	3.8	1.5	9.2	1.8	54	-8.8
Taraba	14.4	7.2	26.8	4.9	72	1.8
Yobe	18.8	10.2	32	5.5	112	6.2
North West						
Jigawa	11.1	6.4	18.6	3	106	-1.5
Kaduna	16.4	9.4	26.9	4.4	100	3.8
Kano	5	2.3	10.5	1.9	236	-7.6
Katsina	13.2	7.7	21.5	3.4	300	0.6
Kebbi	8.6	5.3	13.6	2.1	70	-4
Sokoto	4.9	2.7	8.5	1.4	124	-7.7
Zamfara	7.2	3	16.4	3.1	134	-5.4
South East						
Abia	10.7	1.9	42	8.7	25	-1.9
Anambra	10.2	4.6	21.3	4	63	-2.4
Ebonyi	5.1	2	12.6	2.4	56	-7.5
Enugu	13.5	5.6	29.2	5.8	30	0.9
Imo	18.5	10.8	29.9	4.8	42	5.9
South South						
Akwa Ibom	10.9	4.7	23.1	4.4	72	-1.7
Bayelsa	6.7	3.5	12.4	2.2	52	-5.9
Cross River	10.8	2.8	34.2	7.1	48	-1.8
Delta	8.1	2.7	21.6	4.3	37	-4.5
Edo	10.7	2.5	35.7	7.4	16	-1.9
Rivers	15.2	6	33.5	6.8	76	2.6
South West						
Ekiti	16.9	7.6	33.4	6.4	15	4.3
Lagos	10	2.3	34.3	7.1	40	-2.6
Ogun	28	15.2	45.9	8	36	15.4
Ondo	28.3	12.2	52.8	10.7	36	15.7
Osun	8.9	1.9	33	6.7	39	-3.7
Oyo	58.7	33.4	80.1	12.8	60	46.1
Total (national)	**12.6**	**10.8**	**14.7**	**1.0**	**2,600**	

Table 14. Care-seeking for children under five years of age with fever, by state (2015)

Indicator: Percentage of children under five years of age with fever in the last two weeks for whom advice or treatment was sought by health provider and for whom advice or treatment was sought from a health provider the same or next day

Zone/state	Care-seeking from health provider*					% point difference between state and national estimate	Care-seeking from health provider* the same or next day					% point difference between state and national estimate
	%	LCI	UCI	SE	N		%	LCI	UCI	SE	N	
North Central												
Benue	81.3	66.7	90.4	6	41	15.2	54.1	34.3	72.8	10.3	41	18.7
FCT Abuja	80.6	60.3	91.9	8	8	14.5	27.9	18.2	40.2	5.7	8	-7.5
Kogi	93.4	81.3	97.9	3.7	27	27.3	58.7	48.7	68	5	27	23.3
Kwara	46	36.5	55.8	5	44	-20.1	18.3	10.9	29	4.6	44	-17.1
Nassarawa	83.5	69.4	91.9	5.6	68	17.4	57	48	65.6	4.5	68	21.6
Niger	81.9	69.6	90	5.1	84	15.8	35.1	24.6	47.4	5.9	84	-0.3
Plateau	75.1	65.8	82.6	4.3	81	9	44.8	35.1	54.9	5.1	81	9.4
North East												
Adamawa	55.5	41.3	68.9	7.7	74	-10.6	26.7	16.5	40.2	6.6	74	-8.7
Bauchi	89.1	76.7	95.3	5.5	117	23	39.6	28.8	51.4	6.3	117	4.2
Borno	81.3	46.1	95.7	12.6	6	15.2	60	45	73.2	7.4	6	24.6
Gombe	85.4	72.3	92.9	5.1	54	19.3	48	26.7	70	11.8	54	12.6
Taraba	50.6	42	59.2	5.1	72	-15.5	27.6	17.6	40.5	6.2	72	-7.8
Yobe	60.3	47.8	71.6	6.1	112	-5.8	41.3	28	55.9	7.3	112	5.9
North West												
Jigawa	78.1	59.9	89.4	7.6	106	12	21.6	15.9	28.6	3.2	106	-13.8
Kaduna	58.9	45.2	71.3	7.3	100	-7.2	38.2	26.3	51.6	6.5	100	2.8
Kano	85.2	74	92.1	4.4	236	19.1	61.6	43	77.3	9.2	236	26.2
Katsina	52.1	40.8	63.3	5.6	300	-14	21.4	13	33.2	5	300	-14
Kebbi	44.3	28.2	61.8	8.9	70	-21.8	35.1	19.7	54.4	9.2	70	-0.3
Sokoto	26.1	10.6	51.3	9.3	124	-40	13.5	6.5	26	4.8	124	-21.9
Zamfara	55.2	33.2	75.3	11.4	134	-10.9	18.1	10.6	29.1	4.7	134	-17.3
South East												
Abia	78.8	59.7	90.3	7.8	25	12.7	51.6	27.7	74.9	13	25	16.2
Anambra	64.7	50.6	76.6	6.7	63	-1.4	41.8	26.5	58.9	8.5	63	6.4
Ebonyi	73	57.9	84.2	6.8	56	6.9	45.8	27.7	65	10	56	10.4
Enugu	88.4	73.4	95.5	5.3	30	22.3	48.7	33.7	63.9	7.9	30	13.3
Imo	87.9	73	95.1	5.3	42	21.8	39.4	23.3	58.1	9.2	42	4
South South												
Akwa Ibom	68.9	62.3	74.7	3.2	72	2.8	17.6	6.8	38.4	7.9	72	-17.8
Bayelsa	56.3	49.6	62.7	2.8	52	-9.8	22.3	15.8	30.5	3.7	52	-13.1
Cross River	61.8	47	74.6	7.2	48	-4.3	26.5	14.4	43.6	7.6	48	-8.9

Zone/state	Care-seeking from health provider*					% point difference between state and national estimate	Care-seeking from health provider* the same or next day					% point difference between state and national estimate
	%	LCI	UCI	SE	N		%	LCI	UCI	SE	N	
Delta	61.1	50.4	70.8	5.3	37	-5	33.2	18.1	52.7	9.1	37	-2.2
Edo	76.1	53.1	90	9.6	16	10	51.7	29	73.7	12.2	16	16.3
Rivers	73.3	63.1	81.5	4.7	76	7.2	27.9	12.6	50.8	10.1	76	-7.5
South West												
Ekiti	69.4	56.3	79.9	11.5	15	3.3	52.9	35.5	69.6	10.5	15	17.5
Lagos	65.1	37.8	85.2	13	40	-1	48.8	26.3	71.9	12.5	40	13.4
Ogun	33.8	19.2	52.2	8.6	36	-32.3	2.8	0.4	18.4	2.9	36	-32.6
Ondo	59.2	39.5	76.3	9.8	36	-6.9	27.1	15.5	43	7.1	36	-8.3
Osun	70.2	47.9	85.7	10	39	4.1	33.7	14.6	60.1	12.3	39	-1.7
Oyo	83.3	67.6	92.3	6.2	60	17.2	74.2	61.2	84	5.8	60	38.8
Total (National)	**66.1**	**63.1**	**69**	**1.5**	**2,600**		**35.4**	**32.4**	**38.6**	**1.6**	**2,600**	

*Includes care sought from a public or private source, excludes shop, traditional practitioner, drug hawker, or other source.

Table 15. ACT treatment coverage, among all children with fever who received any antimalarial by state (2015)

Indicator: Percentage receiving an ACT, among children under five years of age with fever in the last two weeks who received any antimalarial treatment

Zone/state	%	LCI	UCI	SE	N	% point difference between state and national estimate
North Central						
Benue	49.4	26.8	72.3	12.5	26	11.8
FCT Abuja	67.8	48.2	82.7	9.1	4	30.2
Kogi	30.6	6.1	74.9	20.7	7	-7
Kwara	36.5	21.6	54.5	8.7	11	-1.1
Nassarawa	37	14.1	67.7	15.1	13	-0.6
Niger	48.8	10.7	88.3	26.3	10	11.2
Plateau	46	30.6	62.3	8.3	48	8.4
North East						
Adamawa	30.9	21.5	42.2	5.3	48	-6.7
Bauchi	60.3	32.1	83	14.2	28	22.7
Borno	31.6	11.7	61.8	13.7	5	-6
Gombe	7	1.6	25.3	5	33	-30.6
Taraba	13.2	4.9	31.1	6.3	33	-24.4
Yobe	39.6	23.7	58.1	9.1	59	2
North West						
Jigawa	49.9	37.4	62.4	6.5	24	12.3
Kaduna	14.5	5.8	31.8	6.4	41	-23.1
Kano	39.6	22	60.3	10.2	101	2
Katsina	42.4	25.9	60.7	9.2	116	4.8
Kebbi	8.1	2.4	24.2	4.9	32	-29.5
Sokoto	33.1	14.6	58.8	11.9	34	-4.5
Zamfara	41.5	23.1	62.5	10.6	54	3.9
South East						
Abia	12.3	5.5	25.1	4.8	16	-25.3
Anambra	66.7	39.4	86	12.7	24	29.1
Ebonyi	57	39.5	72.9	8.8	22	19.4
Enugu	37	20.2	57.7	10	13	-0.6
Imo	47.9	20.1	77.1	16.4	27	10.3
South South						
Akwa Ibom	23.6	8	52.3	11.6	19	-14
Bayelsa	14.8	7.2	28.1	5.2	20	-22.8
Cross River	73.2	42.6	90.9	13	16	35.6
Delta	25.6	4.8	70.1	18.6	11	-12
Edo	57.6	20.8	87.5	20.4	9	20
Rivers	49.9	35.4	64.5	7.6	55	12.3
South West						
Ekiti	31.6	13.2	58.3	12.2	12	-6
Lagos	17.2	6.7	37.6	7.7	28	-20.4
Ogun	37.6	16.5	64.8	13.3	15	0
Ondo	31.4	8.2	70.2	17.9	15	-6.2
Osun	33.7	12	65.4	14.9	21	-3.9
Oyo	62.3	32.5	85.1	14.7	22	24.7
Total (national)	**37.6**	**33.4**	**41.9**	**2.2**	**1,070**	

Table 16. Parasitemia prevalence among children 6–59 months of age by state (2015)

Indicator: Parasite prevalence: Percentage of children 6–59 months of age with malaria infection (via RDT and microscopy)

Zone/state	RDT					% point difference between state and national estimate	Microscopy					% point difference between state and national estimate
	%	LCI	UCI	SE	N		%	LCI	UCI	SE	N	
North Central												
Benue	55.3	36.2	73	9.8	246	10.2	44.5	35.1	54.4	5	246	17.1
FCT Abuja	38.5	18.5	63.3	12.2	26	-6.6	20.2	6.9	46.2	10	26	-7.2
Kogi	26.2	14.1	43.3	7.5	143	-18.9	5.4	2.9	9.8	1.7	131	-22
Kwara	49.7	26.2	73.4	13	122	4.6	26.4	12.8	46.5	8.8	113	-1
Nassarawa	57.1	44.2	69.1	6.5	108	12	35.9	22.4	52	7.7	106	8.5
Niger	52.9	35.3	69.8	9.1	265	7.8	33.5	20.4	49.6	7.6	254	6.1
Plateau	57.6	41.4	72.3	8.1	224	12.5	35.8	24.3	49.2	6.5	219	8.4
North East												
Adamawa	55.5	38.2	71.6	8.8	139	10.4	34.7	21.4	50.9	7.7	137	7.3
Bauchi	41.1	21.4	64.2	11.6	253	-4	19.6	8.6	38.9	7.7	241	-7.8
Borno	5.6	2.1	14.2	2.7	20	-39.5	0			0	20	-27.4
Gombe	46.5	30.2	63.6	8.8	105	1.4	28.6	14.8	48	8.7	100	1.2
Taraba	53.4	39	67.3	7.4	130	8.3	42.9	26.6	60.9	9.1	127	15.5
Yobe	29.7	16.5	47.4	8.1	178	-15.4	18.9	10.6	31.4	5.3	176	-8.5
North West												
Jigawa	58.2	38.7	75.4	9.8	336	13.1	27.9	17.8	41	6	318	0.5
Kaduna	55.2	39.6	69.8	7.9	250	10.1	36.7	20.3	57	9.7	241	9.3
Kano	60.2	35.8	80.4	12.2	376	15.1	27.7	14.1	47.2	8.6	332	0.3
Katsina	54.2	36.4	71	9.2	463	9.1	27.8	17.5	41.2	6.1	439	0.4
Kebbi	48.9	35.9	62.1	6.8	167	3.8	63.6	45.7	78.4	8.6	156	36.2
Sokoto	66	51.5	78	6.9	154	20.9	46.6	31.5	62.3	8.1	144	19.2
Zamfara	69.9	59.1	78.8	5.1	206	24.8	62.6	43.7	78.3	9.1	203	35.2
South East												
Abia	21.1	11.2	36.1	6.3	64	-24	8.2	3.8	16.8	3.1	55	-19.2
Anambra	21.1	11.6	35.1	6	127	-24	10.2	3.9	23.9	4.7	127	-17.2
Ebonyi	51.1	36.4	65.7	7.7	131	6	30	18.6	44.4	6.7	127	2.6
Enugu	35.1	24.8	46.9	5.7	89	-10	10.5	3.9	25.7	5.2	88	-16.9
Imo	24.1	12.4	41.6	7.5	105	-21	5.1	1.8	13.6	2.6	100	-22.3
South South												
Akwa Ibom	27.7	14.9	45.6	8	106	-17.4	22.8	9.4	45.5	9.3	101	-4.6
Bayelsa	36.2	23.9	50.5	6.9	109	-8.9	31.4	17.9	49	8.1	103	4
Cross River	40.7	28.5	54	6.6	90	-4.4	26.1	15.8	39.9	6.2	84	-1.3
Delta	24.7	11	46.6	9.2	116	-20.4	20.4	6.6	48.1	10.6	115	-7

Zone/state	RDT					% point difference between state and national estimate	Microscopy					% point difference between state and national estimate
	%	LCI	UCI	SE	N		%	LCI	UCI	SE	N	
Edo	35	19.4	54.5	9.3	60	-10.1	18.6	10.6	30.5	5	57	-8.8
Rivers	19.5	10.4	33.8	5.9	187	-25.6	7.3	2.2	21.5	4.3	187	-20.1
South West												
Ekiti	36	23.4	50.8	7.1	75	-9.1	28.8	19.8	39.7	5.1	73	1.4
Lagos	1.9	0.9	4.4	0.8	270	-43.2	0			0	273	-27.4
Ogun	34.6	22	49.9	7.3	101	-10.5	14.7	6.9	28.5	5.3	92	-12.7
Ondo	48.1	35	61.5	6.9	129	3	21.3	13.3	32.5	4.9	113	-6.1
Osun	54.6	36	72	9.6	138	9.5	33.4	16.8	55.5	10.3	121	6
Oyo	42.1	21.2	66.3	12.3	244	-3	19.2	8.1	39.2	7.9	221	-8.2
Total (national)	**45.1**	**41.5**	**48.8**	**1.8**	**6,050**		**27.4**	**24.7**	**30.4**	**1.4**	**5,765**	

Table 17. Moderate anemia prevalence among children 6–59 months of age by state (2015)
Indicator: Percentage of children 6–59 months of age with a hemoglobin measurement of 8–9.9 g/dL

Zone/state	%	LCI	UCI	SE	N	% point difference between state and national estimate
North Central						
Benue	24.5	18.9	31.1	3.1	246	-9.3
FCT Abuja	32.6	21	46.7	6.6	26	-1.2
Kogi	32.2	25.3	40	3.8	143	-1.6
Kwara	29.5	19.8	41.5	5.6	123	-4.3
Nassarawa	35.3	28.5	42.8	3.6	108	1.5
Niger	42.2	31.1	54.2	6	265	8.4
Plateau	28.1	20.7	36.9	4.1	224	-5.7
North East						
Adamawa	26.5	19.7	34.6	3.8	142	-7.3
Bauchi	30.4	21.5	41	5	254	-3.4
Borno	14.2	6.2	29.2	5.7	20	-19.6
Gombe	24.2	17.6	32.5	3.8	105	-9.6
Taraba	38.6	29.4	48.7	5	130	4.8
Yobe	28.7	20.7	38.2	4.5	178	-5.1
North West						
Jigawa	40.2	35.2	45.4	2.6	336	6.4
Kaduna	40.9	29.2	53.8	6.4	250	7.1
Kano	40.6	32.1	49.7	4.5	378	6.8
Katsina	39.1	31.3	47.4	4.1	463	5.3
Kebbi	63.7	52.4	73.7	5.5	167	29.9
Sokoto	38.6	30.5	47.4	4.3	154	4.8
Zamfara	51.3	44.9	57.5	3.2	206	17.5
South East						
Abia	21.4	14.7	30.1	3.9	63	-12.4
Anambra	11.5	6.1	20.8	3.6	127	-22.3
Ebonyi	42.5	33.6	51.9	4.7	131	8.7
Enugu	15.4	10.6	21.9	2.9	89	-18.4
Imo	21.1	13.4	31.4	4.6	105	-12.7
South South						
Akwa Ibom	36.4	24.2	50.6	6.8	106	2.6
Bayelsa	38.9	30.2	48.4	4.7	109	5.1
Cross River	47.8	36.7	59.1	5.8	90	14
Delta	28.1	19	39.5	5.3	117	-5.7
Edo	27.5	21.5	34.3	3.3	60	-6.3
Rivers	25	16.7	35.6	4.8	187	-8.8
South West						
Ekiti	24.4	15.1	36.9	5.6	75	-9.4
Lagos	20.6	13.2	30.7	4.4	270	-13.2
Ogun	35.1	27.5	43.5	4.1	101	1.3
Ondo	40.9	27.2	56.2	7.6	129	7.1
Osun	22.2	15.3	31	4	138	-11.6
Oyo	26.8	16.2	40.9	6.4	242	-7
Total (national)	33.8	32	35.7	0.9	6,055	

Table 18. Severe anemia prevalence among children 6–59 months of age by state (2015)
Indicator: Percentage of children 6–59 months of age with a hemoglobin measurement of <8 g/dL

Zone/state	%	LCI	UCI	SE	N	% point difference between state and national estimate
North Central						
Benue	1.6	0.4	5.5	1	246	-7.7
FCT Abuja	9	3.2	23.3	4.7	26	-0.3
Kogi	5.1	2.4	10.5	1.9	143	-4.2
Kwara	5.4	2	14	2.7	123	-3.9
Nassarawa	6.5	3.6	11.5	1.9	108	-2.8
Niger	0.6	0.1	3.3	0.5	265	-8.7
Plateau	10.2	8.2	12.5	1.1	224	0.9
North East						
Adamawa	11.4	5.9	21	3.7	142	2.1
Bauchi	6.9	2.4	18.2	3.6	254	-2.4
Borno	1.6	0.2	10.4	1.6	20	-7.7
Gombe	5.6	2.3	13.1	2.5	105	-3.7
Taraba	8.2	3.8	16.9	3.1	130	-1.1
Yobe	5.3	2.3	11.8	2.2	178	-4
North West						
Jigawa	17.1	9.4	29.3	5	336	7.8
Kaduna	14.3	8.3	23.4	3.8	250	5
Kano	25.8	17.9	35.7	4.5	378	16.5
Katsina	16.1	10.2	24.5	3.6	463	6.8
Kebbi	3.7	0.9	14	2.6	167	-5.6
Sokoto	19.4	13.2	27.4	3.6	154	10.1
Zamfara	21.4	14.2	31	4.3	206	12.1
South East						
Abia	1.4	0.3	6.7	1.1	63	-7.9
Anambra	6	1.9	17.4	3.4	127	-3.3
Ebonyi	7.9	4.5	13.4	2.2	131	-1.4
Enugu	4.7	2.6	8.3	1.4	89	-4.6
Imo	4.4	2.2	8.6	1.5	105	-4.9
South South						
Akwa Ibom	4.1	1.4	11.1	2.1	106	-5.2
Bayelsa	5.5	1.9	14.6	2.9	109	-3.8
Cross River	7.2	3.9	13	2.2	90	-2.1
Delta	4.6	2.6	8	1.3	117	-4.7
Edo	8.2	3.6	17.7	3.4	60	-1.1
Rivers	5.2	1.7	14.5	2.8	187	-4.1
South West						
Ekiti	6.5	2.1	18.3	3.6	75	-2.8
Lagos	2.1	0.9	4.6	0.9	270	-7.2
Ogun	3.9	1.4	10.7	2.1	101	-5.4
Ondo	0			0	129	-9.3
Osun	10.5	4.6	21.9	4.2	138	1.2
Oyo	6.4	2	18.6	3.7	242	-2.9
Total (national)	9.3	8.1	10.8	0.7	6,055	

Research Objective 2 Tables

Table 1. Women's knowledge of correct cause of malaria

Indicator: Percentage of women 15–49 years of age with knowledge of correct cause of malaria

	2010 MIS				2015 MIS						
	%	LCI	UCI	N	%	LCI	UCI	N	p-value*	% point change from 2010 to 2015	p-value for trend
PMI states	72.9	67.1	78	1,647	88.8	86.5	90.7	2,100		15.9	**<0.001**
Non-PMI states	85	82.8	87	4,344	87.3	85.9	88.6	4,915	0.2456	2.3	0.128
Total (national)	81.7	79.5	83.7	5,991	87.8	86.6	88.9	7,015		6.1	

Note: Correct knowledge includes identifying mosquitoes cause malaria

*Assessed differences between PMI- and non-PMI-supported states in the Nigeria MIS 2015 survey

Table 2. Women's knowledge of correct treatment of malaria

Indicator: Percentage of women 15–49 years of age with knowledge of correct treatment of malaria

	2010 MIS				2015 MIS						
	%	LCI	UCI	N	%	LCI	UCI	N	p-value*	% point change from 2010 to 2015	p-value for trend
PMI states	35	29.2	41.3	1,647	50.3	44.8	55.9	1,974		15.3	**0.005**
Non-PMI states	63	58.9	66.9	4,344	54.8	51.7	57.9	4,716	0.166	-8.2	**0.002**
Total (national)	55.3	52.1	58.5	5,991	53.5	50.8	56.2	6,689		-1.8	

Note: Correct treatment was identified if respondent stated: SP/Fansidar, chloroquine, quinine, ACT

*Assessed differences between PMI- and non-PMI-supported states in the Nigeria MIS 2015 survey

Table 3. Women's knowledge of symptoms of malaria

Indicator: Percentage of women 15–49 years of age with knowledge of symptoms of malaria

	2010 MIS								2015 MIS											
	PMI				Non-PMI states				PMI				Non-PMI states							
Symptom	%	LCI	UCI	N	%	LCI	UCI	N	%	LCI	UCI	N	%	LCI	UCI	N	p-value*	% point change 2010 to 2015 for PMI States	p-value for trend	% point change 2010 to 2015 for non-PMI States	p-value for trend
Fever	55.1	51.4	58.8	1,647	70.9	68.2	73.5	4,344	70.2	67.8	72.5	2,100	69	67.2	70.8	4,915	0.4412	15.1	**<0.001**	-1.0	0.301
Chills/shivering	47.8	44.7	51	1,647	43.2	40.8	45.7	4,344	36.8	33.3	40.6	2,100	33.6	31.8	35.4	4,915	0.1095	-11.0	**<0.001**	-9.0	**<0.001**
Headache	48.4	45	51.8	1,647	57	54.1	59.8	4,344	56.6	53.5	59.8	2,100	50.3	48	52.6	4,915	**0.0016**	8.2	**0.021**	-6.1	**<0.001**
Joint pain	33.7	30.9	36.5	1,647	30.1	28.2	32.1	4,344	37.4	34	40.9	2,100	28.8	27	30.8	4,915	**<0.001**	3.7	0.394	-1.2	0.243
Poor appetite	9.6	7.9	11.6	1,647	27.4	25.2	29.7	4,344	20.4	17.5	23.8	2,100	18.4	17	20	4,915	0.2545	10.8	**<0.001**	-8.2	**<0.001**
Vomiting	9.7	7.6	12.4	1,647	27.3	24.6	30.3	4,344	19.1	16.4	22.2	2,100	11.8	10.5	13.1	4,915	**<0.001**	9.4	**0.002**	-14.1	**<0.001**
Convulsion	0.8	0.3	1.9	1,647	4.1	2.9	5.7	4,344	3.4	1.5	7.5	2,100	1.6	1.2	2.1	4,915	0.0704	2.6	0.312	-1.7	**<0.001**
Cough	na								8.8	7	10.9	2,100	3.9	3.2	4.6	4,915	**<0.001**				
Catarrh/nasal congestion	na								5.6	4.2	7.5	2,100	2.7	2.1	3.5	4,915	**0.0002**				
Other	0.5	0.2	1.2	1,647	0.2	0.1	0.6	4,344	7.4	5.9	9.2	2,100	7.2	6.2	8.3	4,915	0.8166	6.9	**<0.001**	6.1	**<0.001**
Don't know any	3	2.1	4.5	1,647	1.4	1.1	1.9	4,344	3.4	2.5	4.7	2,100	2.8	2.3	3.5	4,915	0.3142	0.4	0.371	1.2	0.100

*Assessed differences between PMI- and non-PMI-supported states in the Nigeria MIS 2015 survey

Table 4a. Women's knowledge of how to prevent malaria

Indicator: Percentage of women 15–49 years of age with knowledge of how to prevent malaria

	2010 MIS								2015 MIS											
	PMI				Non-PMI states				PMI				Non-PMI states							
Prevention method	%	LCI	UCI	N	%	LCI	UCI	N	%	LCI	UCI	N	%	LCI	UCI	N	p-value*	% point change 2010 to 2015 for PMI States	p-value for trend	% point change 2010 to 2015 for non-PMI States	p-value for trend
Sleep inside mosquito net	61	55.6	66.2	1,454	61.7	58.7	64.6	4,061	59.8	56.2	63.2	1,910	54.3	51.9	56.6	4,593	**0.0121**	-1.2	0.678	-7.4	**0.010**
Sleep inside an ITN/LLIN	9.1	7	11.6	1,454	20.4	18.3	22.7	4,061	35.9	32.4	39.5	1,910	31.8	29.7	34	4,593	0.0558	26.8	**<0.001**	11.4	**<0.001**
Use insecticide spray	18.1	15	21.7	1,454	21.1	18.1	24.5	4,061	25.8	20.9	31.5	1,910	21	19	23.1	4,593	0.0782	7.7	0.083	-0.1	0.871
Use mosquito coils	19.9	16.5	23.7	1,454	28.5	25.1	32.1	4,061	21	16.7	26.1	1,910	15.4	13.7	17.3	4,593	**0.018**	1.1	0.814	-13.1	**<0.001**
Keep doors and windows closed	10.6	8.9	12.6	1,454	13.3	11.6	15.2	4,061	13.5	10.9	16.6	1,910	8.5	7.6	9.6	4,593	**0.0002**	2.9	0.269	-4.8	**<0.001**
Use insect repellent	3.3	2.1	5.3	1,454	2.6	2	3.3	4,061	4.7	3.5	6.2	1,910	2.9	2.3	3.7	4,593	**0.0118**	1.4	0.434	0.3	0.714
Keep surroundings clean	24	20.7	27.6	1,454	33.7	30.5	37.1	4,061	31	28.1	34.1	1,910	32.7	30.5	34.9	4,593	0.389	7	**0.028**	-1	0.621
Cut the grass	na								12.4	10.2	14.9	1,910	5.9	4.8	7.4	4,593	**<0.001**	NA		NA	
Eliminate stagnant water	na								13	10.7	15.8	1,910	11.8	10.5	13.2	4,593	0.3961	NA		NA	
Other	9	7	11.6	1,454	6.7	5.3	8.4	4,061	5.9	4.7	7.3	1,910	4.1	3.4	4.9	4,593	**0.0156**	-3.1	**0.021**	-2.6	**0.003**
Don't know	5.3	3.7	7.5	1,454	2.7	2	3.7	4,061	1.3	0.8	1.9	1,910	2.9	2.3	3.6	4,593	**0.0007**	-4	**<0.001**	0.2	0.947

*Assessed differences between PMI- and non-PMI-supported states in the Nigeria MIS 2015 survey

Table 4b. Women's knowledge of how pregnant women can avoid malaria

Indicator: Percentage of women 15–49 years of age with knowledge of how pregnant women can avoid malaria

	2010 MIS								2015 MIS											
	PMI				Non-PMI states				PMI				Non-PMI states							
Prevention method	%	LCI	UCI	N	%	LCI	UCI	N	%	LCI	UCI	N	%	LCI	UCI	N	p-value*	% point change 2010 to 2015 for PMI States	p-value for trend	% point change 2010 to 2015 for non-PMI States	p-value for trend
Sleep inside mosquito net	56.3	50.5	62	1,454	58.5	55.3	61.6	4,061	57.5	53.9	61	1,910	52.3	49.9	54.6	4,593	**0.017**	1.2	0.828	-6.2	**0.038**
Sleep inside an ITN/LLIN	9.3	7.4	11.7	1,454	19	16.8	21.5	4,061	31.7	28.5	35	1,910	29.1	26.7	31.6	4,593	0.2095	22.4	**<0.001**	10.1	**<0.001**
Keep environment clean	20.7	18.2	23.4	1,454	30.3	27.2	33.6	4,061	33.2	29	37.7	1,910	28	25.8	30.3	4,593	0.0321	12.5	**0**	-2.3	0.251
Take SP given during ANC	18.3	15.3	21.6	1,454	23.1	20.8	25.4	4,061	23.4	19.3	28.2	1,910	20.5	18.6	22.5	4,593	**0.218**	5.1	0.166	-2.6	0.130
Take daraprim tablets	5.3	4.1	7	1,454	3.6	2.7	4.8	4,061	1.5	1	2.2	1,910	2.2	1.7	3	4,593	**0.1019**	-3.8	**0**	-1.4	**0.009**
Other	6.8	4	11.4	1,454	3.9	2.8	5.3	4,061	4.9	3.7	6.4	1,910	4.1	3.5	4.9	4,593	**0.3243**	-1.9	0.205	0.2	0.829
Don't know	16	13.3	19.1	1,454	8.9	7.6	10.5	4,061	8.3	6.8	10.1	1,910	9.9	8.7	11.2	4,593	**0.1318**	-7.7	**0**	1	0.637

*Assessed differences between PMI- and non-PMI-supported states in the Nigeria MIS 2015 survey

Table 5a. Women's exposure to malaria messages

Indicator: Percentage of women 15–49 years of age who have seen or heard any message about malaria in the past 6 months, by message

	2010 MIS								2015 MIS											
	PMI				Non-PMI states				PMI				Non-PMI states							
	%	LCI	UCI	N	%	LCI	UCI	N	%	LCI	UCI	N	%	LCI	UCI	N	p-value*	% point change 2010 to 2015 for PMI States	p-value for trend	% point change 2010 to 2015 for non-PMI States	p-value for trend
Exposed to at least one malaria message in past 4 weeks (2010 MIS) or 6 months (2015 MIS)	27.1	22	32.9	1,647	30.7	27.9	33.6	4,344	40.6	36.4	45	2403	33.5	31.1	36	5631	**0.0042**	13.5	0.000	2.8	0.068
Recall of specific messages:																					
Malaria is dangerous	na				na				55.5	50.7	60.3	976	39.4	36	43	1,886	**<0.001**	na		na	
Malaria can kill	na				na				51.2	46.1	56.2	976	38.9	35.6	42.3	1,886	**0.0001**	na		na	
Mosquitos spread malaria	na				na				38.8	32.8	45.2	976	27.4	24.7	30.3	1,886	**0.0007**	na		na	
Sleeping inside a mosquito net is important	na				na				45.5	41.1	50	976	35.3	32.1	38.6	1,886	**0.0003**	na		na	
Who should sleep inside a mosquito net	na				na				17.1	13.9	20.8	976	5.1	4	6.5	1,886	**<0.001**	na		na	
Seek treatment for fever	na				na				21.9	18.2	26.1	976	9.7	8.1	11.6	1,886	**<0.001**	na		na	
Seek treatment for fever promptly (within 24 hours)	na				na				16.7	14.2	19.6	976	6.2	4.9	7.9	1,886	**<0.001**	na		na	
Importance of house spraying	na				na				5.5	3.1	9.6	976	1.6	1	2.5	1,886	**0.0006**	na		na	
Environmental sanitation activities	na				na				23.1	19	27.7	976	14.6	12.2	17.3	1,886	**0.0005**	na		na	
Seek testing before treatment for malaria	na				na				14.6	10.5	20	976	4.5	3.3	6.2	1,886	**<0.001**	na		na	
Early registration for ANC	na				na				11.4	6.9	18.2	976	2.3	1.6	3.3	1,886	**<0.001**	na		na	
Pregnant women should take SP	na				na				10.1	5.9	16.6	976	2.2	1.5	3.3	1,886	**<0.001**	na		na	
Other	na				na				1.9	1.3	3	976	3.1	2.2	4.5	1,886	0.0879	na		na	
Don't know	na				na				2.1	1.4	3.1	976	2	1.5	2.8	1,886	0.9563	na		na	

*Assessed differences between PMI- and non-PMI-supported states in the Nigeria MIS 2015 survey

Table 5b. Women's source of exposure to malaria messages

Indicator: Percentage of women 15-49 years who have seen or heard any message about malaria in the past 6 months, the source of exposure

	2010 MIS								2015 MIS										
	PMI				Non-PMI states				PMI				Non-PMI states						
Source of exposure to malaria messages	%	LCI	UCI	N	%	LCI	UCI	N	%	LCI	UCI	N	%	LCI	UCI	N	p-value***	% point change 2010 to 2015 for PMI States	% point change 2010 to 2015 for non-PMI States
Radio	73.7	66.8	79.6	446	59.6	54.7	64.4	1,333	68.8	63	74.2	976	70.9	67.7	73.9	1,886	0.5179	-4.9	11.3
Television	16.9	10.6	25.9	446	46	38.9	53.2	1,333	35.4	27	44.9	976	29.9	26.1	34	1,886	0.257	18.5	-16.1
Community worker*	3.2	2.1	4.8	446	5.4	3.8	7.4	1,333	18.4	14.7	22.8	976	15.8	13.1	18.8	1,886	0.294	15.2	10.4
Mosque/church	0.4	0	2.5	446	0.2	0.1	0.7	1,333	4.1	2.8	6	976	2.6	1.8	3.9	1,886	0.1048	3.7	2.4
Town announcer/community event	0.2	0	1.5	446	8.8	6.7	11.5	1,333	5.8	4.1	8.1	976	4.5	3.3	6.3	1,886	0.3084	5.6	-4.3
Billboards/poster/t-shirt	13.7	9.7	19.1	446	11.3	8.4	15.1	1,333	14.4	8.9	22.4	976	4.7	3.5	6.2	1,886	**0.0001**	0.7	-6.6
Leaflet/factsheet/brochure	0.7	0.1	5	446	0.7	0.4	1.4	1,333	9.4	5.6	15.4	976	1	0.6	1.7	1,886	**<0.001**	8.7	0.3
Relative/friend/neighbor/school	2.9	1.2	6.9	446	19.3	15.3	24.1	1,333	11.5	8.9	14.8	976	4.4	3.1	6.3	1,886	**<0.001**	8.6	-14.9
Social media**	na								2.5	1.5	4.3	976	0.6	0.3	1.2	1,886	**0.0005**	na	na
Antenatal care visit**	na								2.2	1.3	4	976	1.9	1.3	2.7	1,886	0.5922	na	na
Health center or hospital**	na								4.7	3.1	6.9	976	2.9	2.1	4.1	1,886	0.0722	na	na
Other	0.5	0.1	2	446	0.8	0.2	4	1,333	0.1	0	0.5	976	0.8	0.4	1.4	1,886	**0.0066**	-0.4	0

* In the 2010 MIS, this refers to a community health extension worker, community-oriented resource person, role model caregiver/community worker.
**Only available in the 2015 MIS, not in the 2010 MIS.
***Assessed differences between PMI- and non-PMI-supported states in the Nigeria MIS 2015 survey

Table 6. Household ownership of at least one ITN

Indicator: Percentage of households with at least one ITN

	2008 DHS				2010 MIS				2013 DHS				2015 MIS					% point difference between 2008-2015	p-value for trend
	%	LCI	UCI	N	%	LCI	UCI	N	%	LCI	UCI	N	%	LCI	UCI	N	p-value*		
PMI states	7.3	6.4	8.4	9,159	37.1	32.5	42	1,685	56.2	52.9	59.5	11,306	71.2	67.7	74.5	2,331		63.9	**<0.001**
Non-PMI states	8.2	7.5	9	24,911	43.3	39.7	47	4,210	46.8	45	48.6	27,216	67.8	65.5	70	5,414	0.1063	59.6	**<0.001**
Total (national)	8	7.4	8.6	34,070	41.5	38.6	44.5	5,895	49.5	47.9	51.1	38,522	68.8	66.9	70.7	7,745		60.8	

*Assessed differences between PMI- and non-PMI-supported states in the Nigeria MIS 2015 survey

Table 7. Household access to ITNs

Indicator: Percentage of households with at least one ITN for every two people

	2008 DHS				2010 MIS				2013 DHS				2015 MIS					% point difference between 2008-2015	p-value for trend
	%	LCI	UCI	N	%	LCI	UCI	N	%	LCI	UCI	N	%	LCI	UCI	N	p-value*		
PMI states	2	1.7	2.4	9,136	12.3	10	15	1,681	24.6	22.6	26.7	11,282	34.7	31.2	38.3	2,328		32.7	**<0.001**
Non-PMI states	2.4	2.1	2.7	24,854	15	13.1	17	4,202	21.1	20	22.2	27,175	35	32.7	37.3	5,399	0.8911	32.6	**<0.001**
Total (national)	2.3	2.1	2.5	33,990	14.2	12.7	15.9	5,883	22.1	21.1	23.1	38,457	34.9	33	36.8	7,727		32.6	

*Assessed differences between PMI- and non-PMI-supported states in the Nigeria MIS 2015 survey

Table 8. Household gap in access to ITNs

Indicator: Percentage of households that own less than one ITN for every two household members

	2008 DHS				2010 MIS				2013 DHS				2015 MIS					% point difference between 2008-2015	p-value for trend
	%	LCI	UCI	N	%	LCI	UCI	N	%	LCI	UCI	N	%	LCI	UCI	N	p-value*		
PMI states	98	97.6	98.3	9,136	87.7	85	90	1,681	75.4	73.3	77.4	11,282	65.3	61.7	68.8	2,328		-32.7	**<0.001**
Non-PMI states	97.6	97.3	97.9	24,854	85	83	86.9	4,202	78.9	77.8	80	27,175	65	62.7	67.3	5,399	0.8911	-32.6	**<0.001**
Total (national)	97.7	97.5	97.9	33,990	85.8	84.1	87.3	5,883	77.9	76.9	78.9	38,457	65.1	63.2	67	7,727		-32.6	

*Assessed differences between PMI- and non-PMI-supported states in the Nigeria MIS 2015 survey

Table 9. Population access to ITNs

Indicator: Percentage of population with access to an ITN within their household

	2008 DHS				2010 MIS				2013 DHS				2015 MIS					% point difference between 2008-2015	p-value for trend
	%	LCI	UCI	N	%	LCI	UCI	N	%	LCI	UCI	N	%	LCI	UCI	N	p-value*		
PMI states	4.4	3.8	5	41,577	25.3	21.7	28.9	8,641	41.3	38.9	43.8	53,715	55.6	52.6	58.7	11,610		51.2	**<0.001**
Non-PMI states	4.9	4.4	5.4	108,621	29.5	26.6	32.2	21,746	33.8	32.3	35.2	122,859	54.3	52.1	56.5	26,064	0.4869	49.4	**<0.001**
Total (national)	4.8	4.4	5.2	150,198	28.2	25.9	30.4	30,387	36.1	34.8	37.3	176,574	54.7	52.9	56.5	37,674		49.9	

*Assessed differences between PMI- and non-PMI-supported states in the Nigeria MIS 2015 survey

Table 10. Use of existing ITNs

Indicator: Percentage of existing ITNs used the previous night

	2008 DHS				2010 MIS				2013 DHS				2015 MIS					% point difference between 2008-2015	p-value for trend
	%	LCI	UCI	N	%	LCI	UCI	N	%	LCI	UCI	N	%	LCI	UCI	N	p-value*		
PMI states	71.8	68.1	75.3	1,003	75.6	70.9	79.7	1,199	34.1	30.7	37.7	12,727	64.1	60.1	67.4	3,963		-7.7	**<0.001**
Non-PMI states	66.7	63.5	69.8	2,993	79.3	76.2	82	3,479	35	32.8	37.2	23,883	59.2	56.2	62.2	8,533	**0.0343**	-7.5	**<0.001**
Total (national)	68.0	65.4	70.4	3,966	78.3	75.8	80.6	4,667	34.7	32.8	36.6	36,610	60.8	58.5	63.1	12,496			

*Assessed differences between PMI- and non-PMI-supported states in the Nigeria MIS 2015 survey

Table 11. Vector control coverage

Indicator: Percentage of households with at least one ITN or sprayed by IRS in the last 12 months

	2008 DHS*				2010 MIS				2013 DHS				2015 MIS					% point difference between 2008-2015	p-value for trend
	%	LCI	UCI	N	%	LCI	UCI	N	%	LCI	UCI	N	%	LCI	UCI	N	p-value**		
PMI states	7.3	6.4	8.4	9,159	37.3	32.7	42.2	1,685	56.6	53.3	59.9	11,306	71.3	67.8	74.5	2,331		64	**<0.001**
Non-PMI states	8.2	7.5	9	24,911	43.5	39.9	47.2	4,210	47.4	45.6	49.2	27,216	68.1	65.8	70.3	5,414	0.1203	59.9	**<0.001**
Total (national)	8	7.4	8.6	34,070	41.7	38.8	44.7	5,895	50.1	48.5	51.7	38,522	69	67.1	70.9	7,745		61	

* 2008 DHS Survey looks at households with at least one ITN

**Assessed differences between PMI- and non-PMI-supported states in the Nigeria MIS 2015 survey

Table 12. Vector control coverage (household ITN access or IRS)

Indicator: Percentage of households with at least one ITN for every two people or sprayed by IRS in the last 12 months

	2008 DHS				2010 MIS				2013 DHS				2015 MIS					% point difference between 2008-2015	p-value for trend
	%	LCI	UCI	N	%	LCI	UCI	N	%	LCI	UCI	N	%	LCI	UCI	N	p-value*		
PMI states	2	1.7	2.4	9,159	12.6	10.3	15.4	1,685	25.4	23.4	27.5	11,306	35.3	31.9	38.9	2,331	0.9092	33.3	**<0.001**
Non-PMI states	2.4	2.1	2.7	24,911	15.6	13.6	17.7	4,210	22.4	21.1	23.8	27,216	35.5	33.2	37.9	5,414		33.1	**<0.001**
Total (national)	2.3	2.1	2.5	34,070	14.7	13.2	16.5	5,895	23.3	22.2	24.4	38,522	35.5	33.6	37.4	7,745		33.2	

*Assessed differences between PMI- and non-PMI-supported states in the Nigeria MIS 2015 survey

Table 13. Population use of ITNs

Indicator: Percentage of population that slept under an ITN the previous night

	2008 DHS				2010 MIS				2013 DHS				2015 MIS					% point difference between 2008-2015	p-value for trend
	%	LCI	UCI	N	%	LCI	UCI	N	%	LCI	UCI	N	%	LCI	UCI	N	p-value*		
PMI states	3.2	2.7	3.7	41,577	19.9	16.6	23.6	8,642	14.6	12.8	16.6	53,715	41.6	38.5	44.8	11,610		38.4	**<0.001**
Non-PMI states	3.3	2.9	3.7	108,621	24.2	21.7	26.8	21,746	12.2	11.3	13.2	122,859	35.4	33	38	26,064	**0.0026**	32.1	**<0.001**
Total (national)	3.2	2.9	3.6	150,199	22.9	20.9	25.1	30,387	12.9	12.1	13.9	176,574	37.3	35.4	39.3	37,674		34.1	

*Assessed differences between PMI- and non-PMI-supported states in the Nigeria MIS 2015 survey

Table 14. Population use of ITNs among those with access to an ITN

Indicator: Percentage of population that slept under an ITN the previous night among those with access to an ITN

	2008 DHS				2010 MIS				2013 DHS				2015 MIS					% point difference between 2008-2015	p-value for trend
	%	LCI	UCI	N	%	LCI	UCI	N	%	LCI	UCI	N	%	LCI	UCI	N	p-value*		
PMI states	66.1	58.2	73.1	442	69.9	63.6	75.5	747	35.7	31.6	40	8,432	68.4	64.3	72.2	3,197		2.3	0.603
Non-PMI states	60.6	56.1	64.9	1,409	74.6	70.8	78	2,001	35.5	33.1	38	16,553	62.7	58.9	66.4	7,100	**0.0433**	2.1	0.501
Total (national)	61.9	58	65.6	1,852	73.3	70.1	76.3	2,748	35.6	33.5	37.8	24,985	64.5	61.6	67.2	10,297		2.6	

*Assessed differences between PMI- and non-PMI-supported states in the Nigeria MIS 2015 survey

Table 15. Children under five years of age ITN use

Indicator: Percentage of children under five years of age who slept under an ITN the previous night

	2008 DHS				2010 MIS				2013 DHS				2015 MIS					% point difference between 2008-2015	p-value for trend
	%	LCI	UCI	N	%	LCI	UCI	N	%	LCI	UCI	N	%	LCI	UCI	N	p-value*		
PMI states	5.2	4.4	6.1	7,300	25.5	21	30.6	1,889	17.7	15.3	20.3	9,487	48.5	44.6	52.4	2,059		43.3	**<0.001**
Non-PMI states	5.6	4.9	6.3	18,483	30.4	26.9	34.1	4,346	16.1	14.7	17.6	20,840	41.6	38.4	44.8	4,950	**0.0074**	36	**<0.001**
Total (national)	5.5	4.9	6	25,783	28.9	26.1	31.9	6,234	16.6	15.4	17.9	30,327	43.6	41.1	46.2	7,008		38.1	

*Assessed differences between PMI- and non-PMI-supported states in the Nigeria MIS 2015 survey

Table 16. Pregnant women ITN use

Indicator: Percentage of pregnant women who slept under an ITN the previous night

	2008 DHS				2010 MIS				2013 DHS				2015 MIS					% point difference between 2008-2015	p-value for trend
	%	LCI	UCI	N	%	LCI	UCI	N	%	LCI	UCI	N	%	LCI	UCI	N	p-value*		
PMI states	4.3	3.1	5.9	936	26.1	19.2	34.3	211	18.5	15.4	22.2	1,471	58.9	52.2	65.3	296		54.6	**<0.001**
Non-PMI states	5	4.1	6.1	2,461	36.6	30.2	43.5	540	15.4	13.5	17.4	3,245	44.1	38.8	49.6	601	**0.0008**	39.1	**<0.001**
Total (national)	4.8	4.1	5.7	3,397	33.6	28.6	39.1	752	16.4	14.7	18.2	4,716	49	44.7	53.3	897		44.2	

*Assessed differences between PMI- and non-PMI-supported states in the Nigeria MIS 2015 survey

Table 17a. IPTp coverage (two or more doses)

Indicator: Percentage of women who received two or more doses of IPTp for malaria during ANC visits during their last pregnancy

	2008 DHS				2010 MIS				2013 DHS				2015 MIS					% point difference between 2008-2015	p-value for trend
	%	LCI	UCI	N	%	LCI	UCI	N	%	LCI	UCI	N	%	LCI	UCI	N	p-value*		
PMI states	5.7	4.7	6.8	3,076	9.1	6	13.5	674	9.8	8.5	11.4	4,051	40.6	35	46.5	689	0.1562	34.9	**<0.001**
Non-PMI states	4.6	4	5.4	7,951	14.9	12.3	18.1	1,581	16.9	15.3	18.6	8,422	35.9	32.6	39.3	1,832		31.3	**<0.001**
Total (national)	4.9	4.4	5.5	11,027	13.2	11	15.7	2,255	14.6	13.4	15.9	12,473	37.2	34.3	40.2	2,522		32.3	

*Assessed differences between PMI- and non-PMI-supported states in the Nigeria MIS 2015 survey

Table 17b. IPTp coverage (three or more doses)

Indicator: Percentage of women who received three or more doses of IPTp for malaria during ANC visits during their last pregnancy

	2008 DHS				2010 MIS				2013 DHS				2015 MIS					% point difference between 2008-2015	p-value for trend
	%	LCI	UCI	N	%	LCI	UCI	N	%	LCI	UCI	N	%	LCI	UCI	N	p-value*		
PMI states	2.4	1.8	3.2	3,076	3.9	2.2	6.9	674	4.2	3.5	5	4,051	24.3	19.9	29.3	689	**0.0028**	21.9	**<0.001**
Non-PMI states	2.3	1.9	2.8	7,951	5.6	4.2	7.3	1,581	6.6	5.7	7.6	8,422	17	14.9	19.3	1,832		14.7	**<0.001**
Total (national)	2.4	2	2.8	11,027	5.1	4	6.5	2,255	5.8	5.2	6.5	12,473	19	17	21.1	2,522		16.6	

*Assessed differences between PMI- and non-PMI-supported states in the Nigeria MIS 2015 survey

Table 18. Diagnostic testing for children under five years of age with fever

Indicator: Percentage of children under five years of age with fever in the last two weeks who had a finger or heel stick

	2008 DHS				2010 MIS				2013 DHS				2015 MIS					% point difference between 2008-2015	p-value for trend
	%	LCI	UCI	N	%	LCI	UCI	N	%	LCI	UCI	N	%	LCI	UCI	N	p-value*		
PMI states	NA	NA	NA	NA	5.9	3.5	9.8	558	10	8.1	12.3	1,116	12.9	9.2	17.6	816	0.8744	7	**0.012**
Non-PMI states	NA	NA	NA	NA	5.3	4	6.9	1,398	11.6	9.8	13.7	2,516	12.5	10.5	14.8	1,784		7.2	**<0.001**
Total (national)	NA	NA	NA	NA	5.4	4.2	7	1,956	11.1	9.7	12.7	3,632	12.6	10.8	14.7	2,600		7.2	

*Assessed differences between PMI- and non-PMI-supported states in the Nigeria MIS 2015 survey

Table 19a. Care-seeking from a health provider for children under five years of age with fever

Indicator: Percentage of children under five years of age with fever in the last two weeks for whom advice or treatment was sought by health provider

	2008 DHS				2010 MIS				2013 DHS				2015 MIS					% point difference between 2008-2015	p-value for trend
	%	LCI	UCI	N	%	LCI	UCI	N	%	LCI	UCI	N	%	LCI	UCI	N	p-value*		
PMI states	55.5	51.9	59.1	1,175	82.1	77.5	85.9	558	31.8	28.1	35.7	1,116	64.6	58.7	70	816	0.4889	9.1	**0.027**
Non-PMI states	53.5	50.8	56.3	2,793	77.6	73.6	81.2	1,398	31.3	28.4	34.4	2,516	66.9	63.3	70.2	1,784		13.4	**<0.001**
Total (national)	54.1	51.9	56.3	3,968	78.9	75.7	81.7	1,956	31.5	29.1	33.9	3,632	66.1	63.1	69	2,600		12	

Note: Excludes pharmacy, chemist/PMS, shop, traditional practitioner, market, and other. Excludes advice or treatment from a traditional practitioner.

*Assessed differences between PMI- and non-PMI-supported states in the Nigeria MIS 2015 survey

Table 19b. Prompt care-seeking from a health provider for children under five years of age with fever

Indicator: Percentage of children under five years of age with fever in the last two weeks for whom advice or treatment was sought by health provider the same or next day

	2008 DHS				2010 MIS				2013 DHS				2015 MIS					% point difference between 2008-2015	p-value for trend
	%	LCI	UCI	N	%	LCI	UCI	N	%	LCI	UCI	N	%	LCI	UCI	N	p-value*		
PMI states	27.4	24.3	30.7	1,175	26.4	21.4	32.1	558	NA	NA	NA	NA	34.8	30.4	39.5	816	0.7702	7.4	**0.019**
Non-PMI states	24.8	22.6	27.2	2,793	36.7	31.8	41.8	1,398	NA	NA	NA	NA	35.7	31.8	34.8	1,784		10.9	**<0.001**
Total (national)	25.6	23.8	27.5	3,968	33.8	29.9	37.8	1,956	NA	NA	NA	NA	35.4	32.4	38.6	2,600		9.8	

Note: Excludes pharmacy, chemist/PMS, shop, traditional practitioner, market, and other. Excludes advice or treatment from a traditional practitioner

*Assessed differences between PMI- and non-PMI-supported states in the Nigeria MIS 2015 survey

Table 20. ACT coverage among children under five years of age with fever

Indicator: Percentage receiving an ACT, among children under five years of age with fever in the last two weeks who received any antimalarial treatment

	2008 DHS				2010 MIS				2013 DHS				2015 MIS					% point difference 2008-2015	p-value for trend
	%	LCI	UCI	N	%	LCI	UCI	N	%	LCI	UCI	N	%	LCI	UCI	N	p-value*		
PMI states	7.6	4.9	11.5	364	6.8	2.5	17.3	158	17.7	13	23.7	291	42.3	34.4	50.7	273	0.1842	34.7	**<0.001**
Non-PMI states	7	5.3	9.2	951	13	10	16.8	804	18.4	15.4	21.9	898	36	31.2	41	798		29	**<0.001**
Total (national)	7.2	5.7	9	1,316	12	9.3	15.4	961	18.3	15.7	21.2	1,189	37.6	33.4	41.9	1,070		30.4	

*Assessed differences between PMI- and non-PMI-supported states in the Nigeria MIS 2015 survey

Table 21a. Parasitemia prevalence (via RDT) among children 6–59 months of age

Indicator: Percentage of children 6–59 months of age with malaria infection (via RDT)

	2010 MIS				2015 MIS					% point difference between 2010 to 2015	p-value for trend
	%	LCI	UCI	N	%	LCI	UCI	N	p-value*		
PMI states	56.3	49.9	62.5	1,665	48.8	42.8	54.9	1,848	0.1654	-7.5	0.109
Non-PMI states	49.3	44	54.5	3,552	43.5	39	48	4,203		-5.8	0.126
Total (national)	51.5	47.4	55.6	5,216	45.1	41.5	48.8	6,050		-6.4	

*Assessed differences between PMI- and non-PMI-supported states in the Nigeria MIS 2015 survey

Table 21b. Parasitemia prevalence (via microscopy) among children 6–59 months of age

Indicator: Percentage of children 6–59 months of age with malaria infection (via microscopy)

	2010 MIS				2015 MIS					% point difference between 2010 to 2015	p-value for trend
	%	LCI	UCI	N	%	LCI	UCI	N	p-value*		
PMI states	48	42.5	53.5	1,661	35.1	29.9	40.7	1,759	**0.0006**	-12.9	**0.006**
Non-PMI states	39.1	33.6	45	3,551	24.2	20.9	27.8	4,006		-14.9	**<0.001**
Total (national)	42	37.8	46.2	5,211	27.4	24.7	30.4	5,765		-14.6	

*Assessed differences between PMI- and non-PMI-supported states in the Nigeria MIS 2015 survey

Table 22. Moderate anemia prevalence among children 6–59 months of age

Indicator: Percentage of children 6–59 months of age with a hemoglobin measurement of 8–9.9 g/dL

	2010 MIS				2015 MIS						
	%	LCI	UCI	N	%	LCI	UCI	N	p-value*	% point difference between 2010 to 2015	p-value for trend
PMI states	31	27.7	34.5	1,658	37.6	34.4	41	1,846	**0.0071**	6.6	**<0.001**
Non-PMI states	36.8	34.1	39.7	3,487	32.1	29.9	34.5	4,209		-4.7	**<0.001**
Total (national)	34.9	32.7	37.2	5,146	33.8	32	35.7	6,055		-1.1	

*Assessed differences between PMI- and non-PMI-supported states in the Nigeria MIS 2015 survey

Table 23. Severe anemia prevalence among children 6–59 months of age

Indicator: Percentage of children 6–59 months of age with a hemoglobin measurement of <8 g/dL

	2010 MIS				2015 MIS						
	%	LCI	UCI	N	%	LCI	UCI	N	p-value*	% point difference between 2010 to 2015	p-value for trend
PMI states	13.8	11.1	16.9	1,658	8.2	6.4	10.5	1,846	0.2516	-5.6	**<0.001**
Non-PMI states	12.1	10.1	14.3	3,487	9.8	8.3	11.6	4,209		-2.3	**<0.001**
Total (national)	12.6	11	14.4	5,146	9.3	8.1	10.8	6,055		-3.3	

*Assessed differences between PMI- and non-PMI-supported states in the Nigeria MIS 2015 survey

Research Objective 3 Tables

Model 1. Household ownership of at least one ITN and parasitemia prevalence (via microscopy) in children 6-59 months

Background characteristic	N	Parasitemia prevalence (%)	Unadjusted OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value
Total	**3,220**	**24.9**				
Household ITN ownership						
No ITN	785	22.3	1.00 (reference)	-	1.00 (reference)	-
Owns at least one ITN	2,434	25.8	1.20 (1.01–1.43)	0.042	0.81 (0.65–1.01)	0.057
Sex of child						
Male	1,623	25.9	1.00 (reference)	-	1.00 (reference)	-
Female	1,596	24.0	0.89 (0.77–1.04)	0.163	0.87 (0.73–1.04)	0.119
Age of child						
6–23 months	1,072	18.1	1.00 (reference)	-	1.00 (reference)	-
24–59 months	2,148	28.3	1.83 (1.54–2.18)	<0.001	**1.93 (1.58–2.36)**	**<0.001**
Mother's education						
No formal education	1,355	36.9	1.00 (reference)	-	1.00 (reference)	-
Primary education	552	25.5	0.58 (0.47–0.73)	<0.001	0.89 (0.69–1.15)	0.362
Secondary or higher education	1,313	12.2	0.24 (0.20–0.30)	<0.001	**0.72 (0.54–0.94)**	**0.017**
Place of residence						
Urban	1,201	9.4	1.00 (reference)	-	1.00 (reference)	-
Rural	2,019	34.2	4.31 (3.55–5.23)	<0.001	**2.94 (1.48–5.83)**	**0.002**
Wealth						
Highest	730	3.1	1.00 (reference)	-	1.00 (reference)	-
Fourth	599	15.5	4.58 (3.03–6.93)	<0.001	**3.57 (2.23–5.72)**	**<0.001**
Middle	581	25.9	8.24 (5.51–12.32)	<0.001	**4.91 (2.98–8.08)**	**<0.001**
Second	705	39.6	16.77 (11.32–24.84)	<0.001	**8.91 (5.31–14.97)**	**<0.001**
Lowest	606	42.4	20.65 (13.85–30.79)	<0.001	**9.73 (5.64–16.80)**	**<0.001**
Region						
North Central	578	30.6	1.00 (reference)	-	1.00 (reference)	-
North East	431	24.9	0.93 (0.73–1.18)	0.541	0.40 (0.12–1.32)	0.131
North West	964	35.5	1.79 (1.45–2.23)	<0.001	**2.58 (1.22–5.48)**	**0.013**
South East	282	10.1	0.39 (0.28–0.56)	<0.001	**2.32 (1.04–5.16)**	**0.040**
South South	379	18.2	0.64 (0.48–0.84)	0.001	2.43 (0.95–6.19)	0.063
South West	586	13.4	0.49 (0.37–0.65)	<0.001	**2.62 (1.22–5.61)**	**0.013**
Effect of region for rural residents						
North Central	452	36.9	-	-	1.00 (reference)	-
North East	337	31.1	-	-	2.56 (0.75–8.74)	0.135
North West	744	40.9	-	-	0.51 (0.23–1.13)	0.096
South East	101	8.2	-	-	**0.19 (0.07–0.54)**	**0.002**
South South	262	22.3	-	-	0.63 (0.23–1.71)	0.367
South West	124	38.4	-	-	0.82 (0.34–1.99)	0.655
Number of household members						
1-4	975	20.5	1.00 (reference)	-	1.00 (reference)	-
5-7	1,414	25.7	1.26 (1.05–1.52)	0.015	1.12 (0.89–1.40)	0.331
8+	831	28.8	1.45 (1.18–1.77)	<0.001	1.13 (0.88–1.44)	0.334
Malaria risk zone						
Low	856	12.2	1.00 (reference)	-	1.00 (reference)	-
Medium	1,734	28.7	2.27 (1.85–2.77)	<0.001	**1.40 (1.05–1.86)**	**0.021**
High	630	31.8	2.66 (2.09–3.38)	<0.001	**2.10 (1.53–2.87)**	**<0.001**
PMI-supported state						
No	2,226	20.5	1.00 (reference)	-	1.00 (reference)	-
Yes	994	34.8	1.88 (1.61–2.20)	<0.001	**1.52 (1.23–1.88)**	**<0.001**

Model 2. Household ownership of ITNs (by age of net) and parasitemia prevalence (via microscopy) in children 6–59 months of age

Background characteristic	N	Parasitemia prevalence (%)	Unadjusted OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value
Total	**3,150**	**24.9**				
ITN ownership by age of net						
No ITN	785	22.3	1.00 (reference)	-	1.00 (reference)	-
ITN owned 0–2 months	96	38.9	2.18 (1.49–3.20)	<0.001	1.53 (0.93–2.50)	0.091
ITN owned 2–6 months	588	29.0	1.34 (1.06–1.68)	0.013	**0.72 (0.53–0.97)**	**0.029**
ITN owned 7–12 months	1,004	25.5	1.17 (0.95–1.44)	0.137	**0.70 (0.54–0.90)**	**0.006**
ITN owned>12 months	676	21.4	1.00 (0.80–1.25)	0.996	0.89 (0.68–1.18)	0.428
Sex of child						
Male	1,592	25.9	1.00 (reference)	-	1.00 (reference)	-
Female	1,558	23.8	0.88 (0.76–1.03)	0.107	0.85 (0.71–1.02)	0.079
Age of child						
6–23 months	1,050	18.2	1.00 (reference)	-	1.00 (reference)	-
24–59 months	2,100	28.2	1.85 (1.55–2.21)	<0.001	**1.94 (1.59–2.38)**	**<0.001**
Mother's education						
No formal education	1,327	36.8	1.00 (reference)	-	1.00 (reference)	-
Primary education	541	25.5	0.58 (0.47–0.73)	<0.001	0.90 (0.70–1.17)	0.425
Secondary or higher education	1,283	12.3	0.24 (0.20–0.30)	<0.001	**0.75 (0.57–0.99)**	**0.045**
Place of residence						
Urban	1,179	9.4	1.00 (reference)	-	1.00 (reference)	-
Rural	1,971	34.1	4.27 (3.51–5.19)	<0.001	**3.02 (1.51–6.01)**	**0.002**
Wealth						
Highest	714	3.2	1.00 (reference)	-	1.00 (reference)	-
Fourth	581	15.3	4.54 (2.98–6.91)	<0.001	**3.58 (2.21–5.80)**	**<0.001**
Middle	570	25.9	8.30 (5.52–12.49)	<0.001	**4.96 (2.98–8.27)**	**<0.001**
Second	686	39.6	16.97 (11.39–25.30)	<0.001	**8.86 (5.22–15.04)**	**<0.001**
Lowest	600	42.2	20.66 (13.77–30.98)	<0.001	**9.73 (5.57–16.98)**	**<0.001**
Region						
North Central	566	30.2	1.00 (reference)	-	1.00 (reference)	-
North East	423	25.2	0.96 (0.75–1.23)	0.739	0.44 (0.13–1.47)	0.183
North West	945	35.6	1.83 (1.47–2.28)	<0.001	**2.63 (1.23–5.63)**	**0.013**
South East	275	10.1	0.40 (0.28–0.57)	<0.001	2.05 (0.91–4.65)	0.084
South South	361	18.1	0.63 (0.48–0.84)	0.002	2.17 (0.83–5.67)	0.116
South West	580	13.1	0.48 (0.36–0.64)	<0.001	**2.52 (1.17–5.42)**	**0.018**
Effect of region for rural residents						
North Central	445	36.2	-	-	1.00 (reference)	-
North East	329	31.7	-	-	2.40 (0.70–8.25)	0.164
North West	730	41.0	-	-	0.52 (0.23–1.17)	0.116
South East	99	8.4	-	-	**0.20 (0.07–0.58)**	**0.003**
South South	247	55.5	-	-	0.66 (0.24–1.84)	0.432
South West	121	44.8	-	-	0.75 (0.31–1.83)	0.525
Number of household members						
1–4	953	20.3	1.00 (reference)	-	1.00 (reference)	-
5–7	1,384	25.4	1.26 (1.04–1.52)	0.017	1.09 (0.87–1.36)	0.475
8+	813	29.3	1.50 (1.22–1.84)	<0.001	1.15 (0.90–1.47)	0.271
Malaria risk zone						
Low	834	12.1	1.00 (reference)	-	1.00 (reference)	-
Medium	1,704	28.6	2.29 (1.86–2.81)	<0.001	**1.37 (1.02–1.83)**	**0.036**
High	612	31.8	2.70 (2.12–3.45)	<0.001	**2.22 (1.60–3.07)**	**<0.001**
PMI-supported state						
No	2,172	20.5	1.00 (reference)	-	1.00 (reference)	-
Yes	978	34.7	1.88 (1.61–2.20)	<0.001	**1.49 (1.20–1.85)**	**<0.001**

Model 3. Household access to ITNs and parasitemia prevalence (via microscopy) in children 6–59 months of age

Background characteristic	N	Parasitemia prevalence (%)	Unadjusted OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value
Total	**3,220**	**24.9**				
Household access to ITN (one ITN for every two people)						
No ITN	2,358	24.8	1.00 (reference)	-	1.00 (reference)	-
Household owns at least one ITN for every two people	862	25.2	1.06 (0.90–1.26)	0.483	0.89 (0.72–1.09)	0.262
Sex of child						
Male	1,623	25.9	1.00 (reference)	-	1.00 (reference)	-
Female	1,596	24.0	0.89 (0.77–1.04)	0.163	0.86 (0.72–1.03)	0.106
Age of child						
6–23 months	1,072	18.1	1.00 (reference)	-	1.00 (reference)	-
24–59 months	2,148	28.3	1.83 (1.54–2.18)	<0.001	**1.94 (1.59–2.37)**	**<0.001**
Mother's education						
No formal education	1,355	36.9	1.00 (reference)	-	1.00 (reference)	-
Primary education	552	25.5	0.58 (0.47–0.73)	<0.001	0.89 (0.69–1.15)	0.372
Secondary or higher education	1,313	12.2	0.24 (0.20–0.30)	<0.001	**0.71 (0.54–0.94)**	**0.015**
Place of residence						
Urban	1,201	9.4	1.00 (reference)	-	1.00 (reference)	-
Rural	2,019	34.2	4.31 (3.55–5.23)	<0.001	**2.92 (1.47–5.80)**	**0.002**
Wealth						
Highest	730	3.1	1.00 (reference)	-	1.00 (reference)	-
Fourth	599	15.5	4.58 (3.03–6.93)	<0.001	**3.57 (2.23–5.73)**	**<0.001**
Middle	581	25.9	8.24 (5.51–12.32)	<0.001	**4.90 (2.97–8.07)**	**<0.001**
Second	705	39.6	16.77 (11.32–24.84)	<0.001	**8.96 (5.33–15.05)**	**<0.001**
Lowest	606	42.4	20.65 (13.85–30.79)	<0.001	**9.72 (5.63–16.80)**	**<0.001**
Region						
North Central	578	30.6	1.00 (reference)	-	1.00 (reference)	-
North East	431	24.9	0.93 (0.73–1.18)	0.541	0.38 (0.11–1.25)	0.111
North West	964	35.5	1.79 (1.45–2.23)	<0.001	**2.46 (1.17–5.20)**	**0.018**
South East	282	10.1	0.39 (0.28–0.56)	<0.001	**2.29 (1.03–5.09)**	**0.043**
South South	379	18.2	0.64 (0.48–0.84)	0.001	2.42 (0.95–6.16)	0.064
South West	586	13.4	0.49 (0.37–0.65)	<0.001	**2.66 (1.24–5.70)**	**0.012**
Effect of region for rural residents						
North Central	452	36.9	-	-	1.00 (reference)	-
North East	337	31.1	-	-	2.62 (0.77–8.96)	0.124
North West	744	40.9	-	-	0.51 (0.23–1.14)	0.101
South East	101	8.2	-	-	**0.19 (0.07–0.56)**	**0.002**
South South	262	22.3	-	-	0.64 (0.24–1.71)	0.370
South West	124	38.4	-	-	0.80 (0.33–1.94)	0.621
Number of household members						
1–4	975	20.5	1.00 (reference)	-	1.00 (reference)	-
5–7	1,414	25.7	1.26 (1.05–1.52)	0.015	1.08 (0.86–1.36)	0.495
8+	831	28.8	1.45 (1.18–1.77)	<0.001	1.08 (0.84–1.39)	0.558
Malaria risk zone						
Low	856	12.2	1.00 (reference)	-	1.00 (reference)	-
Medium	1,734	28.7	2.27 (1.85–2.77)	<0.001	**1.39 (1.05–1.85)**	**0.022**
High	630	31.8	2.66 (2.09–3.38)	<0.001	**2.08 (1.52–2.84)**	**<0.001**
PMI-supported state						
No	2,226	20.5	1.00 (reference)	-	1.00 (reference)	-
Yes	994	34.8	1.88 (1.61–2.20)	<0.001	**1.51 (1.22–1.86)**	**<0.001**

Model 4. ITN use by children under five and parasitemia prevalence (via microscopy) in children 6–59 months of age

Background characteristic	N	Parasitemia prevalence (%)	Unadjusted OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value
Total	**3,220**	**24.9**				
Used an ITN the previous night						
No	1,800	22.6	1.00 (reference)	-	1.00 (reference)	-
Yes	1,420	27.8	1.33 (1.14–1.55)	<0.001	0.87 (0.72–1.05)	0.155
Sex of child						
Male	1,623	25.9	1.00 (reference)	-	1.00 (reference)	-
Female	1,596	24.0	0.89 (0.77–1.04)	0.163	0.87 (0.72–1.03)	0.112
Age of child						
6–23 months	1,072	18.1	1.00 (reference)	-	1.00 (reference)	-
24–59 months	2,148	28.3	1.83 (1.54–2.18)	<0.001	**1.93 (1.58–2.35)**	**<0.001**
Mother's education						
No formal education	1,355	36.9	1.00 (reference)	-	1.00 (reference)	-
Primary education	552	25.5	0.58 (0.47–0.73)	<0.001	0.89 (0.69–1.14)	0.350
Secondary or higher education	1,313	12.2	0.24 (0.20–0.30)	<0.001	**0.71 (0.54–0.94)**	**0.015**
Place of residence						
Urban	1,201	9.4	1.00 (reference)	-	1.00 (reference)	-
Rural	2,019	34.2	4.31 (3.55–5.23)	<0.001	**2.91 (1.47–5.77)**	**0.002**
Wealth						
Highest	730	3.1	1.00 (reference)	-	1.00 (reference)	-
Fourth	599	15.5	4.58 (3.03–6.93)	<0.001	**3.57 (2.23–5.72)**	**<0.001**
Middle	581	25.9	8.24 (5.51–12.32)	<0.001	**4.95 (3.00–8.16)**	**<0.001**
Second	705	39.6	16.77 (11.32–24.84)	<0.001	**9.12 (5.42–15.33)**	**<0.001**
Lowest	606	42.4	20.65 (13.85–30.79)	<0.001	**9.90 (5.72–17.13)**	**<0.001**
Region						
North Central	578	30.6	1.00 (reference)	-	1.00 (reference)	-
North East	431	24.9	0.93 (0.73–1.18)	0.541	0.38 (0.12–1.27)	0.115
North West	964	35.5	1.79 (1.45–2.23)	<0.001	**2.50 (1.18–5.29)**	**0.016**
South East	282	10.1	0.39 (0.28–0.56)	<0.001	**2.22 (1.00–4.95)**	**0.050**
South South	379	18.2	0.64 (0.48–0.84)	0.001	2.39 (0.94–6.09)	0.067
South West	586	13.4	0.49 (0.37–0.65)	<0.001	**2.61 (1.22–5.59)**	**0.013**
Effect of region for rural residents						
North Central	452	36.9	-	-	1.00 (reference)	-
North East	337	31.1	-	-	2.57 (0.75–8.78)	0.133
North West	744	40.9	-	-	0.51 (0.23–1.13)	0.097
South East	101	8.2	-	-	**0.20 (0.07–0.56)**	**0.002**
South South	262	22.3	-	-	0.63 (0.23–1.69)	0.356
South West	124	38.4	-	-	0.81 (0.33–1.96)	0.632
Number of household members						
1–4	975	20.5	1.00 (reference)	-	1.00 (reference)	-
5–7	1,414	25.7	1.26 (1.05–1.52)	0.015	1.10 (0.88–1.38)	0.381
8+	831	28.8	1.45 (1.18–1.77)	<0.001	1.11 (0.87–1.41)	0.423
Malaria risk zone						
Low	856	12.2	1.00 (reference)	-	1.00 (reference)	-
Medium	1,734	28.7	2.27 (1.85–2.77)	<0.001	**1.37 (1.04–1.82)**	**0.028**
High	630	31.8	2.66 (2.09–3.38)	<0.001	**2.05 (1.50–2.80)**	**<0.001**
PMI-supported state						
No	2,226	20.5	1.00 (reference)	-	1.00 (reference)	-
Yes	994	34.8	1.88 (1.61–2.20)	<0.001	**1.52 (1.23–1.88)**	**<0.001**

Model 5. Household ownership of at least one ITN and moderate anemia prevalence (8-9.9 g/dL) in children 6–59 months of age

Background characteristic	N	Moderate anemia prevalence (%)	Unadjusted OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value
Total	**3,365**	**32.8**				
Household ITN ownership						
No ITN	815	28.5	1.00 (reference)	-	1.00 (reference)	-
Owns at least one ITN*	2,550	34.2	1.23 (1.05–1.44)	0.012	1.00 (0.83–1.20)	0.976
Sex of child						
Male	1,700	35.1	1.00 (reference)	-	1.00 (reference)	-
Female	1,665	30.5	0.88 (0.77–1.01)	0.073	**0.85 (0.73–0.99)**	**0.035**
Age of child						
6–23 months	1,106	39.1	1.00 (reference)	-	1.00 (reference)	-
24–59 months	2,258	29.7	0.65 (0.56–0.75)	<0.001	**0.59 (0.50–0.69)**	**<0.001**
Mother's education						
No formal education	1,435	38.8	1.00 (reference)	-	1.00 (reference)	-
Primary education	581	37.1	0.91 (0.75–1.11)	0.361	1.19 (0.95–1.48)	0.135
Secondary or higher education	1,349	24.6	0.52 (0.44–0.62)	<0.001	0.81 (0.65–1.03)	0.082
Place of residence						
Urban	1,231	23.5	1.00 (reference)	-	1.00 (reference)	-
Rural	2,134	38.2	1.81 (1.56–2.09)	<0.001	**2.13 (1.33–3.39)**	**0.002**
Wealth						
Highest	739	20.3	1.00 (reference)	-	1.00 (reference)	-
Fourth	623	27.7	1.60 (1.27–2.02)	<0.001	1.25 (0.95–1.64)	0.118
Middle	609	34.7	2.04 (1.62–2.57)	<0.001	1.32 (0.96–1.80)	0.085
Second	757	39.6	2.55 (2.03–3.19)	<0.001	1.33 (0.94–1.87)	0.107
Lowest	638	42.5	3.10 (2.45–3.94)	<0.001	**1.52 (1.04–2.23)**	**0.030**
Region						
North Central	601	31.9	1.00 (reference)	-	1.00 (reference)	-
North East	445	31.0	0.92 (0.73–1.15)	0.460	1.39 (0.79–2.46)	0.257
North West	1,024	43.2	1.86 (1.51–2.28)	<0.001	**2.79 (1.68–4.62)**	**<0.001**
South East	290	19.0	0.59 (0.44–0.78)	<0.001	1.34 (0.78–2.29)	0.285
South South	390	30.1	0.95 (0.74–1.21)	0.662	1.43 (0.80–2.56)	0.226
South West	616	26.0	0.80 (0.62–1.01)	0.067	1.40 (0.87–2.28)	0.167
Effect of region for rural residents						
North Central	469	35.7	-	-	1.00 (reference)	-
North East	348	33.3	-	-	0.66 (0.35–1.24)	0.198
North West	792	45.4	-	-	**0.50 (0.29–0.89)**	**0.018**
South East	109	17.3	-	-	**0.35 (0.17–0.72)**	**0.005**
South South	272	34.9	-	-	0.78 (0.41–1.50)	0.462
South West	145	40.4	-	-	0.81 (0.44–1.52)	0.515
Number of household members						
1–4	1,013	31.2	1.00 (reference)	-	1.00 (reference)	-
5–7	1,465	31.8	0.96 (0.81–1.13)	0.615	0.94 (0.79–1.13)	0.538
8+	887	36.4	1.13 (0.94–1.35)	0.188	0.96 (0.78–1.18)	0.683
Malaria risk zone						
Low	871	26.2	1.00 (reference)	-	1.00 (reference)	-
Medium	1,825	34.6	1.33 (1.12–1.57)	0.001	0.97 (0.77–1.21)	0.763
High	669	36.6	1.43 (1.17–1.76)	0.001	1.23 (0.96–1.58)	0.107
PMI-supported state						
No	2,329	30.8	1.00 (reference)	-	1.00 (reference)	-
Yes	1,036	37.4	1.54 (1.33–1.78)	<0.001	**1.38 (1.15–1.66)**	**0.001**

Model 6. Household ownership of ITNs (by age of net) and moderate anemia prevalence (8–9.9 g/dL) in children 6–59 months of age

Background characteristic	N	Moderate anemia prevalence (%)	Unadjusted OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value
Total	**3,294**	**32.7**				
Household ITN ownership						
No ITN	815	28.5	1.00 (reference)	-	1.00 (reference)	-
ITN owned 0–1 month	98	44.6	1.93 (1.3–2.79)	<0.001	**1.69 (1.10–2.59)**	**0.017**
ITN owned 2–6 months	618	41.0	1.60 (1.30–1.97)	<0.001	1.17 (0.91–1.49)	0.224
ITN owned 7–12 months	1,058	33.9	1.20 (1.00–1.45)	0.052	0.94 (0.76–1.16)	0.561
ITN owned >12 months	705	26.9	0.91 (0.74–1.12)	0.357	0.87 (0.69–1.10)	0.241
Sex of child						
Male	1,668	35.2	1.00 (reference)	-	1.00 (reference)	-
Female	1,626	30.1	0.87 (0.76–1.00)	0.057	**0.84 (0.72–0.97)**	**0.021**
Age of child						
6–23 months	1,084	38.3	1.00 (reference)	-	1.00 (reference)	-
24–59 months	2,210	30.0	0.67 (0.58–0.77)	<0.001	**0.61 (0.52–0.72)**	**<0.001**
Mother's education						
No formal education	1,407	38.6	1.00 (reference)	-	1.00 (reference)	-
Primary education	570	37.0	0.93 (0.76–1.13)	0.466	1.22 (0.97–1.53)	0.084
Secondary or higher education	1,318	24.6	0.54 (0.46–0.63)	<0.001	0.86 (0.68–1.09)	0.217
Place of residence						
Urban	1,209	23.6	1.00 (reference)	-	1.00 (reference)	-
Rural	2,085	38.0	1.77 (1.53–2.06)	<0.001	**2.10 (1.31–3.35)**	**0.002**
Wealth						
Highest	723	20.2	1.00 (reference)	-	1.00 (reference)	-
Fourth	604	27.7	1.62 (1.28–2.05)	<0.001	1.29 (0.97–1.70)	0.077
Middle	597	34.8	2.06 (1.63–2.61)	<0.001	1.37 (1.00–1.88)	0.052
Second	738	38.9	2.54 (2.02–3.19)	<0.001	1.34 (0.94–1.90)	0.105
Lowest	632	42.6	3.13 (2.46–3.97)	<0.001	**1.60 (1.09–2.36)**	**0.016**
Region						
North Central	589	32.2	1.00 (reference)	-	1.00 (reference)	-
North East	437	31.0	0.91 (0.73–1.15)	0.443	1.33 (0.75–2.37)	0.326
North West	1,005	42.9	1.82 (1.48–2.24)	<0.001	**2.48 (1.48–4.14)**	**0.001**
South East	281	19.1	0.59 (0.44–0.79)	<0.001	1.21 (0.70–2.08)	0.502
South South	372	29.7	0.94 (0.73–1.20)	0.603	1.38 (0.77–2.48)	0.277
South West	610	25.7	0.78 (0.61–1.00)	0.050	1.34 (0.82–2.17)	0.240
Effect of region for rural residents						
North Central	462	35.8	-	-	1.00 (reference)	-
North East	341	33.4	-	-	0.69 (0.37–1.31)	0.259
North West	778	45.1	-	-	**0.53 (0.30–0.94)**	**0.029**
South East	106	17.8	-	-	**0.37 (0.18–0.77)**	**0.008**
South South	257	34.2	-	-	0.71 (0.36–1.36)	0.300
South West	142	39.8	-	-	0.81 (0.43–1.52)	0.512
Number of household members						
1–4	990	30.9	1.00 (reference)	-	1.00 (reference)	-
5–7	1,434	31.7	0.97 (0.82–1.14)	0.68	0.95 (0.78–1.14)	0.552
8+	870	36.6	1.15 (0.96–1.38)	0.125	0.97 (0.79–1.20)	0.802
Malaria risk zone						
Low	849	25.8	1.00 (reference)	-	1.00 (reference)	-
Medium	1,795	34.5	1.33 (1.13–1.58)	0.001	0.91 (0.72–1.15)	0.416
High	651	36.8	1.46 (1.19–1.80)	<0.001	1.20 (0.93–1.56)	0.160
PMI-supported state						
No	2,274	30.6	1.00 (reference)	-	1.00 (reference)	-
Yes	1,021	37.5	1.56 (1.35–1.80)	<0.001	**1.36 (1.13–1.65)**	**0.001**

Model 7. Household access to ITNs and moderate anemia prevalence (8–9.9 g/dL) in children 6–59 months of age

Background characteristic	N	Moderate anemia prevalence (%)	Unadjusted OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value
Total	**3,365**	**32.8**				
Household access to ITN (one ITN for every two people)						
No ITN	2,459	32.2	1.00 (reference)	-	1.00 (reference)	-
Household owns at least one ITN for every two people	906	34.6	1.06 (0.91–1.23)	0.481	0.93 (0.78–1.11)	0.422
Sex of child						
Male	1,668	35.2	1.00 (reference)	-	1.00 (reference)	-
Female	1,626	30.1	0.88 (0.77–1.01)	0.073	**0.85 (0.73–0.99)**	**0.036**
Age of child						
6–23 months	1,084	38.3	1.00 (reference)	-	1.00 (reference)	-
24–59 months	2,210	30.0	0.65 (0.56–0.75)	<0.001	**0.59 (0.51–0.69)**	**<0.001**
Mother's education						
No formal education	1,407	38.6	1.00 (reference)	-	1.00 (reference)	-
Primary education	570	37.0	0.91 (0.75–1.11)	0.361	1.19 (0.95–1.49)	0.124
Secondary or higher education	1,318	24.6	0.52 (0.44–0.62)	<0.001	0.82 (0.65–1.03)	0.087
Place of residence						
Urban	1,209	23.6	1.00 (reference)	-	1.00 (reference)	-
Rural	2,085	38.0	1.81 (1.56–2.09)	<0.001	**2.14 (1.34–3.42)**	**0.001**
Wealth						
Highest	723	20.2	1.00 (reference)	-	1.00 (reference)	-
Fourth	604	27.7	1.60 (1.27–2.02)	<0.001	1.25 (0.95–1.65)	0.111
Middle	597	34.8	2.04 (1.62–2.57)	<0.001	1.32 (0.97–1.80)	0.080
Second	738	38.9	2.55 (2.03–3.19)	<0.001	1.33 (0.94–1.88)	0.102
Lowest	632	42.6	3.10 (2.45–3.94)	<0.001	**1.53 (1.05–2.24)**	**0.028**
Region						
North Central	589	32.2	1.00 (reference)	-	1.00 (reference)	-
North East	437	31.0	0.92 (0.73–1.15)	0.460	1.41 (0.80–2.49)	0.240
North West	1,005	42.9	1.86 (1.51–2.28)	<0.001	**2.82 (1.70–4.67)**	**<0.001**
South East	281	19.1	0.59 (0.44–0.78)	<0.001	1.36 (0.79–2.32)	0.268
South South	372	29.7	0.95 (0.74–1.21)	0.662	1.44 (0.81–2.57)	0.219
South West	610	25.7	0.80 (0.62–1.01)	0.067	1.41 (0.87–2.29)	0.161
Effect of region for rural residents						
North Central	469	35.7	-	-	1.00 (reference)	-
North East	348	33.3	-	-	0.66 (0.35–1.23)	0.192
North West	792	45.4	-	-	**0.50 (0.29–0.89)**	**0.018**
South East	109	17.3	-	-	**0.34 (0.17–0.71)**	**0.004**
South South	272	34.9	-	-	0.78 (0.41–1.50)	0.462
South West	145	40.4	-	-	0.81 (0.43–1.50)	0.496
Number of household members						
1–4	990	30.9	1.00 (reference)	-	1.00 (reference)	-
5–7	1,434	31.7	0.96 (0.81–1.13)	0.615	0.93 (0.77–1.12)	0.444
8+	870	36.6	1.13 (0.94–1.35)	0.188	0.94 (0.76–1.16)	0.555
Malaria risk zone						
Low	849	25.8	1.00 (reference)	-	1.00 (reference)	-
Medium	1,795	34.5	1.33 (1.12–1.57)	0.001	0.97 (0.77–1.22)	0.782
High	651	36.8	1.43 (1.17–1.76)	0.001	1.24 (0.96–1.59)	0.101
PMI-supported state						
No	2,274	30.6	1.00 (reference)	-	1.00 (reference)	-
Yes	1,021	37.5	1.54 (1.33–1.78)	<0.001	**1.38 (1.15–1.66)**	**0.001**

Model 8. ITN use by children under five years of age and moderate anemia prevalence (8–9.9 g/dL) in children 6–59 months of age

Background characteristic	N	Moderate anemia prevalence (%)	Unadjusted OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value
Total	**3,365**	**32.8**				
Used an ITN the previous night						
No	1,870	29.5	1.00 (reference)	-	1.00 (reference)	-
Yes	552	36.9	1.36 (1.19–1.57)	<0.001	1.08 (0.92–1.26)	0.358
Sex of child						
Male	1,668	35.2	1.00 (reference)	-	1.00 (reference)	-
Female	1,626	30.1	0.88 (0.77–1.01)	0.073	**0.85 (0.73–0.99)**	**0.033**
Age of child						
6–23 months	1,084	38.3	1.00 (reference)	-	1.00 (reference)	-
24–59 months	2,210	30.0	0.65 (0.56–0.75)	<0.001	**0.59 (0.50–0.69)**	**<0.001**
Mother's education						
No formal education	1,407	38.6	1.00 (reference)	-	-	-
Primary education	570	37.0	0.91 (0.75–1.11)	0.361	1.00 (reference)	0.138
Secondary or higher education	1,318	24.6	0.52 (0.44–0.62)	<0.001	0.81 (0.64–1.02)	0.076
Place of residence						
Urban	1,209	23.6	1.00 (reference)	-	1.00 (reference)	-
Rural	2,085	38.0	1.81 (1.56–2.09)	<0.001	**2.12 (1.33–3.38)**	**0.002**
Wealth						
Highest	723	20.2	1.00 (reference)	-	1.00 (reference)	-
Fourth	604	27.7	1.60 (1.27–2.02)	<0.001	1.24 (0.94–1.63)	0.128
Middle	597	34.8	2.04 (1.62–2.57)	<0.001	1.30 (0.95–1.78)	0.101
Second	738	38.9	2.55 (2.03–3.19)	<0.001	1.31 (0.93–1.85)	0.128
Lowest	632	42.6	3.10 (2.45–3.94)	<0.001	**1.50 (1.02–2.19)**	**0.039**
Region						
North Central	589	32.2	1.00 (reference)	-	1.00 (reference)	-
North East	437	31.0	0.92 (0.73–1.15)	0.460	1.37 (0.78–2.43)	0.277
North West	1,005	42.9	1.86 (1.51–2.28)	<0.001	**2.73 (1.65–4.52)**	**<0.001**
South East	281	19.1	0.59 (0.44–0.78)	<0.001	1.35 (0.79–2.30)	0.277
South South	372	29.7	0.95 (0.74–1.21)	0.662	1.44 (0.80–2.57)	0.222
South West	610	25.7	0.80 (0.62–1.01)	0.067	1.41 (0.87–2.29)	0.161
Effect of region for rural residents						
North Central	469	35.7	-	-	1.00 (reference)	-
North East	348	33.3	-	-	0.67 (0.36–1.26)	0.213
North West	792	45.4	-	-	**0.51 (0.29–0.90)**	**0.020**
South East	109	17.3	-	-	**0.35 (0.17–0.73)**	**0.005**
South South	272	34.9	-	-	0.79 (0.41–1.51)	0.471
South West	145	40.4	-	-	0.82 (0.44–1.52)	0.525
Number of household members						
1–4	990	30.9	1.00 (reference)	-	1.00 (reference)	-
5–7	1,434	31.7	0.96 (0.81–1.13)	0.615	0.95 (0.79–1.14)	0.555
8+	870	36.6	1.13 (0.94–1.35)	0.188	0.96 (0.78–1.18)	0.718
Malaria risk zone						
Low	849	25.8	1.00 (reference)	-	1.00 (reference)	-
Medium	1,795	34.5	1.33 (1.12–1.57)	0.001	0.97 (0.77–1.22)	0.787
High	651	36.8	1.43 (1.17–1.76)	0.001	1.24 (0.96–1.59)	0.099
No	2,274	30.6	1.00 (reference)	-	1.00 (reference)	-
Yes	1,021	37.5	1.54 (1.33–1.78)	<0.001	**1.37 (1.14–1.65)**	**0.001**

Model 9. Household ownership of at least one ITN and severe anemia prevalence (<8 g/dL) in children 6–59 months of age

Background characteristic	N	Severe anemia prevalence (%)	Unadjusted OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value
Total	**3,365**	**10.2**				
Household ITN ownership						
No ITN	815	6.7	1.00 (reference)	-	1.00 (reference)	-
Owns at least one ITN	2,550	11.3	1.29 (0.98–1.70)	<0.001	0.81 (0.59–1.11)	0.193
Sex of child						
Male	1,700	10.5	1.00 (reference)	-	1.00 (reference)	-
Female	1,665	9.8	0.94 (0.75–1.18)	0.579	1.00 (0.78–1.28)	0.998
Age of child						
6–23 months	1,106	12.0	1.00 (reference)	-	1.00 (reference)	-
24–59 months	2,258	9.3	0.79 (0.62–0.99)	0.045	**0.72 (0.56–0.94)**	**0.015**
Mother's education						
No formal education	1,435	16.7	1.00 (reference)	-	1.00 (reference)	-
Primary education	581	6.6	0.40 (0.28–0.57)	<0.001	**0.56 (0.38–0.83)**	**0.003**
Secondary or higher education	1,349	4.6	0.26 (0.15–0.20)	<0.001	0.70 (0.47–1.06)	0.089
Place of residence						
Urban	1,231	5.5	1.00 (reference)	-	1.00 (reference)	-
Rural	2,134	12.8	2.52 (1.90–3.33)	<0.001	0.93 (0.64–1.36)	0.716
Wealth						
Highest	739	1.9	1.00 (reference)	-	1.00 (reference)	-
Fourth	623	5.0	3.07 (1.59–5.94)	0.001	**3.03 (1.47–6.25)**	**0.003**
Middle	609	9.0	5.62 (3.00–10.51)	<0.001	**6.05 (2.91–12.57)**	**<0.001**
Second	757	16.2	10.65 (5.82–19.47)	<0.001	**11.75 (5.43–25.39)**	**<0.001**
Lowest	638	18.6	12.90 (7.03–23.69)	<0.001	**11.03 (4.93–24.71)**	**<0.001**
Region						
North Central	601	5.0	1.00 (reference)	-	1.00 (reference)	-
North East	445	7.7	1.44 (0.94–2.18)	0.091	0.89 (0.55–1.43)	0.626
North West	1,024	20.0	3.59 (2.51–5.15)	<0.001	**2.72 (1.78–4.14)**	**<0.001**
South East	290	6.8	0.97 (0.57–1.67)	0.923	**2.29 (1.24–4.25)**	**0.008**
South South	390	6.1	1.01 (0.62–1.63)	0.966	**2.31 (1.26–4.25)**	**0.007**
South West	616	4.6	0.76 (0.45–1.26)	0.283	**1.89 (1.04–3.45)**	**0.037**
Number of household members						
1–4	1,013	9.3	1.00 (reference)	-	1.00 (reference)	-
5–7	1,465	9.5	1.03 (0.78–1.37)	0.812	1.01 (0.74–1.38)	0.959
8+	887	12.2	1.44 (1.07–1.94)	0.015	0.97 (0.69–1.35)	0.840
Malaria risk zone						
Low	871	7.2	1.00 (reference)	-	1.00 (reference)	-
Medium	1,825	10.0	1.75 (1.31–2.33)	<0.001	**1.64 (1.14–2.36)**	**0.008**
High	669	6.1	0.89 (0.60–1.32)	0.547	0.70 (0.44–1.11)	0.132
PMI-supported state						
No	2,329	10.8	1.00 (reference)	-	1.00 (reference)	-
Yes	1,036	8.6	0.99 (0.78–1.26)	0.936	**0.56 (0.41–0.75)**	**<0.001**

Model 10. Household ownership of ITNs (by age of net) and severe anemia prevalence (<8 g/dL) in children 6–59 months of age

Background characteristic	N	Severe anemia prevalence (%)	Unadjusted OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value
Total	**3,294**	**10.3**				
Household ITN ownership						
No ITN	815	6.7	1.00 (reference)	-	1.00 (reference)	-
ITN owned 0–1 month	98	12.1	1.58 (0.87–2.84)	0.130	0.79 (0.39–1.61)	0.519
ITN owned 2–6 months	618	14.3	1.56 (1.11–2.19)	0.011	0.91 (0.61–1.36)	0.644
ITN owned 7–12 months	1,058	12.2	1.33 (0.97–1.82)	0.079	0.80 (0.55–1.15)	0.220
ITN owned >12 months	705	7.5	1.03 (0.72–1.47)	0.869	0.79 (0.53–1.19)	0.257
Sex of child						
Male	1,700	10.5	1.00 (reference)	-	1.00 (reference)	-
Female	1,665	9.8	0.94 (0.75–1.19)	0.635	1.02 (0.79–1.31)	0.870
Age of child						
6–23 months	1,106	12	1.00 (reference)	-	1.00 (reference)	-
24–59 months	2,258	9.3	0.78 (0.61–0.99)	0.038	**0.70 (0.54–0.91)**	**0.008**
Mother's education						
No formal education	1,435	16.7	1.00 (reference)	-	1.00 (reference)	-
Primary education	581	6.6	0.40 (0.28–0.57)	<0.001	**0.56 (0.38–0.83)**	**0.004**
Secondary or higher education	1,349	4.6	0.25 (0.19–0.35)	<0.001	0.68 (0.45–1.03)	0.069
Place of residence						
Urban	1,231	5.5	1.00 (reference)	-	1.00 (reference)	-
Rural	2,134	12.8	2.48 (1.88–3.29)	<0.001	0.90 (0.62–1.32)	0.600
Wealth						
Highest	739	1.9	1.00 (reference)	-	1.00 (reference)	-
Fourth	623	5	2.99 (1.54–5.80)	0.001	**2.97 (1.44–6.15)**	**0.003**
Middle	609	9	5.51 (2.94–10.32)	<0.001	**5.96 (2.86–12.44)**	**<0.001**
Second	757	16.2	10.49 (5.74–19.19)	<0.001	**11.80 (5.42–25.68)**	**<0.001**
Lowest	638	18.6	12.58 (6.85–23.11)	<0.001	**10.86 (4.82–24.44)**	**<0.001**
Region						
North Central	601	5	1.00 (reference)	-	1.00 (reference)	-
North East	445	7.7	1.41 (0.93–2.15)	0.107	0.87 (0.54–1.40)	0.565
North West	1,024	20	3.56 (2.49–5.11)	<0.001	**2.62 (1.70–4.02)**	**<0.001**
South East	290	6.8	0.93 (0.54–1.62)	0.801	**2.18 (1.16–4.10)**	**0.016**
South South	390	6.1	1.01 (0.62–1.64)	0.979	**2.25 (1.20–4.19)**	**0.011**
South West	616	4.6	0.75 (0.45–1.25)	0.272	**1.89 (1.03–3.47)**	**0.039**
Number of household members						
1–4	1,013	9.3	1.00 (reference)	-	1.00 (reference)	-
5–7	1,465	9.5	1.05 (0.79–1.40)	0.724	1.05 (0.76–1.43)	0.783
8+	887	12.2	1.49 (1.10–2.01)	0.009	1.01 (0.72–1.41)	0.972
Malaria risk zone						
Low	871	7.2	1.00 (reference)	-	1.00 (reference)	-
Medium	1,825	10	1.73 (1.30–2.31)	<0.001	**1.58 (1.09–2.29)**	**0.015**
High	669	6.1	0.90 (0.60–1.34)	0.601	0.66 (0.41–1.07)	0.095
PMI-supported state						
No	2,329	10.8	1.00 (reference)	-	1.00 (reference)	-
Yes	1,036	8.6	0.97 (0.76–1/24)	0.823	**0.55 (0.40–0.75)**	**<0.001**

Model 11. Household access to ITNs and severe anemia prevalence (<8 g/dL) in children 6–59 months of age

Background characteristic	N		Severe anemia prevalence (%)	Unadjusted OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value
Total	**3,365**		**10.2**				
Household access to ITN (one ITN for every two people)							
No ITN	2,459	9.6	1.00 (reference)	-	1.00 (reference)		-
Household owns at least one ITN for every two people	906	11.7	1.02 (0.79–1.32)	0.881	0.86 (0.64–1.15)		0.305
Sex of child							
Male	1,700	10.5	1.00 (reference)	-	1.00 (reference)		-
Female	1,665	9.8	0.94 (0.75–1.18)	0.579	1.00 (0.78–1.28)		0.980
Age of child							
6–23 months	1,106	12	1.00 (reference)	-	1.00 (reference)		-
24–59 months	2,258	9.3	0.79 (0.62–0.99)	0.045	**0.73 (0.56–0.94)**		**0.017**
Mother's education							
No formal education	1,435	16.7	1.00 (reference)	-	1.00 (reference)		-
Primary education	581	6.6	0.40 (0.28–0.57)	<0.001	**0.56 (0.38–0.82)**		**0.003**
Secondary or higher education	1,349	4.6	0.26 (0.15–0.20)	<0.001	0.70 (0.46–1.05)		0.084
Place of residence							
Urban	1,231	5.5	1.00 (reference)	-	1.00 (reference)		-
Rural	2,134	12.8	2.52 (1.90–3.33)	<0.001	0.94 (0.65–1.37)		0.743
Wealth							
Highest	739	1.9	1.00 (reference)	-	1.00 (reference)		-
Fourth	623	5	3.07 (1.59–5.94)	0.001	**3.03 (1.47–6.24)**		**0.003**
Middle	609	9	5.62 (3.00–10.51)	<0.001	**6.00 (2.89–12.46)**		**<0.001**
Second	757	16.2	10.65 (5.82–19.47)	<0.001	**11.74 (5.43–25.38)**		**<0.001**
Lowest	638	18.6	12.90 (7.03–23.69)	<0.011	**10.97 (4.90–24.55)**		**<0.001**
Region							
North Central	601	5	1.00 (reference)	-	1.00 (reference)		-
North East	445	7.7	1.44 (0.94–2.18)	0.091	0.87 (0.54–1.39)		0.564
North West	1,024	20	3.59 (2.51–5.15)	<0.001	**2.64 (1.74–3.99)**		**<0.001**
South East	290	6.8	0.97 (0.57–1.67)	0.923	**2.29 (1.24–4.25)**		**0.009**
South South	390	6.1	1.01 (0.62–1.63)	0.966	**2.33 (1.27–4.28)**		**0.006**
South West	616	4.6	0.76 (0.45–1.26)	0.283	**1.93 (1.06–3.51)**		**0.032**
Number of household members							
1–4	1,013	9.3	1.00 (reference)	-	1.00 (reference)		-
5–7	1,465	9.5	1.03 (0.78–1.37)	0.812	0.97 (0.70–1.33)		0.834
8+	887	12.2	1.44 (1.07–1.94)	0.015	0.91 (0.65–1.30)		0.615
Malaria risk zone							
Low	871	7.2	1.00 (reference)	-	1.00 (reference)		-
Medium	1,825	10	1.75 (1.31–2.33)	<0.001	**1.64 (1.14–2.36)**		**0.008**
High	669	6.1	0.89 (0.60–1.32)	0.547	0.70 (0.44–1.12)		0.133
PMI-supported state							
No	2,329	10.8	1.00 (reference)	-	1.00 (reference)		-
Yes	1,036	8.6	0.99 (0.78–1.26)	0.936	**0.55 (0.41–0.75)**		**<0.001**

Model 12. ITN use by children under five and severe anemia prevalence (<8 g/dL) in children 6–59 months of age

Background characteristic	N	Severe anemia prevalence (%)	Unadjusted OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value
Total	**3,365**	**10.2**				
Used an ITN the previous night						
No	1,870	8.5	1.00 (reference)	-	1.00 (reference)	-
Yes	1,495	12.1	1.20 (0.96–1.51)	0.108	**0.67 (0.51–0.87)**	**0.003**
Sex of child						
Male	1,700	10.5	1.00 (reference)	-	1.00 (reference)	-
Female	1,665	9.8	0.94 (0.75–1.18)	0.579	1.01 (0.79–1.30)	0.941
Age of child						
6–23 months	1,106	12	1.00 (reference)	-	1.00 (reference)	-
24–59 months	2,258	9.3	0.79 (0.62–0.99)	0.045	**0.72 (0.55–0.93)**	**0.012**
Mother's education						
No formal education	1,435	16.7	1.00 (reference)	-	1.00 (reference)	-
Primary education	581	6.6	0.40 (0.28–0.57)	<0.001	**0.56 (0.38–0.83)**	**0.004**
Secondary or higher education	1,349	4.6	0.26 (0.15–0.20)	<0.001	0.71 (0.47–1.06)	0.095
Place of residence						
Urban	1,231	5.5	1.00 (reference)	-	1.00 (reference)	-
Rural	2,134	12.8	2.52 (1.90–3.33)	<0.001	0.91 (0.63–1.33)	0.640
Wealth						
Highest	739	1.9	1.00 (reference)	-	1.00 (reference)	-
Fourth	623	5	3.07 (1.59–5.94)	0.001	**3.08 (1.49–6.35)**	**0.002**
Middle	609	9	5.62 (3.00–10.51)	<0.001	**6.38 (3.06–13.28)**	**<0.001**
Second	757	16.2	10.65 (5.82–19.47)	<0.001	**12.68 (5.85–27.52)**	**<0.001**
Lowest	638	18.6	12.90 (7.03–23.69)	<0.001	**11.99 (5.33–26.95)**	**<0.001**
Region						
North Central	601	5	1.00 (reference)	-	1.00 (reference)	-
North East	445	7.7	1.44 (0.94–2.18)	0.091	0.86 (0.54–1.39)	0.543
North West	1,024	20	3.59 (2.51–5.15)	<0.001	**2.80 (1.85–4.24)**	**<0.001**
South East	290	6.8	0.97 (0.57–1.67)	0.923	**2.14 (1.15–3.98)**	**0.016**
South South	390	6.1	1.01 (0.62–1.63)	0.966	**2.19 (1.19–4.04)**	**0.012**
South West	616	4.6	0.76 (0.45–1.26)	0.283	1.81 (0.99–3.30)	0.053
Number of household members						
1–4	1,013	9.3	1.00 (reference)	-	1.00 (reference)	-
5–7	1,465	9.5	1.03 (0.78–1.37)	0.812	0.99 (0.72–1.35)	0.934
8+	887	12.2	1.44 (1.07–1.94)	0.015	0.93 (0.66–1.30)	0.676
Malaria risk zone						
Low	871	7.2	1.00 (reference)	-	1.00 (reference)	-
Medium	1,825	10	1.75 (1.31–2.33)	<0.001	**1.57 (1.09–2.27)**	**0.015**
High	669	6.1	0.89 (0.60–1.32)	0.547	0.66 (0.41–1.05)	0.082
PMI-supported state						
No	2,329	10.8	1.00 (reference)	-	1.00 (reference)	-
Yes	1,036	8.6	0.99 (0.78–1.26)	0.936	**0.57 (0.42–0.76)**	**<0.001**

Research Objective 4 Tables

Model 1. Exposure to malaria BCC messages and ITN use among children under five years of age

Background characteristic	N	ITN use among children under five (%)	Unadjusted OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value
Total	2,826	43.6				
Exposure to malaria BCC messages						
None	2,415	41.0	1.00 (reference)	-	1.00 (reference)	-
Recalled at least one related malaria message	411	58.7	1.87 (1.49–2.34)	<0.001	**2.12 (1.65–2.72)**	**<0.001**
Sex of child						
Male	1,457	43.9	1.00 (reference)	-	1.00 (reference)	-
Female	1,369	43.4	1.00 (0.86–1.16)	0.991	1.00 (0.85–1.18)	0.991
Age of child						
0–11 months	394	41.5	1.00 (reference)	-	1.00 (reference)	-
12–23 months	808	43.5	1.08 (0.84–1.38)	0.547	0.96 (0.73–1.25)	0.742
24–35 months	692	49.2	1.31 (1.02–1.69)	0.038	1.12 (0.85–1.48)	0.412
36–47 months	552	41.8	0.99 (0.75–1.29)	0.916	0.83 (0.62–1.10)	0.197
48–59 months	381	38.5	0.94 (0.70–1.25)	0.668	0.82 (0.60–1.13)	0.227
Mother's education						
No formal education	1,193	54.4	1.00 (reference)	-	1.00 (reference)	-
Primary education	469	41.2	0.63 (0.51–0.79)	<0.001	1.06 (0.82–1.35)	0.670
Secondary or higher education	1,165	33.5	0.47 (0.39–0.55)	<0.001	1.14 (0.89–1.46)	0.295
Place of residence						
Urban	1,054	34.3	1.00 (reference)	-	1.00 (reference)	-
Rural	1,773	49.1	1.56 (1.33–1.83)	<0.001	0.81 (0.64–1.01)	0.067
Wealth						
Highest	645	26.2	1.00 (reference)	-	1.00 (reference)	-
Fourth	523	33.1	1.39 (1.08–1.78)	0.010	**1.56 (1.18–2.07)**	**0.002**
Middle	502	47.1	2.23 (1.81–2.97)	<0.001	**2.97 (2.07–4.26)**	**<0.001**
Second	611	52.2	2.86 (2.24–3.65)	<0.001	**3.87 (2.50–5.99)**	**<0.001**
Lowest	545	61.5	4.17 (3.21–5.41)	<0.001	**4.41 (2.74–7.08)**	**<0.001**
Region						
North Central	515	39.3	1.00 (reference)	-	1.00 (reference)	-
North East	366	50.6	1.39 (1.09–1.77)	0.008	1.22 (0.93–1.60)	0.160
North West	857	65.2	2.68 (2.11–3.39)	<0.001	**2.11 (1.62–2.74)**	**<0.001**
South East	230	22.9	0.48 (0.34–0.67)	<0.001	**0.43 (0.30–0.61)**	**<0.001**
South South	328	32.4	0.66 (0.50 -0.87)	0.004	**0.67 (0.49–0.94)**	**0.018**
South West	532	24.1	0.50 (0.38–0.66)	<0.001	**0.53 (0.38–0.73)**	**<0.001**
Number of household members						
1–4	939	43.5	1.00 (reference)	-	1.00 (reference)	-
5–7	1,182	40.8	0.92 (0.77–1.09)	0.334	0.83 (0.69–1.01)	0.064
8+	705	48.5	1.14 (0.93–1.39)	0.203	**0.69 (0.55–0.87)**	**0.001**
Malaria risk zone						
Low	726	36.8	1.00 (reference)	-	1.00 (reference)	-
Medium	1,537	47.7	1.46 (1.21–1.75)	<0.001	**0.70 (0.54–0.89)**	**0.004**
High	563	41.2	1.17 (0.93–1.47)	0.188	**0.69 (0.53–0.91)**	**0.008**
PMI-supported state						
No	1,949	42.5	1.00 (reference)	-	1.00 (reference)	-
Yes	877	46.2	1.54 (1.31–1.81)	<0.001	**1.41 (1.15–1.72)**	**0.001**
Household ownership of radio						
No	1,134	44.5	1.00 (reference)	-	1.00 (reference)	-
Yes	1,693	43.0	1.00 (0.86–1.16)	0.975	**1.37 (1.14–1.64)**	**0.001**
Household ownership of TV						
No	1,499	52.5	1.00 (reference)	-	1.00 (reference)	-
Yes	1,327	33.5	0.52 (0.45–0.61)	<0.001	**1.36 (1.04–1.78)**	**0.026**

Model 2. Exposure to malaria BCC messages and ITN use among pregnant women

Background characteristic	N	ITN use among pregnant women (%)	Unadjusted OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value
Total	**903**	**48.9**				
Exposure to malaria BCC messages						
None	775	46.8	1.00 (reference)	-	1.00 (reference)	-
Recalled at least one related malaria message	128	61.7	1.94 (1.27–2.95)	0.002	**2.42 (1.46–4.00)**	**0.001**
Woman's age						
15–19	132	48.3	1.00 (reference)	-	1.00 (reference)	-
20–34	649	49.4	0.94 (0.63–1.41)	0.780	1.13 (0.66–1.94)	0.661
35–49	122	46.8	1.00 (0.60–1.68)	0.991	1.67 (0.82–3.41)	0.156
Woman's education level						
No formal education	409	61.9	1.00 (reference)	-	1.00 (reference)	-
Primary education	157	47.9	0.57 (0.39–0.83)	0.003	1.08 (0.68–1.71)	0.744
Secondary or higher education	338	33.7	0.31 (0.23–0.43)	<0.001	1.12 (0.68–1.85)	0.651
Place of residence						
Urban	273	36	1.00 (reference)	-	1.00 (reference)	-
Rural	630	54.5	1.76 (1.31–2.36)	<0.001	**3.78 (1.18–12.06)**	**0.025**
Wealth						
Highest	176	30.4	1.00 (reference)	-	1.00 (reference)	-
Fourth	143	30.7	1.09 (0.68–1.75)	0.731	1.18 (0.65–2.14)	0.580
Middle	168	49.4	2.55 (1.62–4.02)	<0.001	**2.41 (1.19–4.92)**	**0.015**
Second	184	58.5	3.30 (2.10–5.18)	<0.001	**2.49 (1.07–5.78)**	**0.033**
Lowest	232	66.1	4.76 (3.01–7.53)	<0.001	**2.66 (1.09–6.51)**	**0.032**
Region						
North Central	132	37.8	1.00 (reference)	-	1.00 (reference)	-
North East	140	55.5	1.60 (1.02–2.53)	0.042	**6.61 (1.92–22.75)**	**0.003**
North West	326	67.8	3.31 (2.12–5.18)	<0.001	**7.50 (2.21–25.48)**	**0.001**
South East	79	22.7	0.47 (0.26–0.86)	<0.001	2.15 (0.64–7.25)	0.217
South South	108	33.3	0.63 (0.37–1.08)	<0.001	2.05 (0.55–7.72)	0.287
South West	119	33.2	0.65 (0.37–1.13)	<0.001	1.31 (0.39–4.40)	0.666
Parity						
0	186	32.6	1.00 (reference)	-	1.00 (reference)	-
1	166	51.6	2.07 (1.31–3.25)	0.002	**2.68 (1.54–4.64)**	**<0.001**
2	158	53	2.39 (1.52–3.76)	<0.001	**2.89 (1.66–5.03)**	**<0.001**
3+	394	53.8	2.40 (1.64–3.50)	<0.001	**1.89 (1.10–3.25)**	**0.021**
Number of household members						
1–4	393	43	1.00 (reference)	-	1.00 (reference)	-
5–7	263	50.5	1.40 (1.02–1.92)	0.039	1.15 (0.76–1.75)	0.499
8+	247	56.6	1.66 (1.19–2.32)	0.314	0.80 (0.58–1.37)	0.593
Malaria risk zone						
Low	238	44.8	1.00 (reference)	-	1.00 (reference)	-
Medium	500	50.6	1.36 (0.99–1.87)	0.059	**0.44 (0.27–0.70)**	**<0.001**
High	165	49.6	1.23 (0.82–1.86)	0.314	1.07 (0.63–1.84)	0.802
PMI-supported state						
No	606	44	1.00 (reference)	-	1.00 (reference)	-
Yes	297	58.9	2.26 (1.69–3.01)	<0.001	**3.28 (2.20–4.89)**	**<0.001**
Household ownership of radio						
No	344	51	1.00 (reference)	-	1.00 (reference)	-
Yes	546	48	0.91 (0.68–1.20)	0.485	1.12 (0.79–1.59)	0.511
Household ownership of TV						
No	539	58	1.00 (reference)	-	1.00 (reference)	-
Yes	352	35	0.40 (0.30–0.54)	<0.001	1.12 (0.79–1.59)	0.511

Note: Significant interaction found between place of residence and region; results not presented in the model.

Model 3. Exposure to malaria BCC messages and care-seeking from an appropriate provider for children under five years of age with fever in the two weeks preceding the survey

Background characteristic	N	Sought care from appropriate provider (%)	Unadjusted OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value
Total	**1,231**	**66.3**				
Exposure to malaria BCC messages						
None	1146	65.4	1.00 (reference)	-	1.00 (reference)	-
Recalled at least one related malaria message	85	78.8	1.64 (0.96–2.80)	0.070	1.69 (0.94–3.04)	0.078
Sex of child						
Male	621	64.2	1.00 (reference)	-	1.00 (reference)	-
Female	610	68.4	1.24 (0.98–1.57)	0.069	1.19 (0.93–1.53)	0.168
Age of child						
0–11 months	169	64.6	1.00 (reference)	-	1.00 (reference)	-
12–23 months	355	70.6	1.20 (0.81–1.76)	0.367	1.14 (0.76–1.73)	0.525
24–35 months	335	65.0	0.99 (0.67–1.47)	0.977	0.95 (0.63–1.45)	0.823
36–47 months	223	62.6	0.99 (0.65–1.50)	0.946	1.00 (0.63–1.57)	0.997
48–59 months	149	66.3	1.00 (0.63–1.56)	0.991	0.92 (0.56–1.50)	0.731
Mother's education						
No formal education	607	62.9	1.00 (reference)	-	1.00 (reference)	-
Primary education	211	66.5	1.40 (1.01–1.93)	0.046	0.94 (0.64–1.37)	0.747
Secondary or higher education	413	71.1	1.42 (1.09–1.85)	0.008	0.84 (0.57–1.24)	0.385
Place of residence						
Urban	341	72.7	1.00 (reference)	-	1.00 (reference)	-
Rural	890	63.8	0.65 (0.50–0.86)	0.002	**0.68 (0.47–0.98)**	**0.041**
Wealth						
Highest	187	75.1	1.00 (reference)	-	1.00 (reference)	-
Fourth	197	68.6	0.72 (0.47–1.11)	0.133	0.53 (0.19–1.52)	0.240
Middle	214	69.7	0.76 (0.50–1.17)	0.212	**0.23 (0.08–0.69)**	**0.009**
Second	319	63.7	0.61 (0.41–0.91)	0.016	**0.29 (0.09–0.88)**	**0.030**
Lowest	314	59.8	0.44 (0.29–0.66)	<0.001	**0.26 (0.07–0.96)**	**0.044**
Region						
North Central	159	79.5	1.00 (reference)	-	1.00 (reference)	-
North East	194	69.5	0.50 (0.32–0.77)	0.002	**0.48 (0.29–0.77)**	**0.003**
North West	489	56.9	0.26 (0.17–0.39)	<0.001	**0.22 (0.14–0.35)**	**<0.001**
South East	93	82.4	1.00 (0.55–1.84)	0.988	0.77 (0.40–1.49)	0.439
South South	162	65.0	0.39 (0.25–0.63)	<0.001	**0.41 (0.24–0.71)**	**0.002**
South West	134	70.6	0.46 (0.27–0.79)	0.005	**0.36 (0.20–0.65)**	**0.001**
Number of household members						
1–4	403	63.9	1.00 (reference)	-	1.00 (reference)	-
5–7	487	68.5	1.29 (0.98–1.70)	0.071	1.31 (0.96–1.78)	0.086
8+	341	65.9	1.22 (0.90–1.64)	0.196	1.16 (0.81–1.66)	0.416
Number of ITNs owned by household						
0	212	68.2	1.00 (reference)	-	1.00 (reference)	-
1	221	62.3	0.74 (0.51–1.07)	0.112	**0.32 (0.11–0.92)**	**0.034**
2	396	63.8	0.77 (0.55–1.09)	0.140	**0.16 (0.06–0.45)**	**0.001**
3+	403	69.9	1.19 (0.84–1.67)	0.332	0.78 (0.24–2.57)	0.683
Malaria risk zone						
Low	265	67.2	1.00 (reference)	-	1.00 (reference)	-
Medium	736	66.0	1.10 (0.83–1.46)	0.510	1.44 (0.99–2.09)	0.056
High	230	66.2	1.04 (0.72–1.50)	0.840	1.25 (0.81–1.95)	0.315
PMI-supported state						
No	841	67.4	1.00 (reference)	-	1.00 (reference)	-
Yes	391	63.8	0.85 (0.67–1.09)	0.197	**0.72 (0.53–0.98)**	**0.038**
Household ownership of radio						
No	497	59.3	1.00 (reference)	-	1.00 (reference)	-
Yes	734	71.0	1.53 (1.21–1.94)	<0.001	**1.47 (1.12–1.93)**	**0.005**
Household ownership of TV						
No	758	63.4	1.00 (reference)	-	1.00 (reference)	-
Yes	473	70.9	1.48 (1.16–1.89)	0.001	1.06 (0.69–1.61)	0.801

Note: Bold p-value = statistically significant; Significant interaction found between wealth and the number of household ITNs owned; results not presented in the model.

APPENDIX C. SUMMARY OF MULTIPLE REGRESSION AND CHAID MODELS FOR RESEARCH OBJECTIVES 3, 4, AND 5

Table C.1. Multiple regression models assessing ITN ownership and use and malaria parasitemia, moderate anemia, and severe anemia prevalence in children 6–59 months of age

Models	Outcome variable	Explanatory variables	Other predictor variables	Target population	Sample
1–4	Parasitemia prevalence (measured through microscopy)	• Household ownership of at least one ITN • Household ownership of ITNs by age of net (0 to less than 2 months, 2–6 months; 7–12 months, >12 months) • Household access to an ITN • ITN use among children 6–59 months of age	Sex of child, age of child, mother's education level, place of residence, household wealth quintile, region, number of household members, malaria risk zone, PMI-supported state (yes/no)	Children 6–59 months of age	3,220
5–8	Moderate anemia prevalence (hemoglobin level of 8–9.9 g/dL)	• Household ownership of at least one ITN • Household ownership of ITNs by age of net (0 to less than 2 months, 2–6 months, 7–12 months, >12 months) • Household access to an ITN • ITN use among children 6–59 months of age	Sex of child, age of child, mother's education level, place of residence, household wealth quintile, region, number of household members, number of ITNs owned by household, malaria risk zone, PMI-supported state (yes/no)	Children 6–59 months of age	3,365
9–12	Severe anemia prevalence (hemoglobin level of <8 g/dL)	• Household ownership of at least one ITN • Household ownership of ITNs by age of net (0 to less than 2 months, 2–6 months, 7–12 months; >12 months) • Household access to an ITN • ITN use among children 6–59 months of age	Sex of child, age of child, mother's education level, place of residence, household wealth quintile, region, number of household members, number of ITNs owned by household, malaria risk zone, PMI-supported state (yes/no)	Children 6–59 months of age	3,365

Table C.2. Summary of multiple regression models and case study assessing the relationship between exposure to malaria messages and key malaria behavioral outcomes

	Outcome variable	Explanatory variable	Other predictor variables	Target population	Sample
Multiple regression models					
1	ITN use the previous nigh among children under five years of age	Exposure to malaria social and behavior change (SBC) messages—not exposed vs. recall of at least one malaria SBC message related to ITN use (e.g., sleeping inside a mosquito net is important, who should sleep inside a mosquito net)	Sex of child, age of child, mother's education level, place of residence, household wealth quintile, region, number of household members, number of ITNs owned by household, malaria risk zone, household ownership of radio and TV, residence in PMI-supported state	Children under five years of age	2,826
2	ITN use the previous night among pregnant women	Exposure to malaria SBC messages (not-exposed vs. recall of at least one malaria SBC message related to ITN use (e.g., sleeping inside a mosquito net is important; who should sleep inside a mosquito net)	Women's age, women's education level, place of residence, household wealth quintile, region, parity, number of household members, malaria risk zone, household ownership of radio and TV, residence in PMI-supported state	Pregnant women between 15–49 years of age	903
3	Children under five years of age with fever in the two weeks preceding the survey for whom advice or treatment was sought from an appropriate health provider	Exposure to malaria SBC messages—not exposed vs. recall of at least one malaria SBC message related to care-seeking or treatment for fever (e.g., seek treatment for fever, seek treatment for fever promptly, seek testing for treatment for malaria)	Sex of child, age of child, mother's education level, place of residence, household wealth quintile, region, number of household members, malaria risk zone, household ownership of radio and TV, residence in PMI-supported state	Children under five years of age with fever in the two weeks preceding the survey	1,231
Case-control study					
1	Women 15–49 years of age	Exposure to at least one	Age of woman, woman's education level, place of	Women 15–49 years of	2,490

	Outcome variable	Explanatory variable	Other predictor variables	Target population	Sample
	who had a live birth in the past two years who received IPTp2 (two or more doses of SP)	malaria-related message	residence, household wealth quintile, parity, residence in PMI-supported state	age who had a live birth in the past two years	
2	Women 15–49 years of age who had a live birth in the past two years who received IPTp3 (three or more doses of SP)	Exposure to at least one malaria-related message	Age of woman, woman's education level, place of residence, household wealth quintile, parity, residence in PMI-supported state	Women 15–49 years of age who had a live birth in the past two years	2,490

IPTp=intermittent preventive treatment in pregnancy, SP=sulfadoxine-pyrimethamine

Table C.3. Summary of CHAID models

	Outcome of Interest	Predictor variables assessed in bivariate analysis	Predictor variables included in CHAID model	CHAID variables selected in final model	Target population	Sample
1	Household ownership of at least one ITN	Education level of household head, household wealth quintile, place of residence, region, number of household members	Education level of household head, household wealth quintile, place of residence, region, number of household members	Education level of household head, household wealth quintile, place of residence, region, number of household members	Households surveyed	7,745
2	ITN use among children under five	Sex of child, age of child, mother's education level, household wealth quintile, place of residence, region, number of household members	Age of child, mother's education level, household wealth quintile, place of residence, region, number of household members	Mother's education level, household wealth quintile, place of residence, region, number of household members	Children under five years of age	6,960
3	ITN use among pregnant women	Women's age, women's education level, place of residence, household wealth quintile, region, parity, number of household members, number of ITNs owned by household	Women's education level, place of residence, household wealth quintile, region, parity, number of household members	Region, household wealth quintile	Pregnant women 15–49 years of age	861
4	ITN use among general population	Education level of household head, place of residence, household wealth quintile, region, number of household members	Education level of household head, place of residence, household wealth quintile, region, number of household members	Place of residence, household wealth quintile, region, number of household members	General population	37,776
5	IPTp (three or more doses) uptake among women who had a live birth in the past two years	Women's age, women's education level, place of residence, household wealth quintile, region, parity, ANC provider, number of household members	Women's education level, place of residence, region, household wealth quintile	Women's education level, place of residence, region	Women 15–49 years of age who had a live birth in the past two years	2,522

	Outcome of Interest	Predictor variables assessed in bivariate analysis	Predictor variables included in CHAID model	CHAID variables selected in final model	Target population	Sample
6	Children under five with fever in the two weeks preceding the survey that received ACT treatment	Sex of child, age of child, mother's education level, household wealth quintile, place of residence, region, number of household members, number of ITNs owned by household	Women's education level, place of residence, household wealth quintile	Women's education level, place of residence	Children under five years of age with fever in the two weeks preceding the survey	2,605
7	Exposure to at least one malaria SBC message in the past six months	Age of woman, woman's education level, household wealth quintile, place of residence, region, number of household members	Age of woman, woman's education level, household wealth quintile, place of residence, region	Age of woman, woman's education level, household wealth quintile, place of residence, region	Women 15–49 years of age	8,034
8	Parasitemia prevalence (via microscopy) among children 6–59 months of age	Sex of child, age of child, mother's education level, household wealth quintile, place of residence, region, number of household members, number of ITNs owned by households	Age of child, mother's education level, household wealth quintile, place of residence, region, number of household members	Age of child, household wealth quintile, place of residence, region	Children 6–59 months of age tested for parasitemia via microscopy	5,733
9	Severe anemia prevalence among children 6–59 months of age	Sex of child, age of child, mother's education level, household wealth quintile, place of residence, region, number of household members, number of ITNs owned by households	Age of child, mother's education level, household wealth quintile, place of residence, region, number of ITNs owned by households	Age of child, household wealth quintile, region	Children 6–59 months of age tested for anemia	6,055

ANC=antenatal care, IPTp=intermittent preventive treatment in pregnancy, ACT=artemisinin-based combination therapy, ITN=insecticide-treated net, SBC=social and behavior change

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