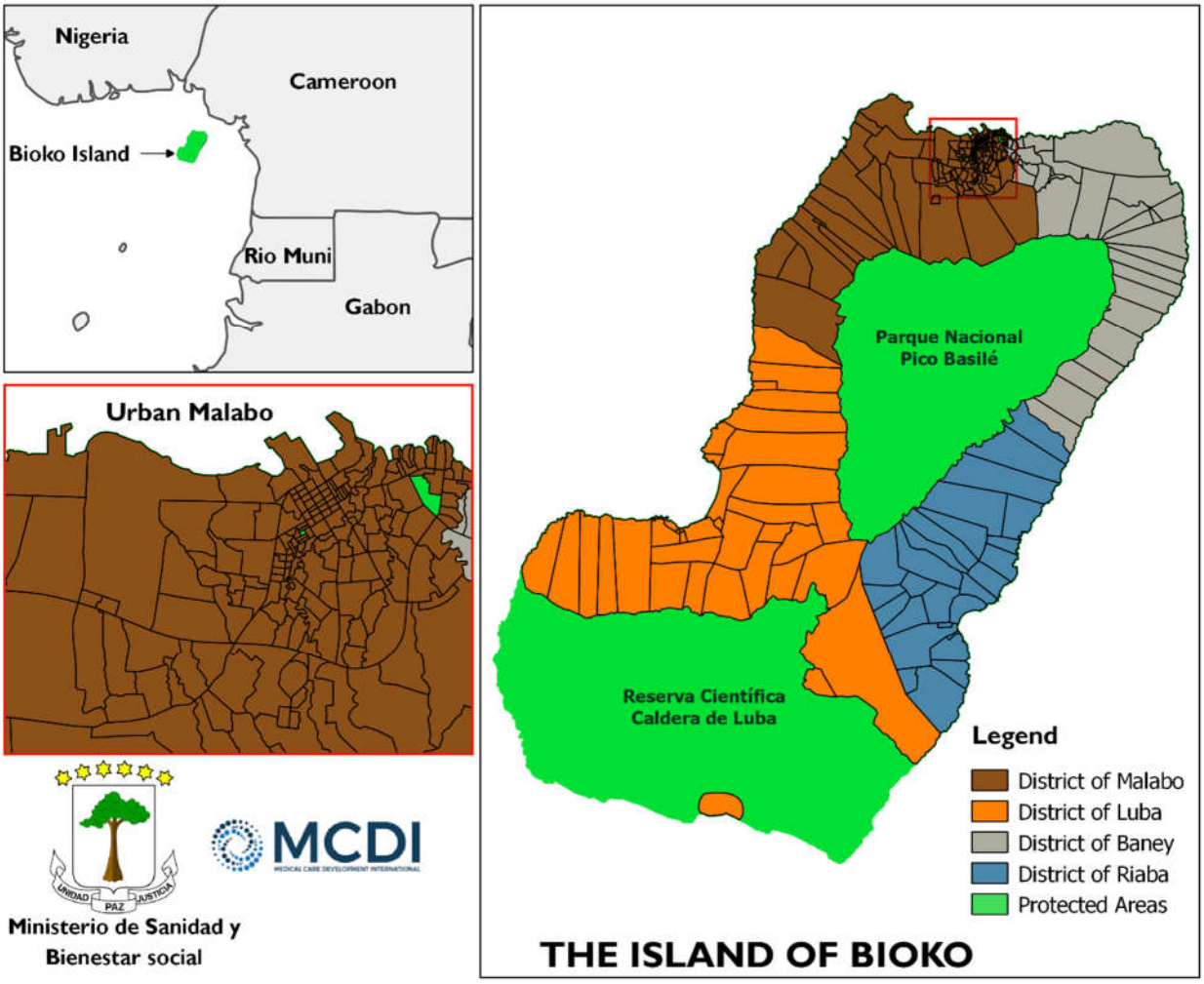
Creciendo Sin Paludismo en Guinea Ecuatorial

Bioko Island Malaria Elimination Project (BIMEP)

ANNUAL MALARIA INDICATOR SURVEY
2019

Medical Care Development International (MCDI), Equatorial Guinea

Ministerio de Sanidad y Bienestar Social · Ministerio de Minas Industria y Energia · Marathon Oil Corporation · noble energy · SANARIA · Ifakara Health Institute · Atlantic Methanol · GEPETROL · MCDI · SONAGAS · University of Southern Maine · Texas A&M University · IVCC · SwissTPH · Yale University


Nigeria
Cameroon
Bioko Island
Rio Muni
Gabon
Urban Malabo
Parque Nacional
Pico Basilé
Reserva Científica
Caldera de Luba
Legend
District of Malabo
District of Luba
District of Baney
District of Riaba
Protected Areas
THE ISLAND OF BIOKO
UNIDAD
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Abbreviations

AL	Arthemeter-Lumefantrine
AMPCO	Atlantic Methanol Production Company
ANC	Antenatal Care
ASAQ	Artesunate-Amodiaquine
BIMCP	Bioko Island Malaria Control Project
BIMEP	Bioko Island Malaria Elimination Project
CIMS	Campaign Information Management System
DBS	Dried Blood Spot
EGMVI	Equatorial Guinea Malaria Vaccine Initiative
EIR	Entomological Inoculation Rate
GDP	Gross Domestic Product
GIS	Geographic Information System
HIS	Health Information System
HLC	Human Landing Catch
ICF	Inner City Fund
IEC	Information Education Communication
IHI	Ifakara Health Institute
IMR	Infant Mortality Rate
IPTp	Intermittent Preventive Treatment In Pregnancy
IRB	Institutional Review Board
IRS	Indoor Residual Spraying
ITN	Insecticide Treated Net
LLIN	Long Lasting Insecticidal Net
LRT	Local Residual Transmission
LSHTM	London School of Hygiene and Tropical Medicine
LSM	Larval Source Management
LSTM	Liverpool School of Tropical Medicine
LT	Light Trap
M&E	Monitoring And Evaluation
MCDI	Medical Care Development International
MDA	Mass Drug Administration
MIS	Malaria Indicator Survey
MoHSW	Ministry of Health And Social Welfare
NGO	Non-Governmental Organization
NMCP	National Malaria Control Program
ODK	Open Data Kit
PfSPZ	plasmodium falciparum Sporozoite
PSU	Primary Sampling Unit
RDT	Rapid Diagnosis Test
SBCC	Social Behavioral Change Communication
SOP	Standard Operational Procedure
SP	Sulfadoxine-Pyrimethamine
SRS	Simple Random Sampling
Swiss TPH	Swiss school of Tropical Public Health
TF	Travel Fraction
TFR	Total Fertility Rate
U5MR	Under Five Mortality Rate
USM	University of Southern Maine
WI	Wealth Index

Acknowledgments

The 2019 Bioko island Malaria Indicator Survey (MIS) was conducted on a representative sample of 5,074 households. This survey was implemented by Medical Care Development International (MCDI), under the auspices of the National Malaria Control Program (NMCP) within the Ministry of Health and Social Welfare (MoHSW) of the republic of Equatorial Guinea. This is a follow-up to previous surveys that have been conducted on the island since 2004 to provide updated estimates of basic demographic and malaria indicators; and, therefore, stands as the cornerstone to malaria decision and policy-making.

The NMCP highly appreciates the participation of all institutions and individuals that made the survey achievable. Our gratitude goes to all public and private donors, and the various institutions for standing in the frontline against malaria in Bioko. Specific mention is due to Medical Care Development International (MCDI) for over 15 years of active malaria control on the island, and to the London School of Hygiene and Tropical Medicine (LSHTM) for constantly providing technical assistance in the organization and implementation of the Bioko island MIS.

We are grateful to numerous people who contributed to the success of the 2019 Bioko island MIS. Dr. Immo Kleindsmidt (LSHTM), Dr. Jacky Cooks (LSHTM), Dr. Carlos Guerra (MCDI), Mr. Guillermo Garcia (MCDI), Mr. Jordan Smith (MCDI), Mr. Wonder Phiri (MCDI), and Mr. Olivier Tresor Donfack (MCDI) defined the survey sample size, actualized the sampling frame, sampled households to be surveyed; and revised, updated and programed the survey questionnaire. Mr. Olivier Tresor Donfack updated the training material, trained the survey personnel, and deployed the survey; with technical assistance from Mr. Jeremias Nzamio. Data collection, data quality control, data management and analysis, and report production were managed by Mr. Olivier Tresor Donfack, with the assistance of survey coordinators and supervisors. Mr. Guillermo Garcia, Mr. Wonder Phiri, Dr. Carlos Guerra, and Mr. Alvaro Armas proofread and translated the final report in Spanish.

Special thanks goes to the data collection team, and to the administrative and local officials for granting access to the populations. Most important, we highly appreciate all the survey respondents for their participation, especially caregivers and all those who accepted to be tested for malaria and anemia, and those who provided blood samples for further analyses.

Sincerely,

Dr. Matilda Riloha Rivas
Director of the National Malaria Control Program
Ministry of Health and Social Welfare
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Executive summary

Similar to many other Sub-Saharan African countries, malaria remains one of the leading causes of morbidity and mortality in Equatorial Guinea and especially on the island of Bioko. When Marathon Oil acquired assets on Bioko in 2002, malaria was the largest social risk to the communities and business. As a measure, a public-private partnership was established with the government of Equatorial Guinea to substantially reduce malaria transmission. The fruit of this collaborative effort, jointly with other business partners, gave birth to the Bioko Island Malaria Control Project (BIMCP); which was implemented in 2004 by Medical Care Development International (MCDI). Interventions and activities were primarily based on widespread Indoor Residual Spraying (IRS), coupled with an improved case management approach to promote early diagnosis and effective treatment of malaria. Long Lasting Insecticidal Nets (LLINs), and Larval Source Management (LSM) were later on introduced to supplement IRS. A comprehensive Social Behavior Change Communication (SBCC) and Information, Education, and Communication (IEC) approach was established to promote malaria knowledge and behavior change within the population. After completing 3 phases of malaria control over a period of 15 years, the BIMCP merged with the Equatorial Guinea Malaria Vaccine Initiative (EGMVI) to form the Bioko Island Malaria Elimination Project (BIMEP). Over time, the BIMEP progressively established a robust Monitoring and Evaluation (M&E) system. The latter included a Geographic Information System (GIS)-based mapping of households on the entire island, malaria vector monitoring, routine monitoring of malaria cases through surveillance and a Health Information System (HIS), and most essentially periodic evaluations to assess project outcomes and impact in order to guide immediate and long term actions.

A Malaria Indicator Survey (MIS) has been conducted annually since the inception of the BIMEP to depict a long-term view of trends against targets. The main objectives of the 2019 Bioko island MIS were: (1) to assess malaria knowledge among populations living in Bioko; (2) to track household ownership of Insecticidal-Treated mosquito Nets (ITNs), population access to and use of ITNs; (3) to assess malaria prevention among pregnant women through Intermittent Preventive Treatment in pregnancy (IPTp); (4) to describe fever management among children aged less than 5 years; (5) to assess malaria parasite prevalence in the population; and (6) to assess the prevalence of anemia among pregnant women and children aged 6 to 59 months. The survey was based on a representative sample of households drawn from the entire island. During a 3-months period, five teams of five surveyors each successfully surveyed 5,074 households and interviewed a respondent in each, collected information on 20,012 *de jure* household members and tested 13,939 for malaria and anemia. Results of the interviews and malaria and anemia testing are presented in this report. The main indicators derived from the MIS are summarized below:

- Exposure to malaria related message was low, as only 43% of respondents acknowledged to have heard or seen a malaria related message within the past six-months preceding the survey. The main source of exposure to malaria related messages was TV. Eight in ten (83%) respondents cited mosquitos as the cause of malaria, 75% cited sleeping under mosquito nets as a way of avoiding malaria while only 18% cited IRS as a malaria control intervention.
- Sixty-one percent of households had at least one ITN, and 41% had at least one ITN for every two persons who slept in the house the night before the survey (universal coverage). Fifty-tree percent of the household population had access to an ITN and only 31.9% slept under an ITN the night before the survey. ITN use in children less than 5 years old and in pregnant women were respectively 47.5% and 37.5%.
- ANC attendance was optimal (97.2%) amongst women who reported to have had a live birth within the past two years preceding the survey. However, only 36.1% took the recommended three doses of Fansidar. Twenty-five percent of the women attended ANC in private clinics.

- About 9% of children less than five years old were reported to have had fever within the two weeks preceding the survey. Of the children with fever, care was sought for 66%, and blood was taken from 45.1% for testing. Amongst those who were treated with antimalarial drugs, only 30.2% took ACTs. Care was sought for 23% in private clinics.
- Malaria prevalence was 15.8%, 9.8%, and 8.2 respectively in the general population, children less than five years old, and pregnant women. Prevalence continued to be much higher in the South-Eastern and North-Western (Malabo and peripheries) parts of the island (Riaba district), and lower in the North-Eastern part of the island (Baney district). Overall malaria prevalence increased significantly between 2018 and 2019. In a similar manner, *Plasmodium falciparum* prevalence increased among children age two to fourteen years in historical sentinel sites, from 12.5% in 2018 to 16.6% in 2019. Severe anemia was almost absent among children (0.5%) and pregnant women (0.4%)

1 Introduction

1.1 History and Geography

The island of Bioko, formerly known as Fernando Po, is located on the West African continent shelf, precisely in the Gulf of Guinea and separated from Cameroon by no more than 32 kilometers of shallow ocean. With its total land surface of 2000 km^2, Bioko forms part of the nation of Equatorial Guinea. The rest of the country consists of a mainland part called Rio Muni, which is found between Cameroon and Gabon; and four other small islands: Annobon, Corisco, Elobey Grande and Elobey Chico. Formerly a Spanish colony, Equatorial Guinea became independent in 1968; therefore, Spanish remains its primary language, even though French was later integrated as a second official language. Administratively, the island of Bioko is divided into two provinces: Bioko Norte harboring the districts of Malabo (the national capital of Equatorial Guinea) and Baney; and Bioko Sur harboring the districts of Luba and Riaba. The original inhabitants of Bioko are the Bubi, descendants of Bantu migrants from the mainland. However, significant numbers of mainlanders, mostly the Fang, colonized Bioko since the mid-1960's. Bioko was also the home of Nigerian workers and Fernandinos, descendants of former slaves liberated by the British from Sierra Leone and Cuba.

The island has a typical equatorial climate, with high temperatures, high humidity, and heavy rainfall. The temperature, particularly in Malabo, ranges from 16°C to 33°C; though on the southern Moka plateau, normal high temperatures are only 21°C. Annual rainfall varies from 193 cm in Malabo to 1,092 cm in Ureka. The main wet season lasts between April and October, when the African monsoon blows from the southwest, bringing moist air from the ocean.

1.2 Economy and basic demographic indicators

Traditionally, the economy of Equatorial Guinea depended on three commodities, cocoa, coffee and timber. The high quality cocoa cultivated in Bioko was the pillar of the country's economy, as Bioko possessed the right soil and climate for intensive cultivation. However, after the departure of Nigerian workers, cocoa and coffee outputs and quality dropped significantly and exports almost ceased from the island. Today the economy essentially relies on the outstanding growth of the petroleum industry. Fishing also contributes to the economy and timber production from the mainland part of the country is still significant. Despite the makeable increase in the country's Gross Domestic Product (GDP) related to petroleum business in the past decades, most people still live under the threshold of poverty.

The Bioko island's population was estimated to about 335,000 out of 1,225,377 for the entire country in 2018 [1]. Of the estimated 97,000 households enumerated on the island in 2018, 84% were found in Malabo, and only 71% were occupied [2]. Similarly, to the rest of the country, Bioko's population is relatively young with children age less than 5 years old representing approximately 15%. More to that, published figures [3] depict a balance in gender, an estimated life expectancy of 66 years in women and 64 years in men, an estimated Under-5 Mortality Rate (U5MR) of 54.2/1000 live-births and Infant Mortality Rate (IMR) of 38.3/1000 live-births, and an estimated Total Fertility Rates (TFR) of 3.9 among women at childbearing age.

1.3 Malaria control on the Island of Bioko

Malaria has historically been hyperendemic in Bioko with year round transmission. As a response to the high burden of malaria in the early 2000's, a public-private partnership was established between the Government of Equatorial Guinea and Marathon Oil Corporation, through its corporate social

responsibility, to fund the Bioko Island Malaria Control Project (BIMCP). Other partners involved in the funding consortium were Noble Energy, Sonagas, GEPetrol, and Atlantic Methanol Company (AMPCO). The BIMCP was later implemented in 2004 by Medical Care Development International (MCDI), an American Non-Governmental Organization (NGO), under the auspices of the National Malaria Control Program (NMCP) within the Ministry of Health and Social Welfare (MoHSW) of Equatorial Guinea. External support, and technical expertise were provided by higher educational institutions, including the London School of Hygiene and Tropical Medicine (LSHTM), the Liverpool School of Tropical Medicine (LSTM), the Department of Computer Science within the University of Southern Maine (USM), and the Texas A&M University.

At inception yearly rounds of Indoor Residual Spraying (IRS) were conducted on the entire island as the main malaria control intervention, coupled with an improved case management system to promote early detection of cases and appropriate treatment. IRS was later supplemented with the distribution of Long-Lasting Insecticidal Nets (LLINs), and the management of mosquitos breeding sites. A comprehensive Social and Behavioral Change Communication (SBCC) framework was established to promote malaria messages and knowledge in the population. The BIMCP over time established one of the most powerful M&E frameworks in recent history, which included a Geographic Information System (GIS) based mapping of all households on the island to track cases and interventions, malaria vector monitoring, routine monitoring of malaria cases through surveillance and Health Information System (HIS), and most essentially periodic evaluations to assess project outcomes and impact in order to guide immediate and long term actions.

Fifteen years of malaria control on the island of Bioko resulted in massive reductions in transmission, anemia in children, and all-cause U5MR [4–6]. In fact, *P. falciparum* prevalence in children aged 2 to 14 years dropped drastically from over 45% in 2003 to 12.5% in 2018 (Figure 1.1), all-cause U5MR dropped from 152 deaths/1000 live-births in 2004 to 57 deaths/1000 live-births in 2018, and severe anemia among children age under 5 years reduced by over 90%. Besides, tremendous results were achieved as concerning entomological indicators: the Entomological Inoculation Rate (EIR) reduced significantly from over 800 infected bites per person per year at inception to around 10 in 2018, and one malaria vector species, Anopheles *funestus* disappeared from the island [7,8].

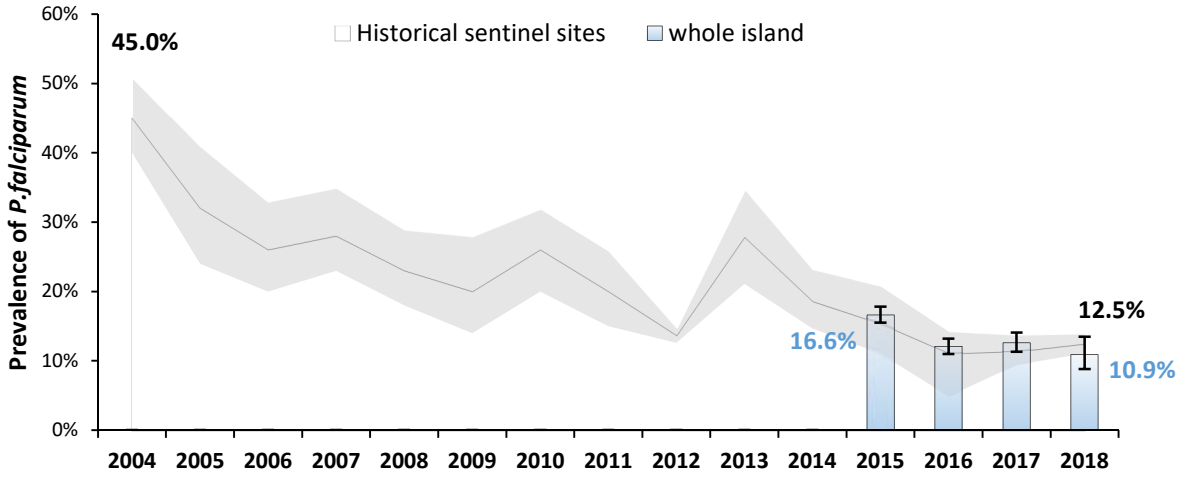

Figure 1.1 Plasmodium *falciparum* positivity trend in children age 2-14 years old on Bioko

Despite the noticeable achievements leveraged by the BIMCP, a serious concern arose with the plateauing of malaria prevalence over the past few years (2015 to date). The latter triggered the quest for innovative ideas and additional control tools.

Established in 2013, the Equatorial Guinean Malaria Vaccine Initiative (EGMVI) was aimed at testing the safety and protective efficacy of whole *P. falciparum* sporozoite (PfSPZ) malaria vaccine in Equatorial Guinea. This live, attenuated, whole SPZ vaccine manufactured by Sanaria Inc., and with an established safety record and technical profile, was identified as an important cornerstone to the battle for driving malaria towards elimination on the island of Bioko. Over time, the EGMVI has established clinical research capacities in the country, through personnel development, infrastructure, regulatory process, ethical review, clinical laboratory, and a vision for a national research institute; all of which form a critical platform to receive a Phase 3 clinical trial. Given the established experience and impressive progress made over the years, and the ambitious aim of freeing Bioko from malaria, the PfSPZ vaccine development group and the BIMCP later merged to form the Bioko Island Malaria Elimination Project (BIMEP). This association resulted in the implication of other partners including the Ifakara Health Institute (IHI), Sanaria Inc., and the Swiss school of Tropical Public Health (Swiss TPH). Henceforth, the objectives of the BIMEP included the following:

- The continuation of the highly effective malaria vector control, surveillance, case management, SBCC, and M&E activities implemented by the BIMCP
- The implementation of a Phase 3 malaria vaccine trial to support licensure of the PfSPZ vaccine in early 2020
- The implementation of a Phase 4 trial aimed at measuring the combined impact of mass vaccination and optimized malaria control in the population
- An island-wide immunization, using a step-wedge approach that will evolve into full implementation and control program
- The establishment of a vaccination program to protect travelers from the mainland of EG to Bioko Island to reduce malaria cases importation
- The establishment of an ongoing surveillance program to flag imported malaria cases

1.4 The Bioko Island Malaria Indicators Survey

With the interest of measuring the impact of interventions on the island of Bioko, a Malaria Indicators Survey (MIS) was designed to gather information on key malaria indicators on a yearly basis. Consequently, it stands as the principal source of evidence to inform malaria decision-making and policy. A baseline survey was conducted in 2003 before the inception of the project.

The quest of representativeness of the survey sample over time imposed major changes to the sampling strategy. Between 2004 and 2014, inclusive samples were drawn from 18 areas identified across the island to serve as sentinel sites of malaria transmission (Figure 1.2). The latter were also of entomological interest and were used for malaria vector monitoring. However, with the availability of more complete data and reliable census information, the strategy changed in 2015 to include households in all localities across the island.

The survey was standardized to collect similar data each year, with additional modules added as necessary. The survey originally tested only children 1 to 14 years old for malaria and anemia. However, with the introduction of serological data collection in 2008, a random adult member was added in each targeted household to allow seroconversion rates calculation. From 2012 onwards, all consenting household members present at the time of the survey were considered for malaria and anemia testing.

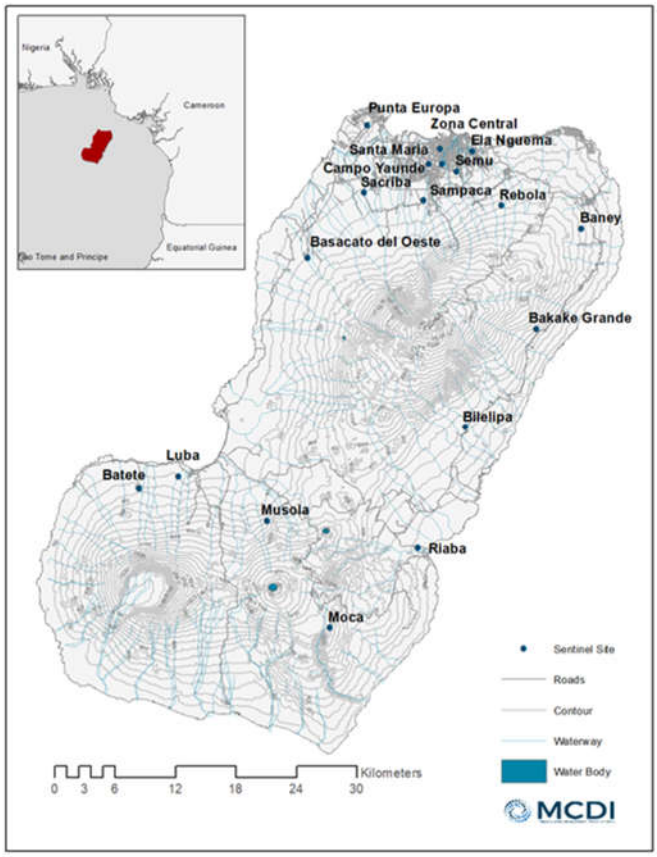

Figure 1.2 MIS sampling sites between 2004 and 2014

1.4.1 Survey objectives

The Bioko island MIS was designed to measure malaria interventions progress and, more specifically, the 2019 edition had as objectives to:

- Asses malaria knowledge, attitudes and practice in the general population
- Measure the extent of household ownership, population access, and use of LLINs/ITNs
- Measure vector control interventions coverage (LLIN/ITN and IRS) on the island
- Measure Antenatal Care (ANC) attendance and Intermittent Preventive Treatment in pregnancy (IPTp) coverage among women at childbearing age
- Identify healthcare seeking behaviors and fever management practices for children under 5 years' old
- Measure the prevalence of malaria in the general population
- Measure the prevalence of anemia among pregnant women and children 6 to 59 months' old

Moreover, with the elimination of malaria in perspective, and given the problem of malaria importation from the mainland [6,9,10], it was imperative to further characterize and understand the heterogeneity of malaria transmission and its intensity in Bioko. The latter will contribute to support current control strategies and to guide the deployment of future interventions.

1.4.2 Survey organization and implementation

The survey was organized and implemented by MCDI and the NMCP of Equatorial Guinea. Traditionally, candidate surveyors were recruited from the open labor market and trained, prior to deployment. However, for this edition, no external recruitment was done; but instead, twenty-six best performing surveyors out of thirty-six who participated in the 2018 MIS were invited for training. Two nurses and two prepackaging personnel were also invited. The training took place in Malabo and was conducted over a period of two weeks (from July 15 to 25 2019). The training staff was composed of the BIMEP's M&E, vector control, case management, admin, and GIS teams. The following topics were covered during training: rules and regulations when conducting surveys, interview techniques, ethical issues in surveys and consent procedures, generalities on malaria and anemia, survey material, malaria and anemia diagnosis, Dried Blood Spots (DBS) preparation on filter paper, map reading, use of tablets for data collection, and supervision and data quality control guidelines (for survey coordinators and supervisors only) (Picture 1.1). Moreover, practical sessions were organized to perform malaria and anemia testing, and map reading.

Picture 1.1 Colorful images captured during MIS training

At the top left, trainees keenly following lectures – at the lower left, the case management team, featuring **Leonor Ada Okenve**, explaining malaria diagnosis – at the middle, a trainee, **Samuel Vicente Evale**, practicing DBS preparation on filter paper – at the right, a survey supervisor, **Crisantos Bakale Mangue** demonstrating malaria diagnosis. Photo credit, **Olivier Tresor Donfack**

On the 29 of July 2019, the survey was piloted, and on a random sample of 300 households which were not part of the original sample, in one community (5-7.1 Santa Maria IV), and under strict supervision. After the pilot, the quality of the data was controlled and all mistakes were documented. Therefore, surveyors were invited the following day to address issues, and for coaching. The MIS was officially launched on August 1, 2019 (Picture 1.2).

Picture 1.2 The 2019 MIS team ready for deployment
Photo credit, **Teobaldo Babo Dougan**

1.4.3 Survey design and sampling

A stratified cluster sampling was applied to target 5% (~4,800) of all households on the entire island. Contrary to previous years, map-areas were preferred over communities for Primary Sampling Units (PSU). Map-areas were deemed to be more coherent and consistent than communities. The latter are virtual georeferenced rectangular grids of 1km square covering the whole territory of the Bioko island, numbered from West to East and from North to South developed by the BIMEP to support the implementation, targeting, and monitoring of interventions in the field [2].

With geo-statistical and mathematical modelling applied on previously collected MIS data (2015 to 2017), it was possible to estimate the fraction of transmission that could be explained by imported infections through travelling to mainland EG (travel fraction (TF)) as well as the prevalence of malaria without imported infections from the mainland (local residual transmission (LRT)). The latter analysis was supported by existing evidence of malaria importation from the mainland part of EG to the island [6,9,10]. The median estimated LRT of 7.6% was used to divide the island into (1) high LRT areas (≥7.6%), and (2) low LRT areas (<7.6%). Similarly, population density was used to divide the island into (1) peri-urban and urban areas (≥250 inhabitants per square km) and (2) rural areas (<250 inhabitants per square km). Then, a composite weighted score was derived from the 2 above criteria to stratify the island into (Figure 1.3):

- Stratum 1: map-areas with low population density and high LRT
- Stratum 2: map-areas with high population density and low LRT

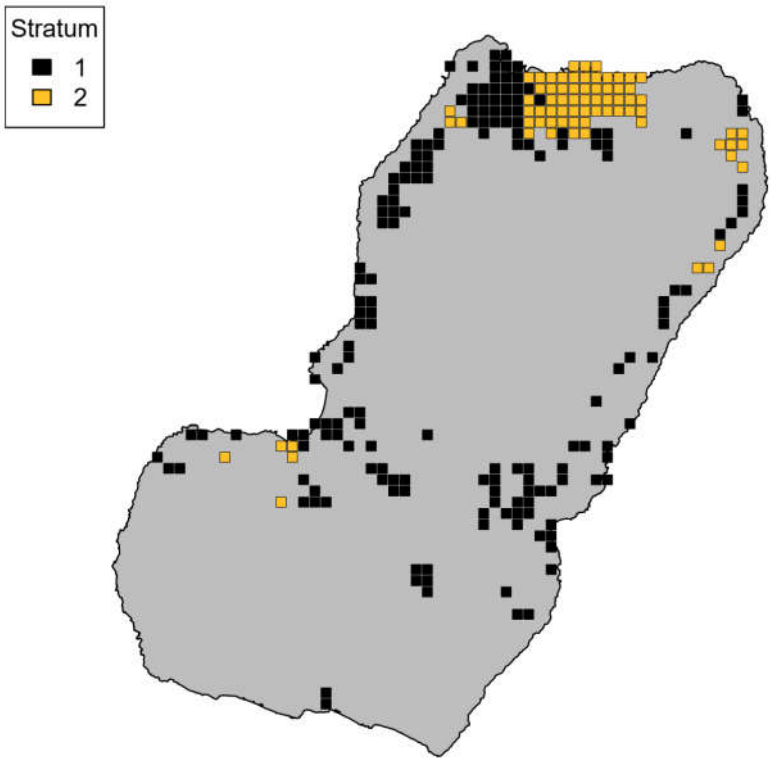

Figure 1.3 Map-area stratification according to a composite score of LRT and population density

Prior to stratification, map-areas with at least 100 households were considered as single PSUs and those with less than 100 households were spatially grouped to form single PSUs. The grouping was done contiguously or, in the case of isolated map-areas, to the closest neighbor while taking into consideration the spatial distribution of households within them. The later was done to balance the differences in number of households within map-areas. A total of 111 PSU were therefore defined, with 55 belonging to stratum 1 and 56 belonging to stratum 2. The number of households in stratum 1 were roughly 9,585, with about 18,457 inhabitants, while stratum 2 had approximately 77,452 households with roughly 220,533 inhabitants.

Simple Random Sampling (SRS) was applied to select 20% of households per PSU belonging to stratum 1, and 4% of households in each PSU belonging to stratum 2. Therefore, the number of selected households was 3,098 in stratum 2, and 1,917 in stratum 1, giving a targeted sample size of 5,015 households.

1.4.4 Survey questionnaire

The Bioko island MIS questionnaire was adapted from the standard MIS package developed by the Roll Back Malaria Monitoring and Evaluation Reference Group (RBM-MERG) and the Inner City Fund (ICF) International, to assess key household coverage and morbidity indicators [11]. The questionnaire was translated in Spanish and adapted for use in the setting. Additional questions were added as required for research purposes. The BIMEP M&E team coded and programmed the questionnaire on XLSForm to run on Android tablets computers via Open Data Kit (ODK) Collect.

The household section of the questionnaire was used to gather information on characteristics of the household dwelling units, such as the source of water, type of toilet facilities, material used for construction (floor, roof, walls), ownership of goods (radio, television, cooker, washing machine, etc.). Additionally,

malaria knowledge among survey respondents, and the use and acceptance of IRS were captured. The household members and short term visitors' rosters were established, and some basic information were recorded, including age, sex, relation to the household head, and bed net use the night before the survey. The purpose of establishing the rosters was to organize every consenting and present household member and short term visitor for malaria and anemia testing, and to identify women at childbearing age for further questioning on malaria prevention in pregnancy.

The individuals section of the questionnaire was used to collect in-depth information on each person that was recorded in the household members roster. This included, level of education, polio and measles vaccination (for children age less than 6 years), ANC attendance and use of Fansidar during pregnancy (for women age 15 to 49 years), history of travel in and out of the island in the past 8 weeks, fever in the past 2 weeks, treatment seeking behavior, and malaria test and hemoglobin measurement results.

The bed nets section of the questionnaire was used to record information on all bed nets owned by the household and more specifically type, condition, origin, frequency of use, and the people who slept under each the night before the survey.

1.4.5 Survey data collection

Data was collected between August 1 and October 16, 2019, by a team of 25 surveyors, 6 supervisors, 2 coordinators, 2 nurses, 3 prepackaging personnel, and 5 drivers (Appendix 1). Field work was conducted 6 days a week, and sometimes including Sundays to increase chances of meeting people at home. In all closed households or where eligible respondents were out of their homes, a minimum of two additional callback visits were done on two separate days to increase chances of participation. An advanced team preceded the surveyors to seek authorizations from community leaders and local authorities and inform the community on calendars. Equal workloads were prepared based on past experience of a mean of 4 surveys completed daily by each surveyor. Paper maps corresponding to the community and the pertaining sectors (high resolution grids of 100m x 100m) were attached on each workload. Henceforth, surveyors used the latter to locate assigned households on the field (Picture 1.3). Once at the assigned location, the unique household identifier on the door sticker provided by the NMCP was used for confirmation.

Picture 1.3 Surveyors using paper maps to locate assigned households in the field

Featuring **Rosa Ngum**, at the top left – **Louis Simon Avomo** and **Crisantos Bakale** at the lower left – **Romualdo Macias**, **Marcos Mbulito**, and **Eduardo Samuel Coffi** at the top and lower right. Photo credit, **Olivier Tresor Donfack**.

Data collection was preceded by consent procedures, during which the surveyor was entailed to give full detailed information regarding the survey to the household head or his designee. In case of mutual agreement, the consent form was duly signed by both parties and also by all consenting adults, that were present and willing to be tested for malaria and anemia. A special box was included for the interviewee, and any present adult to tick if willing to provide blood sample for laboratory assays.

Subsequently, the rosters of household permanent members and short term visitors were respectively established. Thus, all consenting members and short-term visitors were tested for malaria and anemia and results were recorded accordingly on the corresponding rosters. While waiting for test results, the interview was conducted and the answers were directly captured on Android tablet computers, via ODK Collect (Picture 1.4). After completing the interview, test results were explained to the household members.

Supervisors and coordinators ensured that surveys were conducted following established protocols and Standard Operational Procedures (SOP), and under strict ethical compliance. Moreover, they provided reliable solutions and assistance related to challenges encountered in the field.

Picture 1.4 Interview and data collection

Glowing images of surveyors conducting interviews and collecting data on Android tablets computers. Featuring **Rosa Ngum** at the top left, Samuel **Vicente Evale** at the lower left, **Rogelio Alfonso,** and his supervisor **Teobaldo Babo Dougan** at the top right, and **Marcelina Nzua Abeso** at the lower right. Photo credits, **Crisantos Abeso Nsue**, and **Olivier Tresor Donfack.**

1.4.6 Malaria and anemia testing

Surveyors received thorough training on malaria and anemia diagnostics in field conditions, and on ethical principles when conducting surveys. Therefore, written informed consent for testing was sought from the parent or legal guardian of all children and under age members, and from all adult members (≥18 years) present at the household at the time of the survey.

A single, disposable, sterile lancet was used to make a finger prick (Picture 1.5). After cleaning the first drop, a sterile microcuvette was used to collect a drop of blood. The latter was used for hemoglobin measurement on site using a battery-operated portable HemoCue® 301 analyzer (HemoCue AB, Angelholm, Sweden). The result was read in less than 30 seconds and recorded on the household members or visitors' roster. A tiny drop of blood was subsequently used for malaria testing with the CareStart™ Malaria Pf/PAN (HRP2/pLDH) Ag Combo RDT (ACCES BIO, 65 Clyde Road, NJ, USA). Technically, blood collected using a sterile loop applicator was placed in the appropriate well on the test device, and two drops of test buffer were added in the indicated well. After 20 minutes of full migration and resolution, the result was interpreted and recorded. At the end of the survey, malaria and anemia tests outcomes were respectively explained to the household.

Picture 1.5 Surveyors performing malaria and anemia testing in the field

Featuring **Marcelina Nzua Abeso** at the upper left, **Cristeta Nzang** under the supervision of **Faustino Etoho** at the lower, and Anna **Delicia Caba** at the right. Photo credit, **Olivier Tresor Donfack** and **Guillermo Garcia.**

When possible, drops of blood were collected on a Whatman 903™ Protein Saver card (GE healthcare Ltd, Forest farm, Cardiff, UK) and air dried. Each filter paper was uniquely barcoded, with the same identifier as on the corresponding RDT. The filter papers were packed appropriately inside gas free zip lock bags with desiccant, processed to the laboratory and stored at -20°Celcius.

The two survey nurses ensured that all individuals that were positive for malaria received the appropriate treatment as recommended by the Equatorial Guinea national malaria treatment guidelines (Picture 1.6) and that all cases of anemia were referred to a health center for proper follow-up.

Picture 1.6 Survey nurses administering malaria treatment in the field

Featuring **Isabel Mibuy** on the left and **Silverio Okenve** on the right. Photo credits, **Olivier Tresor Donfack** and **Crisantos Nsue Abeso**.

1.4.7 Data processing and validation

Data was collected in Android tablet computers and wireless internet connection was used to transfer complete and valid questionnaires to the server every evening. To ease communication and follow-up, unique identifiers were assigned to each field worker using their name initials. The latter, alongside a unique password, was used to login to the data collection software, and launch a new questionnaire under a specific household location. As such, each completed survey was automatically tagged with the field worker's unique identifier, the date of creation, and the unique household identifier. Upon returning to the central office, data collected by surveyors were controlled and checked for inconsistencies and outliers by their respective supervisors (Picture 1.7).

Consent forms pertaining to surveyed households were reviewed for completeness of signatures. Barcode identifiers on RDTs and filter papers for each individual were carefully checked to assure uniqueness. The household members and short-term visitors (if any) rosters were checked for completeness, and the information was compared with what was entered in the tablets. Mistakes on both rosters and tablets were investigated, discussed, corrected appropriately, and documented for follow-up and coaching purposes. RDTs and filter papers were processed and stored as per protocol. Surveys were finalized, validated and uploaded to the server via wireless internet connection. Data collection softwares (CIMS-tablets and ODK Collect) were updated to their latest version signatures if available. All the various rosters, forms and other field materials were stored appropriately, and with restricted access. Workloads and deployment plans for the next day were prepared while prepackaging personnel refilled survey materials and consumables (Picture 1.7).

Picture 1.7 Data quality control and material preparation

Featuring, survey supervisors **Teobaldo Babo Dougan** and **Santiago Eneme** respectively at the top and lower left – prepackaging personnel, **Genoveva Mofuman**, at the right. Photo credit, **Olivier Tresor Donfack**.

1.4.8 Ethics

The protocol of the Bioko Island MIS was approved by the scientific and ethical review committee of the MoHSW of Equatorial Guinea, and by the Institutional Review Board (IRB) of the London School of Hygiene and Tropical Medicine (LSHTM). All information and data collected were treated with strict confidentiality. Access to databases was restricted and malaria RDTs and filter papers were barcoded with unique identifiers to protect the identity of the participant.

Written informed consent was sought for malaria testing from all adult members present in the household during which procedure, risks, and benefits were explained to them in detail. The risk for participation was minimal and was limited to temporal discomfort associated with either discussion of potential sensitive information or the finger-prick blood collection. Respondents unable to sign the form were authorized to use their thumb print to indicate participation. The direct benefits of participation included malaria and anemia testing for everybody and free treatment or referral as appropriate. As indirect benefit, the results will continue to strengthen the NMCP's ability to monitor key malaria indicators and will help to improve malaria policies and interventions. Participants were not compensated in any sense.

2 Household characteristics

This chapter presents basic socioeconomic and demographic information on households that were sampled during the 2019 Bioko island MIS. A household was defined as a person or group of persons, related or not, who usually live together, who recognize an adult member as the household head and who have common cooking arrangements. Therefore, information was collected on the conditions in which the population lives, including: source of drinking water, type of sanitation facilities, availability of electricity, building material, possession of household amenities, and wealth. The latter information was used to facilitate the interpretation of key health indicators and also to assess the representativeness of the survey sample.

2.1 Household environment

Household characteristics are important determinants of the health status of household members. Respondents were questioned about their household environment, source of drinking water, type of toilet facilities, building characteristics etc.

2.1.1 Housing characteristics

Table 2.1 below shows the percent distribution of households by access to electricity and construction materials, according to the district of residence. Almost all the households (90.7%) had access to electricity. The most commonly used construction material was cement (58.5%), followed by wood (40.5%). Cement houses were more predominant in Malabo, followed by Baney, while wooden houses were mostly found in Riaba and Luba. The most common flooring materials were tiles or stones followed by cement. Floors with tiles were mostly found in Malabo while floors with cement were mostly found in Riaba.

Table 2.1 Household characteristics

Percent distribution of households by access to electricity and construction materials, according to districts

Housing characteristics	District				Total
	Malabo	Baney	Luba	Riaba	
Electricity					
Yes	94.6	87.3	65.9	74.4	90.7
No	5.4	12.7	34.0	25.6	9.3
Walls material					
Brick	0.1	0.0	0.5	0.0	0.1
Wood	38.2	44.8	48.9	55.4	40.5
Cement	61.2	52.5	48.5	44.1	58.5
Mud	0.0	0.0	0.0	0.0	0.0
Thin sheeting	0.3	2.5	1.8	0.5	0.7
Other	0.1	0.1	0.3	0.0	0.1
Floor material					
Earth/dust/sand	2.0	4.6	15.2	10.8	3.7
Wood	0.2	0.3	0.8	0.0	0.3
Cement	37.7	46.1	53.4	61.0	40.9
Tile or stone	56.5	48.1	28.6	25.1	52.1
Marble	0.8	0.0	0.0	0.0	0.6
Parquet of polished wood	0.5	0.2	0.0	0.0	0.4
Other	2.2	0.8	2.1	3.1	2.1
Roof material					
Tin sheeting	79.2	83.9	87.6	91.7	80.9
Cement	12.5	7.1	6.2	6.2	11.1
Tiles	0.4	0.7	1.0	0.5	0.5
Wood	4.3	5.5	3.3	1.0	4.3
Palm or thatch	0.1	0.0	0.7	0.0	0.1
Asphalt tiles	2.3	2.2	1.0	0.5	2.1
Pitch	0.2	0.0	0.0	0.0	0.2
Other	0.9	0.6	0.0	0.0	0.8
Total households	**3,840**	**651**	**388**	**195**	**5,074**

2.1.2 Household source of drinking water and sanitation facilities

The source of household drinking water is an indicator of water quality. Sources likely to be considered as improved are piped water, protected well water, borehole water, rain water in cisterns, and bottled water; and sources considered as unimproved are unprotected well water, river or stream water, water truck, and other rain water. Well-constructed and maintained latrines are essential in reducing the amount of human feces in the environment. This in turn decreases the transfer of pathogens between feces and food by flies.

Table 2.1 presents household source of drinking water, and latrine facility according to the district of residence. Ninety-two percent of households in Bioko have access to improved drinking water. Access to improved drinking water was almost optimal in Malabo (96%) and Baney (93%), compared to Riaba (78%) and Luba (69%). The most common sources of drinking water were piped water in public taps (51.4%), bottled water (20.6%), piped water in-house (10.9%), and piped water in the compound (6.9%). River water was mostly used for drinking in households in Luba (29.1%) and Riaba (18.5%). Fifty-seven percent of household had flush toilets and these were mostly found in Malabo and Baney compared to Luba and Riaba districts. However, Twenty-two percent of the households used shared toilet facilities.

Table 2.2 Household source of drinking water

Percent distribution of households by source of drinking water and time to obtain drinking water, according to districts

Source of drinking water	District				Total
	Malabo	Baney	Luba	Riaba	
Improved source of drinking water	**96.1**	**92.9**	**69.1**	**78.5**	**92.9**
Piped water in house	11.1	12.7	7.9	7.1	10.9
Piped water in compound/yard/plot	7.4	5.8	6.4	3.6	6.9
Piped water in public tap	50.3	57.3	45.3	58.5	51.4
Protected well in compound	1.2	0.3	0.0	0.0	0.9
Protected well outside compound	1.2	0.5	0.0	1.0	1.0
Borehole inside compound	1.4	0.6	0.8	0.0	1.2
Borehole outside compound	0.2	0.3	0.0	0.0	0.2
Rain water in cistern	0.1	0.0	0.0	1.5	0.1
Bottled water	23.4	15.4	8.5	6.7	20.6
Unimproved source of drinking water	**3.9**	**7.1**	**3.1**	**2.2**	**7.0**
Unprotected well inside compound	0.4	0.0	0.0	0.0	0.3
Unprotected well outside compound	0.4	0.2	1.0	0.5	0.4
River/stream	1.9	6.1	29.1	18.5	5.2
Water truck	0.1	0.2	0.0	0.0	0.1
Other rain water	0.1	0.2	0.0	0.5	0.1
Other source of drinking water	**0.9**	**0.5**	**0.8**	**2.1**	**0.9**
Type of toilet/latrine facility					
Flush	58.9	60.8	43.3	26.7	56.8
Bucket	0.2	0.6	0.8	0.5	0.3
Traditional non ventilated latrine	2.7	8.9	12.9	26.2	5.2
Ventilated pit latrine	12.2	15.1	16.5	17.9	13.1
Shared toilet	25.1	12.3	13.7	16.4	22.2
Other/bush/field/river	0.9	2.3	12.9	12.3	2.5
Total number of households	**3,840**	**651**	**388**	**195**	**5,074**

2.1.3 Household possessions and Wealth Index (WI)

Ownership of domestic goods such as furniture and electronics along with land and livestock provide a measure of household wealth and general well-being. Moreover, particular goods have specific benefits. Wealth index was constructed by Principal Component Analysis (PCA), using household asset data. The latter is used in this report as a proxy of household Socioeconomic Status (SES).

Table 2.3 presents the percent distribution of household possessions by district. Thirty-three percent (33%) of households owned a radio, and this percentage was higher in Luba and Riaba districts compared to Malabo and Baney. Television ownership was 83% and was higher in Malabo, followed by Baney. Telephone ownership was almost optimal (94%). Twenty-seven percent (27%) of the households owned a car as means of transportation.

Table 2.3 Household possessions

Percentage of households possessing various amenities according to district of residence

Household possessions and Wealth index	District				Total
	Malabo	Baney	Luba	Riaba	
Possessions					
Radio	30.9	34.9	46.6	44.1	33.2
Television	87.2	78.0	60.6	66.2	83.2
VCR/DVD	32.4	34.7	34.2	43.1	33.3
Computer	30.3	26.1	6.7	9.2	27.2
Camera	5.9	5.1	3.1	2.6	5.5
Telephone	96.2	87.7	82.9	83.1	93.6
Clock	27.2	31.2	19.1	13.3	26.5
Watch	69.6	61.9	50.8	50.8	66.5
Sofa	82.6	80.5	62.1	55.9	79.8
Table	78.0	82.2	71.6	67.2	77.7
Armoire	63.6	54.8	38.9	36.4	59.6
Cabinet	32.3	29.8	23.9	19.5	30.8
Fans	73.8	43.3	20.6	31.3	64.2
Air conditioner	28.9	24.7	4.1	1.5	25.4
Refrigerator	82.8	76.0	52.3	63.1	78.9
Stove	78.8	65.9	50.8	53.3	74.0
Washing machine	30.5	29.8	12.1	6.7	28.1
Car	29.9	27.6	14.4	12.8	27.8
Total number of households	**3,840**	**651**	**388**	**195**	**5,074**

Table 2.4 presents the percentage distribution of households and *de jure* household population by wealth index and according to district of residence. Luba and Riaba districts had the highest proportions of households belonging to the lowest wealth category, while Malabo, followed by Baney had the highest percentages of households belonging to the highest wealth category. Eleven percent (11%) of the *de jure* household population belonged to the lowest wealth category and this was higher in Luba and Riaba districts compared to Malabo and Baney. Almost one in two people belonged to the two highest wealth categories.

Table 2.4 Wealth Quintiles

Percent distribution of households, and *de jure* population by wealth quintiles, according to district of residence

Wealth Index	Households					De jure household population				
	Malabo	Baney	Luba	Riaba	Total	Malabo	Baney	Luba	Riaba	Total
Lowest	16.1	23.9	42.7	41.5	20.1	8.3	13.8	30.2	30.9	11.4
Second	18.9	21.8	23.9	25.1	19.9	16.4	20.7	26.5	26.9	18.1
Middle	20.9	17.1	17.8	21.5	20.3	21.4	19.9	22.3	24.9	21.5
Fourth	21.6	17.5	10.1	10.3	19.8	25.1	20.2	13.1	13.8	23.2
Highest	22.3	19.7	5.4	1.5	19.9	28.6	25.3	7.9	3.5	25.9
Total number	**3,840**	**651**	**388**	**195**	**5,074**	**16,051**	**2,755**	**1,430**	**776**	**21,012**

2.2 Household population by age, sex, and residence

The distribution of the *de jure* household population is shown in Table 2.5 by 5-year age groups, gender, and district of residence. The *de jure* household population was 21,012, out of which 20,994 had valid age information (10,646 males and 10,348 females). Fourteen percent of the population were children under age 5, and Forty percent was under age 15. In general, both men and women populations declined as the age increased, reflecting the young age structure of the population in Bioko.

Table 2.5 Household population by age, sex, and residence

Percent distribution of the *de jure* household population by 5-years age groups, according to gender and residence, Bioko 2019

	Malabo			Baney			Luba			Riaba			Total		
Age in years	**Male**	**Female**	**Total**	**Male**	**Female**	**Total**	**Male**	**Female**	**Total**	**Male**	**Female**	**Total**	**Male**	**Female**	**Total**
<5	14.1	13.8	13.9	13.8	15.4	14.6	13.6	15.6	14.5	13.2	14.4	13.8	13.9	14.1	14.1
5 to 9	13.8	13.2	13.5	14.5	13.8	14.2	13.4	14.5	13.9	16.2	13.0	14.7	13.9	13.4	13.7
10 to 14	11.2	12.0	11.6	13.6	12.3	12.9	12.4	11.6	11.9	11.3	14.1	12.6	11.6	12.1	11.9
15 to 19	9.7	10.4	10.0	9.8	9.5	9.6	9.8	7.1	8.6	7.4	6.8	7.1	9.6	9.9	9.8
20 to 24	8.9	9.9	9.4	7.7	8.5	8.1	5.2	5.9	5.5	7.1	7.3	7.2	8.4	9.4	8.9
25 to 29	9.3	10.3	9.8	7.0	7.8	7.4	5.3	6.4	5.8	6.6	6.3	6.4	8.7	9.6	9.1
30 to 34	9.6	9.4	9.5	8.1	9.0	8.6	5.4	4.9	5.2	6.6	6.3	6.4	9.0	8.9	8.9
35 to 39	7.3	6.9	7.2	6.9	5.2	6.0	6.8	4.6	5.8	5.9	5.2	5.5	7.2	6.5	6.9
40 to 44	5.6	4.2	4.9	4.7	3.6	4.1	5.7	4.6	5.2	5.4	6.8	6.1	5.5	4.2	4.9
45 to 49	3.2	2.4	2.8	3.3	2.7	3.0	3.9	4.9	4.3	3.7	4.9	4.3	3.3	2.7	3.0
50 to 54	2.9	2.5	2.7	3.4	2.8	3.1	5.4	4.8	5.1	6.1	7.3	6.7	3.2	2.9	3.1
55 to 59	1.7	1.6	1.6	1.7	3.1	2.4	3.3	4.0	3.6	2.5	3.8	3.1	1.9	2.0	1.9
60 to 64	1.3	1.3	1.3	2.6	1.9	2.3	4.3	4.3	4.3	3.4	1.4	2.5	1.8	1.6	1.7
65 to 69	0.6	0.7	0.6	0.7	1.8	1.3	1.6	2.4	1.9	1.9	0.3	1.2	0.7	0.8	0.9
70 to 74	0.4	0.4	0.4	1.0	0.9	0.9	2.4	1.6	2.0	1.2	1.1	1.2	0.6	0.6	0.6
75 to 79	0.2	0.3	0.3	0.8	1.1	0.9	1.1	1.3	1.2	0.9	0.5	0.8	0.4	0.5	0.5
80+	0.1	0.5	0.3	0.4	0.6	0.5	0.5	1.5	1.0	0.5	0.5	0.5	0.2	0.6	0.4
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Total Number	**8,104**	**7,933**	**16,037**	**1,381**	**1,373**	**2,754**	**753**	**674**	**1,427**	**408**	**368**	**776**	**10,646**	**10,348**	**20,994**

Figure 2.1 illustrates the age-sex structure of the Bioko population in a population pyramid. The broad base of the pyramid indicates that the majority of Bioko's population is young, with a high percentage under age 15.

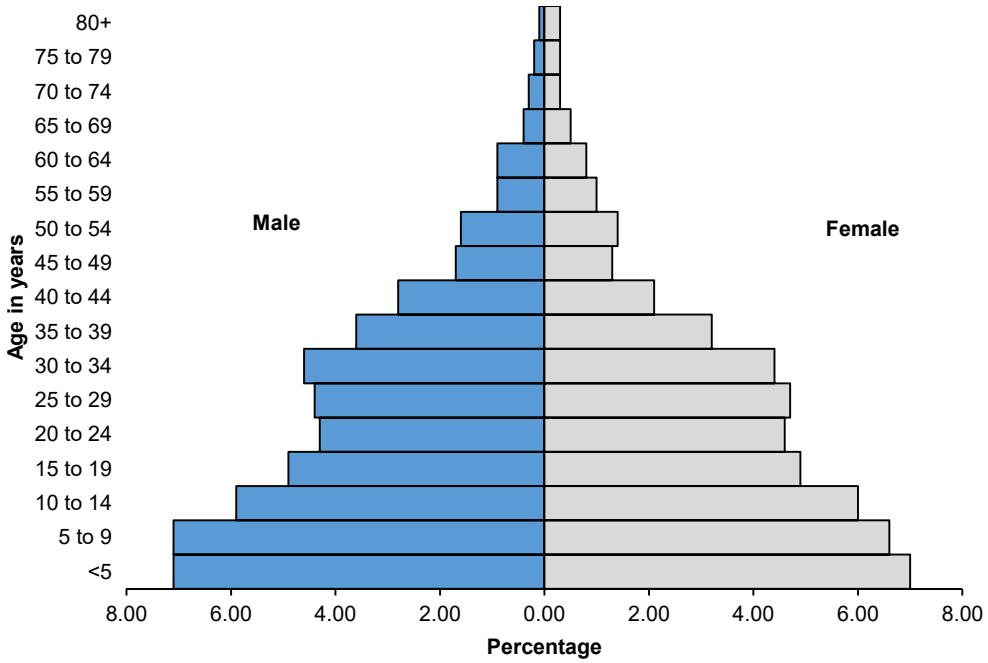

Figure 2.1 Population pyramid

2.3 Household composition

Table 2.6 describes the household size and by age and sex of the household head. The majority of the households in Bioko are headed by men (70%) and this was consistent across all four districts. The mean household size was 4, and was also consistent across all four districts.

Table 2.6 Household composition

Percent distribution of households by age and gender of household head, *de jure* household size, and mean household size by district

Characteristics	District of residence				Total
	Malabo	Baney	Luba	Riaba	
Household headship					
Male	70.3	69.9	73.2	72.3	70.5
Female	29.7	30.1	26.8	27.7	29.5
Age of the household head					
15-34	41.1	32.3	19.3	24.6	37.7
35-49	38.6	35.0	32.9	32.8	37.5
50+	20.1	32.6	47.7	42.6	24.7
Don't know	0.1	0.1	0.0	0.0	0.1
Number of residents					
1	17.3	18.3	27.5	23.1	18.4
2	17.1	17.9	22.9	21.5	17.8
3	14.0	11.2	9.3	11.8	13.2
4	14.1	12.7	9.0	10.8	13.4
5	9.3	9.9	8.2	8.2	9.3
6	8.4	8.3	4.6	5.1	7.9
7	6.9	7.8	6.4	6.2	6.9
8	5.1	5.5	2.8	2.6	4.9
9+	7.7	8.1	9.2	10.8	7.9
Mean size of households	4.2	4.2	3.7	4.0	4.1
Total number of households	**3,840**	**651**	**388**	**195**	**5,074**

2.4 Characteristics of the principal respondents

Table 2.7 presents the percent distribution of survey respondents, by district of residence and according to age, sex and level of education. This information is essential for the interpretation of findings presented later in this report and provides an indication of the representativeness of the survey sample. Thirty-six percent (36%) of the respondents were between 25 years and 34 years old and 56% were women. Only 4.4% of the survey respondents did not attain school, while 16.8% attained primary education, 51.6% secondary education, and 24.7% post-secondary education.

Table 2.7 Characteristics of the survey respondents

Percent distribution of respondents by districts, according to selected background characteristics

Background Characteristics	District of residence				Total
	Malabo	Baney	Luba	Riaba	
Age in years					
15-24	21.6	19.5	10.3	13.3	20.1
25-34	39.5	31.5	17.8	25.1	36.3
35-44	21.8	18.1	20.1	19.5	21.1
45-54	9.2	11.9	19.6	21.0	10.8
55+	7.9	18.9	32.2	21.0	11.7
Gender					
Male	43.5	42.9	48.7	54.4	44.2
Female	56.5	57.1	51.3	45.6	55.8
Level of education					
None	4.8	1.9	3.4	6.7	4.4
Primary	14.1	18.4	33.5	31.3	16.8
Secondary	51.3	53.3	51.8	51.3	51.6
Post-secondary	27.4	23.8	6.7	8.7	24.7
Not sure	2.4	2.5	4.6	2.1	2.5
Total respondents	3,840	651	388	195	5,074

3 Malaria knowledge

The NMCP aims to promote SBCC at all levels of the society. The target of the SBCC package is to improve and sustain knowledge and behavior regarding malaria prevention and management to at least 80 percent of the general population. The program uses mass media communication (radio and TV programs), as well as community gatherings, schools, places of worship, sporting and social events, pamphlets and posters to provide information on malaria prevention, and treatment to the population of Bioko. The SBCC is also an important topic covered during training of health care personnel by the NMCP. During school based LLINs distributions, the SBCC program also works in close collaboration with the Ministry of basic education to train primary school teachers and pupils on malaria prevention and treatment as necessary. When required, community health volunteers are also trained to disseminate malaria messages and stimulate behavior change within communities.

This chapter presents data on basic knowledge on malaria among populations of Bioko, which can be used to access the success of the NMCP's SBCC programs.

3.1 Exposure to malaria related messages

Forty-three percent of the respondents reported to have heard or seen a malaria related message in the past 6 months preceding the survey (Table 3.1). exposure increased with age, level of education, and wealth. Women were more likely to have heard or seen malaria related messages in the past 6-months preceding the survey. Respondents living in Riaba had higher exposure than those living in the other districts.

Respondents who reported hearing or seeing malaria related messages in the past 6 months preceding the survey were also asked to cite the specific sources of exposure. Table 3.1 also shows the percentage of respondents who cited specific sources of malaria messages, according to background characteristics.

One of every two respondent reported seeing messages on TV, while 18% reported hearing messages on the radio. Four percent said they were exposed through home visits by volunteers, 5% through home visits by IRS and and/or LLINs distribution teams, 6% through pamphlets or posters, 11% through health care providers, and 11% through group discussions.

Table 3.1 Exposure to malaria related messages by survey respondents

Percentage of respondents who reported hearing or seeing a malaria related messages in the past 6 months before the survey; percentages of specific sources of messages that were heard or seeing amongst those who agreed to have been exposed, according to background characteristics

	Total respondents		Source of exposure amongst respondents who heard malaria related messages in the past 6 months												
Background characteristics	Percentage who heard message	Total number	Radio	Television	Home visit from a volunteer	Home visit by IRS/ITN team	Theater show	Poster / pamphlet	Group discussion	Health provider /center	Social event	Neighbors	Other	Not sure	Total number
Age in years															
15-24	38.3	1,022	9.7	40.9	4.3	3.3	0.5	10.9	14.1	12.5	0.3	2.3	8.4	2.6	391
25-34	41.7	1,841	12.6	51.2	4.3	7.0	0.3	6.5	11.2	13.8	0.4	1.8	4.6	1.3	767
35-44	46.1	1,071	21.1	54.5	4.7	4.3	0.0	5.1	9.9	12.7	0.0	2.0	5.3	0.6	494
45-54	49.5	547	20.3	59.0	4.1	5.2	0.4	4.4	8.5	3.7	0.0	1.5	2.2	1.5	271
55+	45.6	593	32.8	49.4	4.8	3.3	0.4	2.9	11.8	6.6	0.0	1.1	5.2	0.4	271
Education															
none	22.1	222	24.5	42.9	12.2	4.1	0.0	6.1	12.2	6.1	0.0	0.0	4.1	0.0	49
Primary	32.4	854	24.9	47.7	3.9	7.2	0.0	2.1	10.1	7.9	0.0	3.9	3.9	0.0	277
secondary	43.8	2,617	16.2	49.8	4.4	5.1	0.3	6.5	11.2	12.2	0.2	1.4	5.8	1.6	1,147
post-secondary	54.6	1,252	16.4	54.4	3.9	4.2	0.3	7.9	10.9	11.1	0.3	1.9	4.9	1.3	684
not sure	28.7	129	10.8	54.1	5.4	2.7	0.0	2.7	18.9	13.5	0.0	0.0	2.7	2.7	37
Sex															
Male	41.9	2,244	23.5	51.1	4.1	4.8	0.4	7.1	10.5	5.6	0.1	2.3	4.3	1.5	942
Female	44.2	2,830	12.9	50.7	4.6	5.2	0.2	5.7	11.7	15.4	0.2	1.4	5.8	1.1	1,252
District															
Malabo	43.4	3,840	14.2	53.2	3.6	4.7	0.3	7.2	11.3	11.4	0.2	1.9	5.3	1.3	1,666
Luba	42.5	388	41.2	42.4	7.3	3.0	0.6	2.4	9.7	4.2	0.0	3.6	4.2	0.6	165
Baney	40.8	651	21.8	45.9	6.0	3.4	0.0	4.5	11.3	13.5	0.4	1.1	5.6	1.9	266
Riaba	49.7	195	20.6	38.1	9.3	19.6	0.0	2.1	10.3	13.5	0.0	0.0	3.1	1.0	97
Wealth Quintiles															
Lowest	29.5	1,020	29.6	36.5	4.9	6.6	0.3	7.3	10.9	8.9	0.3	2.7	3.3	3.3	301
Second	40.9	1,012	16.2	42.5	6.5	6.3	0.5	6.3	10.9	13.3	0.0	2.2	5.3	2.4	414
Middle	43.4	1,028	13.9	56.3	5.2	5.8	0.0	3.8	11.9	10.1	0.2	1.8	3.8	0.7	446
Fourth	48.7	1,004	14.7	56.1	2.0	4.3	0.2	7.6	10.8	12.1	0.2	2.2	6.1	0.6	489
Highest	53.9	1,010	17.1	56.1	4.0	3.3	0.4	6.6	11.2	11.1	0.2	0.7	6.4	2.0	544
Total	**43.2**	**5,074**	**17.5**	**50.9**	**4.4**	**5.1**	**0.3**	**6.3**	**11.2**	**11.2**	**0.2**	**1.8**	**5.2**	**1.3**	**2,194**

3.2 Knowledge of malaria transmission

Table 3.2 presents data on knowledge of possible ways of getting malaria. Mosquitos were mostly cited as the cause of malaria (84%). Knowing that mosquitos are the cause of malaria increased with higher levels of education, and with increasing wealth; and also varied across districts, with Riaba having the lowest level.

Table 3.2 Knowledge of causes of malaria by survey respondents

Percentage of respondents who cite specific ways malaria could be transmitted, according to background characteristics

	Cause of malaria									
Background characteristics	Person to person	Mosquitos	Poor personal hygiene	Drinking contaminated water	Eating contaminated food	Stagnant water	Traditional disease	Other	Don't know	Total number
Age in years										
25-34	0.3	84.7	15.3	6.2	6.5	8.4	0.0	3.9	9.2	1,841
35-44	0.2	85.3	13.7	5.6	6.3	7.8	0.0	3.6	9.7	1,071
45-54	0.9	78.7	10.5	5.1	7.7	7.4	0.0	2.9	14.5	547
55+	0.7	80.5	11.0	3.1	7.1	6.7	0.3	5.5	13.8	593
Education										
none	0.0	73.1	10.9	2.1	6.1	4.3	0.0	1.6	21.4	2,244
Primary	0.4	73.6	12.1	4.4	7.6	6.6	0.2	2.5	18.5	2,830
secondary	0.6	84.1	13.6	5.6	5.6	7.8	0.0	4.0	9.6	
post-secondary	0.1	90.6	14.4	5.3	5.9	7.7	0.0	4.6	4.8	222
not sure	0.0	65.7	8.4	3.6	4.5	1.3	0.0	1.3	29.3	854
Sex										2,617
Male	0.5	84.2	13.1	5.1	5.9	6.6	0.0	4.6	9.5	1,252
Female	0.3	83.2	13.7	5.2	5.9	7.7	0.0	3.2	11.1	129
District										
Malabo	0.4	83.9	14.1	5.4	6.2	7.4	0.0	3.7	9.9	3,840
Luba	0.3	85.7	5.9	2.8	5.9	4.7	0.0	2.7	11.1	388
Baney	0.2	81.7	10.9	4.8	4.9	7.4	0.0	4.4	12.6	651
Riaba	0.0	71.5	8.6	2.6	4.6	4.0	0.0	5.5	22.9	195
Wealth Quintiles										
Lowest	0.1	75.4	11.7	5.0	3.9	6.1	0.0	3.4	16.8	1,020
Second	0.9	80.7	13.9	6.4	6.3	8.2	0.1	3.2	12.9	1,012
Middle	0.2	82.0	14.7	6.0	6.7	7.5	0.0	5.6	11.3	1,028
Fourth	0.0	86.9	14.5	4.1	6.1	6.7	0.0	4.4	6.9	1,004
Highest	0.6	90.3	11.7	4.4	6.2	7.8	0.0	2.3	6.2	1,010
Total	**0.4**	**83.6**	**13.4**	**5.2**	**5.9**	**7.3**	**0.0**	**3.8**	**10.4**	**5,074**

3.3 Knowledge of malaria prevention

Survey respondents were asked if they know specific ways to avoid malaria, and results are presented in Table 3.3. Seventy-six percent cited sleeping under mosquito nets, 18.5% cited using IRS, 32% cited the elimination of solid wastes. The percentage of respondents who cited specific ways of avoiding malaria varied with gender, education, district of residence and wealth.

Table 3.3 Knowledge of malaria prevention methods among respondents

Percentage of respondents who cited specific ways of preventing malaria, according to background characteristics

	Specific ways of preventing malaria							
Background characteristics	Can't be prevented	mosquito nets	IRS	Preventive treatment	Eliminate solid waste	Don't know	Other	Total number
Age in years								
15-24	0.8	78.5	19.9	8.6	31.4	7.6	11.7	1,022
25-34	1.5	76.7	18.8	7.3	35.1	8.4	13.2	1,841
35-44	1.5	74.9	19.1	8.8	34.1	8.8	13.6	1,071
45-54	0.7	71.2	15.7	12.3	25.1	11.6	13.5	547
55+	1.9	68.4	13.2	11.9	23.2	8.9	19.8	593
Sex								
Male	1.2	69.7	17.1	9.5	32.3	10.1	15.5	2,244
Female	1.4	79.5	19.1	8.3	31.9	7.6	12.3	2,830
Education								
none	1.3	61.3	6.9	8.8	17.9	19.1	12.5	222
Primary	1.5	68.8	11.7	8.3	21.9	13.4	12.1	854
secondary	1.2	77.1	18.5	8.1	31.1	7.7	11.7	2,617
post-secondary	1.3	79.1	23.5	10.8	41.5	5.5	18.5	1,252
not sure	2.3	58.9	9.7	3.9	24.9	22.2	9.6	129
District								
Malabo	1.4	76.2	18.7	8.4	32.2	8.4	13.5	3,840
Luba	0.5	71.4	12.3	11.4	31.9	9.4	12.0	388
Baney	0.8	73.4	17.9	10.4	31.8	9.7	14.7	651
Riaba	2.0	72.9	11.4	10.1	29.9	14.2	11.8	195
Wealth Quintiles								
Lowest	1.1	64.2	12.5	11.2	22.4	15.5	12.2	1,020
Second	1.8	74.8	15.2	8.8	28.9	9.1	12.7	1,012
Middle	1.2	77.5	18.8	7.0	33.7	8.8	11.9	1,028
Fourth	0.4	79.7	18.9	9.5	35.2	6.2	13.1	1,004
Highest	1.9	77.7	24.1	8.2	36.9	5.8	17.7	1,010
Total	**1.3**	**75.5**	**18.3**	**8.8**	**32.1**	**8.6**	**13.6**	**5,074**

3.4 Knowledge of malaria symptoms

Knowledge of malaria symptoms could influence seeking timely diagnosis and treatment. Respondents were asked about symptoms of malaria and results are presented in Table 3.4. The most commonly cited symptoms were fever (78.2%), headache (29.7%), pallor (26.9%), and vomiting (25.7%). Only 10% of the survey respondents cited loss of appetite as a symptom of malaria.

Table 3.4 Knowledge of malaria symptoms by survey respondents

Percentage of respondents who cited specific malaria symptoms, according to background characteristics

Background characteristics	Malaria symptoms																Total number
	Fever	Headache	Vertigo	Circulatory Pain	Chills	Cough	Diarrhea	Pallor	Seizure	Vomiting	Loss of appetite	Skin problems	Ear ache	Sweating	Don't know	Other	
Age in years																	
15-24	74.9	31.0	2.7	2.9	2.0	1.0	6.5	26.5	0.6	26.2	7.9	2.3	0.0	0.4	13.2	6.2	1,022
25-34	80.7	30.0	1.6	3.9	3.3	1.1	5.1	26.8	0.8	29.4	8.3	1.8	0.0	0.4	9.3	5.8	1,841
35-44	80.9	28.8	1.7	7.7	3.4	1.1	5.4	25.7	0.2	25.5	11.9	1.9	0.1	0.8	7.5	4.7	1,071
45-54	73.0	28.8	1.7	8.3	2.3	0.9	4.1	27.7	0.6	21.5	12.7	2.0	0.0	0.6	8.9	3.8	547
55+	74.0	28.4	1.5	7.2	3.9	1.3	3.1	29.5	2.2	13.9	15.2	1.5	0.3	0.6	8.6	5.5	593
Education																	
None	68.1	28.7	1.9	7.9	2.7	0.0	4.3	16.7	0.1	17.6	6.9	0.8	0.0	0.0	14.9	5.5	2,244
Primary	74.5	27.7	1.8	4.9	2.9	1.0	2.7	19.9	1.5	17.9	9.6	1.6	0.4	0.4	9.5	5.9	2,830
Secondary	76.6	29.1	2.2	4.9	2.7	1.0	5.3	27.6	0.9	27.2	9.9	1.6	0.0	0.4	10.4	5.2	
Post-secondary	84.1	32.3	1.4	5.7	3.8	1.4	6.4	31.3	1.3	29.2	11.1	2.8	0.0	0.8	7.3	5.8	222
Not sure	81.4	29.3	0.0	3.6	0.0	0.2	7.6	16.4	0.2	12.2	6.6	3.7	0.2	0.0	12.5	2.7	854
Gender																	2,617
Male	70.7	28.6	1.8	5.9	2.7	0.9	4.1	27.4	0.8	18.0	8.9	2.1	0.0	0.3	13.9	5.5	1,252
Female	83.4	30.5	1.9	4.7	3.2	1.1	6.1	26.5	1.2	31.2	10.8	1.8	0.0	0.6	6.7	5.4	129
District																	
Malabo	79.3	30.6	1.9	5.3	3.1	1.1	5.5	26.3	1.0	25.9	9.9	2.0	0.1	0.6	9.6	5.4	3,840
Luba	62.9	15.9	0.7	3.7	3.6	1.6	4.9	27.4	0.9	21.7	16.7	1.1	0.0	0.0	13.9	6.1	388
Baney	75.4	28.2	1.6	5.3	2.4	0.7	5.3	30.9	0.9	26.0	9.9	1.8	0.0	0.2	8.6	5.2	651
Riaba	71.0	20.6	3.0	3.1	2.6	1.5	4.6	21.6	1.5	19.0	6.3	0.0	0.0	0.5	13.7	7.7	195
Wealth Quintiles																	
Lowest	68.5	25.0	1.6	4.5	1.9	0.7	3.6	24.5	0.7	15.7	7.9	2.3	0.0	0.4	14.7	6.3	1,020
Second	74.7	29.6	1.6	5.2	2.3	0.9	3.7	26.5	1.3	23.3	7.8	1.5	0.0	0.4	12.1	5.3	1,012
Middle	78.8	28.5	2.3	5.0	2.7	1.5	5.1	26.4	0.9	27.1	7.9	1.7	0.2	0.2	8.5	6.3	1,028
Fourth	82.3	30.9	1.2	5.7	3.1	1.2	5.9	27.3	0.8	28.7	11.9	1.8	0.1	0.7	7.2	4.4	1,004
Highest	83.5	33.2	2.4	5.4	4.5	1.1	7.4	28.8	1.4	30.8	13.6	2.6	0.0	0.9	7.3	5.1	1,010
Total	**78.2**	**29.7**	**1.8**	**5.2**	**2.9**	**1.1**	**5.2**	**26.9**	**1.0**	**25.7**	**10.0**	**1.9**	**0.0**	**0.5**	**9.6**	**5.4**	**5,074**

3.5 Knowledge of the best antimalarial treatment

Table 3.5 depicts the percentage of survey respondents who cited specific medicines to treat malaria, according to background characteristics. The data reflect poor knowledge of malaria treatment as 51% of respondents stated not knowing any treatment and only 27% cited specific anti-malarials.

Table 3.5 Knowledge of best antimalarial drugs by survey respondents

Percentage of respondents who cite specific medicine to treat malaria, according to background characteristics

Background characteristics	Best antimalarial treatment											Total number
	None	ASAQ	Artesunate	Amodiaquine	Chloroquine	SP/Fansidar	Quinine	Artemether	AL	Other	Don't know	
Age in years												
15-24	3.4	2.5	3.5	0.3	0.3	1.8	1.1	3.7	0.3	19.1	63.9	1,022
25-34	4.0	3.2	6.8	1.1	0.3	3.7	1.9	10.1	1.6	17.1	50.0	1,841
35-44	4.4	5.4	7.8	1.3	0.0	3.6	2.5	11.8	3.3	15.2	44.5	1,071
45-54	5.6	4.6	6.8	1.8	1.3	2.7	3.6	7.7	1.5	21.2	43.0	547
55+	3.7	3.1	5.2	2.8	2.1	3.7	3.8	6.0	0.6	20.9	48.1	593
Education												
None	11.1	1.3	0.2	0.1	0.8	1.1	2.4	1.8	0.0	23.8	57.3	2,244
Primary	5.3	3.1	4.2	1.5	0.8	2.3	2.5	6.0	0.5	19.5	54.2	2,830
Secondary	3.7	4.1	6.3	1.3	0.5	2.9	2.1	8.8	1.3	17.6	51.4	
Post-secondary	3.2	3.6	8.0	1.0	0.3	4.4	2.3	10.1	3.1	16.5	47.4	222
Not sure	7.9	1.4	1.8	1.3	0.0	2.3	0.7	7.4	0.0	21.9	55.3	854
Sex												2,617
Male	4.2	1.9	4.4	0.9	0.0	1.9	1.9	4.8	2.1	19.9	57.8	1,252
Female	4.0	4.9	7.4	1.5	0.8	4.0	2.4	11.1	1.2	16.4	46.2	129
District												
Malabo	3.9	3.7	6.2	1.1	0.4	3.2	2.3	8.8	1.8	17.9	50.9	3,840
Luba	4.1	5.6	5.9	4.2	1.5	5.6	1.2	4.7	0.0	25.9	41.2	388
Baney	5.8	3.1	6.2	1.1	0.6	2.4	2.0	8.6	0.6	15.0	54.5	651
Riaba	2.6	4.1	4.2	5.6	0.6	2.1	0.9	4.7	0.5	30.0	44.6	195
Wealth Quintiles												
Lowest	6.2	1.8	1.9	0.9	0.4	1.8	2.6	4.5	1.4	22.3	56.1	1,020
Second	3.9	2.8	5.6	1.2	0.8	2.8	1.8	6.3	1.4	19.1	54.5	1,012
Middle	3.2	3.6	6.9	1.2	0.5	2.6	1.8	8.6	1.4	17.5	52.7	1,028
Fourth	3.4	4.5	8.2	1.3	0.4	3.6	2.3	9.8	1.4	18.4	46.7	1,004
Highest	4.5	4.8	6.9	1.5	0.4	4.6	2.6	11.9	2.5	13.5	46.8	1,010
Total	**4.1**	**3.7**	**6.1**	**1.2**	**0.5**	**3.2**	**2.2**	**8.5**	**1.6**	**17.9**	**51.0**	**5,074**

3.6 Knowledge of free antimalarial treatment and prevention in pregnancy

Table 3.6 describes knowledge of free antimalarial treatment in public health facilities in Bioko, and knowledge of IPTp dosage among female respondents, according to background characteristics. Forty-seven percent of the survey respondents knew malaria treatment was free in public health facilities in Bioko, while 24% and 29% did not know about this or were not sure. Among female respondents, only 19.8% cited 3 doses of Fansidar as appropriate to prevent malaria during pregnancy.

Table 3.6 Knowledge of free antimalarial treatment and IPTp doses

Percentage of respondents who know ACT are free in public health facilities, and percentage of female respondents who know IPTp doses, according to background characteristics

	knowledge of free ACT in public health facilities amongst all respondents				knowledge of IPTp doses amongst female respondents						
Background characteristics	Free	Not free	Don't know	Total number	Zero	One	Two	Three	Four or more	Don't know	Total number
Age in years											
15-24	44.9	21.5	33.5	1,022	0.3	6.5	10.4	14.4	8.3	60.1	589
25-34	49.5	23.8	26.7	1,841	0.8	7.9	11.9	25.4	6.2	47.7	1,080
35-44	47.0	24.9	28.0	1,071	0.5	5.3	10.1	21.8	5.8	56.4	564
45-54	43.9	27.7	28.2	547	0.7	3.8	9.4	12.2	5.2	68.5	286
55+	45.0	25.9	28.9	593	0.6	3.5	3.9	12.9	4.5	74.5	311
Education											
none	33.1	21.3	45.5	222	1.0	3.1	3.1	15.3	5.1	72.4	98
Primary	42.1	22.1	35.8	854	1.1	6.1	11.4	18.1	5.0	58.3	537
secondary	50.1	23.4	26.4	2,617	0.5	6.5	10.5	21.4	6.9	54.1	1,530
post-secondary	46.3	26.3	27.3	1,252	0.4	6.5	9.5	19.6	6.3	57.7	567
not sure	38.0	30.8	31.2	129	1.0	3.1	7.1	6.1	3.1	79.6	98
Sex											
Male	39.2	22.5	38.3	2,244	-	-	-	-	-	-	-
Female	52.6	25.3	22.1	2,830	-	-	-	-	-	-	-
District											
Malabo	46.2	24.4	29.3	3,840	0.7	5.5	10.6	18.9	5.8	58.4	2,170
Luba	49.4	31.7	18.8	388	1.0	8.5	5.0	29.6	9.5	46.2	199
Baney	51.3	20.8	27.9	651	0.3	8.9	8.6	18.8	6.9	56.5	372
Riaba	57.0	19.9	22.9	195	0.0	6.7	13.5	20.2	7.9	51.7	89
Wealth Quintiles											
Lowest	38.1	20.3	45.1	1,020	1.7	6.4	7.9	15.1	5.7	63.1	404
Second	43.1	24.0	32.8	1,012	0.4	5.8	9.8	23.2	5.4	55.3	569
Middle	51.9	22.7	25.4	1,028	0.5	5.9	11.4	18.1	7.7	56.5	625
Fourth	51.3	25.3	23.3	1,004	0.8	7.4	10.2	19.4	6.6	55.6	635
Highest	47.9	27.1	24.9	1,010	0.2	5.5	10.2	21.4	5.7	56.9	597
Total	**47.1**	**24.2**	**28.8**	**5,074**	**0.7**	**5.9**	**10.8**	**19.8**	**5.7**	**57.1**	**2,830**

4 Malaria prevention

Malaria control on the island of Bioko relies primarily on vector control. At inception, one or two rounds of IRS were implemented on the entire island on a yearly basis. In 2015, IRS became targeted based on risk stratification at the community level, and LLINs became the main malaria control intervention. To achieve and maintain universal LLINs coverage, the NMCP applied the WHO's recommendation of combining mass free distributions through campaigns repeated at intervals of 3 years, and continuous distributions through multiple channels, in particular through ANC clinics and schools. Moreover, LSM was introduced in 2013 in heavy construction sites and in some communities to supplement IRS and LLINs. As a follow-up to prevention in pregnancy, the NMCP also made available free preventive treatment with Fansidar for all women attending ANC clinics in government health facilities.

This chapter presents results of the assessment of malaria control implementation. This includes household ownership of mosquito nets, population access to mosquito nets, vector control coverage (proportion of households with at least one mosquito net and/or that received IRS in within the past twelve months preceding the survey), universal vector control coverage (proportion of households with at least 1 mosquito net for every 2 persons that stayed in the houses the night before the survey or that received IRS within the past 12 months), mosquito nets use in the general population, mosquito nets use in children under 5 years old, mosquito nets use in pregnant women, ANC attendance by women who gave birth to a live baby in the past two years preceding the survey, and IPTp.

4.1 Household ownership of mosquito nets

Table 4.1 describes household mosquito nets ownership in Bioko in 2019. Sixty-two percent of households owned at least one ITN, and the average number of ITN per households was 1.4. Only 41.3% of households owned at least one ITN for every 2 persons who stayed in the household the night before the survey (universal ITN coverage). Both ITN coverage and universal ITN coverage varied across districts, and were higher in Luba and lowest in Baney. Similarly, both indicators decreased as household wealth index increased.

Table 4.1 Household ownership of mosquito nets

Percentage of households owning at least one mosquito net (treated or untreated), percentage of households owning at least one ITN[1], percentage of households owning at least one net of any type for any two persons who spent the previous night in the household, and percentage of households with at least one ITN[1] for every two persons who spent the previous night in the household; stratified by background characteristics

Background characteristics	Percentage of households owning:		Average number of mosquito nets per household		Number of households	Percentage of households owning at least one mosquito net for every two persons who slept in the house the night before the survey[2]		Number of households in which at least one person slept in the night before the survey
	At least one net	At least one ITN	Any type of net	ITN		Any mosquito net	ITN	
District								
Malabo	62.4	62.2	1.37	1.36	3,840	41.9	41.7	3,761
Luba	78.8	78.6	1.95	1.94	388	60.3	60.3	372
Baney	55.1	54.7	1.41	1.40	651	33.8	33.6	621
Riaba	68.1	68.1	1.48	1.48	195	45.0	44.9	186
Wealth quintile								
Lowest	59.4	58.9	1.04	1.03	1,020	49.7	49.2	965
Second	63.4	63.3	1.45	1.44	1,012	42.5	42.5	994
Middle	66.3	66.0	1.59	1.59	1,028	42.2	42.2	1,001
Fourth	66.7	66.5	1.62	1.61	1,004	43.6	43.4	982
Highest	53.6	53.4	1.42	1.41	1,010	32.3	31.9	998
Total	**62.0**	**61.8**	**1.40**	**1.39**	**5,074**	**41.5**	**41.3**	**4,940**

[1] An insecticide-treated net (ITN) is (1) a factory-treated net that does not require any further treatment (LLIN), or (2) a pre-treated net obtained within the past 12 months, or (3) a net that has been soaked with insecticide within the past 12 months.
[2] *De facto* household members

Household ownership of at least one ITN decreased substantially from 84.8% in 2018 to 61.8% in 2019; and also decreased between 10% and 20% across all districts (Figure 4.1)

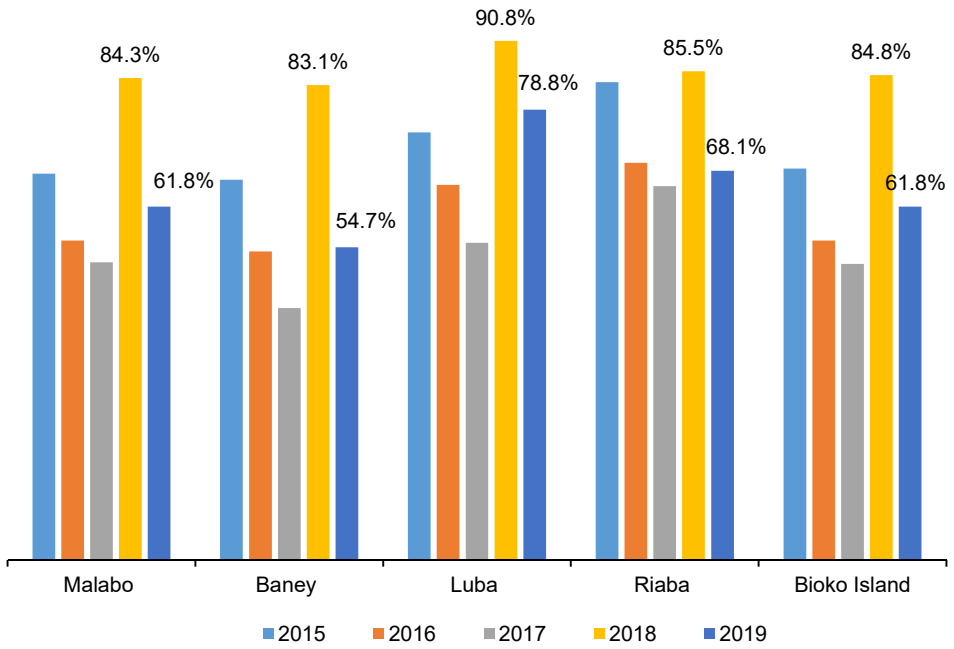

Figure 4.1 Trend in household ownership of at least one ITN

Similarly, household ownership of at least one ITN for every 2 persons who slept in the house the night before the survey reduced drastically (20%) between 2018 and 2019 on the island of Bioko (Figure 4.2). The drop in universal ITN coverage from 2018 to 2019 varied across districts and was more pronounced in Baney (24%) and Riaba (~22%) compared to Malabo and Luba.

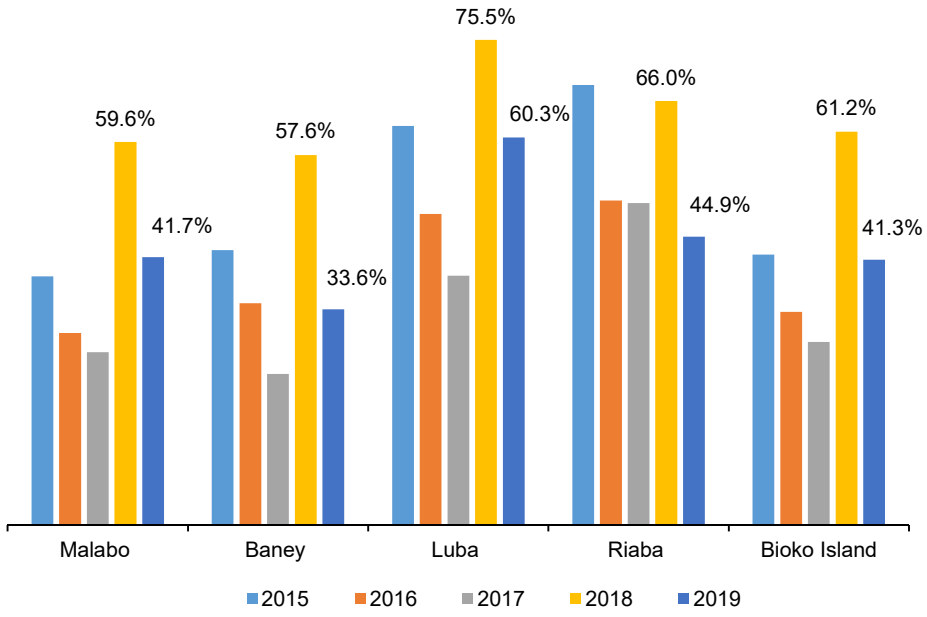

Figure 4.2 Trend in household ownership of a least one ITN for every two people

4.2 Vector control coverage

Table 4.2 shows that 70% of households in Bioko had at least one ITN and /or have had IRS in the past 12 months preceding the survey. The latter was above 80% in Riaba and Luba, and lower in Malabo and Baney; which could be explained by the fact that IRS in 2019 was targeted in Malabo and Baney, while Riaba and Luba were almost entirely sprayed. Households with the highest wealth index had the lowest vector control coverage. Fifty-four percent of households had at least one ITN for every two persons who stayed in the house the night before the survey and/or have received IRS in the past 12 months; and the latter was higher in Luba and Riaba compared to Malabo and Baney. Similarly, to vector control coverage, universal vector control coverage was lowest in households with the highest wealth index.

Table 4.2 Vector control coverage

Percentage of households with at least one mosquito net and/or IRS within the past 12 months; percentage of households with at least one ITN and/or IRS within the past 12 months; percentage of households with at least one mosquito net for every 2 persons who stayed in the house the night before the survey and/or IRS within the past 12 months; and percentage of households with at least one ITN for every 2 persons who stayed in the houses the night before the survey and/or IRS within the past 12 months; according background characteristics

	Vector control coverage			Universal vector control coverage		
Background characteristics	Percentage households with one mosquito net and/or IRS in the past 12 months	Percentage households with one ITN and/or IRS in the past 12 months	Number of households surveyed	Percent households with at least one mosquito net for every two persons who stayed in the house last night[1] and/or IRS in the past 12 months	Percent households with at least one ITN for every two persons who stayed in the house last night[1] and/or IRS in the past 12 months	Number of households with a least one person who stayed in the house last night
District						
Malabo	70.0	69.8	3,840	53.7	53.6	3,761
Luba	89.7	89.5	388	87.7	87.7	372
Baney	65.4	65.2	651	48.5	48.2	621
Riaba	92.7	92.7	195	89.1	89.1	186
Wealth quintile						
Lowest	69.3	68.8	1,020	63.1	62.6	965
Second	71.5	71.3	1,012	55.3	55.3	994
Middle	74.5	74.3	1,028	55.8	55.8	1,001
Fourth	75.8	75.7	1,004	58.4	58.3	982
Highest	60.0	59.8	1,010	42.7	42.5	998
Total	**70.2**	**70.0**	**5,074**	**54.5**	**54.3**	**4,940**

[1] *De facto* household members

4.3 Source and condition of mosquito nets

Table 4.3 describes the source of mosquito nets according to background characteristics. Of the total nets that were reported by survey respondents, the vast majority (83%) were obtained through mass distribution campaigns. However, 5.5% of the nets were purchased from retail shops. Households in Luba had the highest proportions of nets obtained through mass distribution campaigns whereas wealthier households had the highest proportion of purchased nets.

Table 4.3 Source of mosquito nets

Percent distribution of mosquito nets by the source of the net, by background characteristics

	Mosquito net source										
Background characteristics	Government clinic/hospital	School	Shop	Pharmacy	Workplace	Mass distribution campaign	Community distribution	MCDI office	Other	Not sure	Total reported nets
District											
Malabo	5.2	0.7	6.7	0.08	0.6	80.6	0.4	0.1	3.9	1.8	5,264
Luba	2.3	0.7	1.3	0.0	0.0	91.8	0.5	0.0	2.5	0.9	757
Baney	6.1	1.5	2.8	0.0	0.1	85.4	0.0	0.0	3.1	0.9	917
Riaba	5.9	1.4	1.7	0.0	0.0	88.5	1.7	0.0	0.4	0.4	288
Wealth quintile											
Lowest	4.8	0.7	4.1	0.0	0.09	83.1	0.4	0.0	5.5	1.4	1,057
Second	6.2	0.9	3.8	0.0	0.1	82.6	0.7	0.0	4.9	0.8	1,463
Middle	4.5	0.6	4.4	0.0	0.06	85.9	0.2	0.1	2.8	1.6	1,639
Fourth	5.9	1.1	5.5	0.06	0.3	81.9	0.6	0.06	2.5	2.0	1,628
Highest	3.8	0.8	9.5	0.2	1.6	79.9	0.07	0.2	2.4	1.6	1,439
Total	**5.1**	**0.8**	**5.5**	**0.06**	**0.4**	**82.7**	**0.4**	**0.08**	**3.5**	**1.5**	**7,226**

MCDI: Medical Care Development International

A total of 4,404 (60.9%) nets were directly observed by surveyors, of which 72% were in good condition, while 13% had only thumb-sized holes and 9% had at least a head-sized hole. However, about 6% of the observed nets had never been used by their owners (Table 4.4). The highest proportion of mosquito nets in bad conditions were observed in Malabo and Riaba. The proportion of mosquito nets with at least a head-sized hole decreased with increasing household wealth. Households with the highest wealth also had the highest proportion of nets that had never been used.

Table 4.4 Condition of mosquito nets that were observed in households

Percentage of nets with only thumb-sized holes, percentage of nets with at least a head-size hole, percentage of nets never used, and percentage of nets with uncertain conditions amongst nets observed by surveyors; all by background characteristics

	Condition of mosquito nets observed					
Background characteristics	Percentage with no holes	Percentage with only thumb - sized holes	Percentage with at least a head-size hole	Percentage never used	Percentage for which not sure	Total observed nets
District						
Malabo	71.2	14.3	9.3	5.1	0.1	3,254
Luba	78.8	6.3	5.5	9.4	0.0	477
Baney	74.5	10.4	7.9	6.9	0.2	491
Riaba	70.9	12.6	9.9	6.6	0.0	182
Wealth quintile						
Lowest	72.3	12.2	10.0	5.3	0.1	719
Second	71.4	13.3	10.1	5.2	0.1	904
Middle	71.5	15.1	9.5	3.9	0.0	1,006
Fourth	71.8	13.9	7.8	5.2	0.2	975
Highest	74.3	9.0	6.4	10.4	0.0	800
Total	**72.4**	**12.9**	**8.8**	**5.9**	**0.09**	**4,404**

4.4 Population access to mosquito nets

The 2019 MIS data was used to estimate the proportion of the population that could sleep under an ITN assuming that they had access to at least one ITN for every two people. ITN access, when measured against ITN use, provides useful information on the magnitude of the behavioral gap between having access to an ITN but not using it. The latter analysis helps malaria control programs to decide whether they need to achieve higher ITN coverage, promote ITN use or both [11]. Therefore, if the difference between access to ITNs and use is significant, efforts need to be made to promote behavioral change and identifying barriers to ITN use, and design appropriate interventions.

One-third of the population slept in households with no ITNs, and only 7.4% slept in households with at least 5 ITNs (Table 4.5). Fifty-two percent of the population of Bioko could sleep under an ITN if each ITN in the household were used by 2 people. ITN access decreased as the household size increased.

Table 4.5 Household population with access to an ITN

Percent distribution of the *de facto* household population by the number of ITNs the household owns, and percentage with access to an ITN, according to the number of persons who stayed in the house the night before the survey

	Number of persons who stayed in the household the night before the survey								
Number of ITNs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8+**	**Total**
0	45.6	42.7	36.4	34.6	32.3	32.0	28.5	27.9	33.2
1	34.3	24.7	21.1	15.6	16.5	11.4	13.6	13.4	16.9
2	11.0	19.4	21.4	29.7	23.5	19.6	18.5	12.8	19.0
3	5.7	7.9	14.1	13.3	16.7	20.1	20.5	14.3	14.7
4	2.6	4.4	4.8	4.2	8.6	11.1	10.9	13.3	8.7
5+	0.7	1.0	2.5	2.5	2.5	5.8	7.9	18.3	7.4
Total (%)	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Total number	**1,160**	**1,776**	**1,947**	**2,380**	**2,215**	**2,268**	**2,114**	**4,988**	**18,848**
(%) with access to an ITN[1]	54.3	57.3	56.6	57.5	53.1	53.9	50.9	46.3	52.5

[1] Percentage of the *de facto* household population who could sleep under an ITN if each ITN in the household were used by up to two people

Population access to ITN was highest in Luba (65.2%) and lowest in Baney (46.7%). The latter dropped by more than 20% on the entire island between 2018 and 2019; and also dropped by ~20% across districts (Figure 4.3).

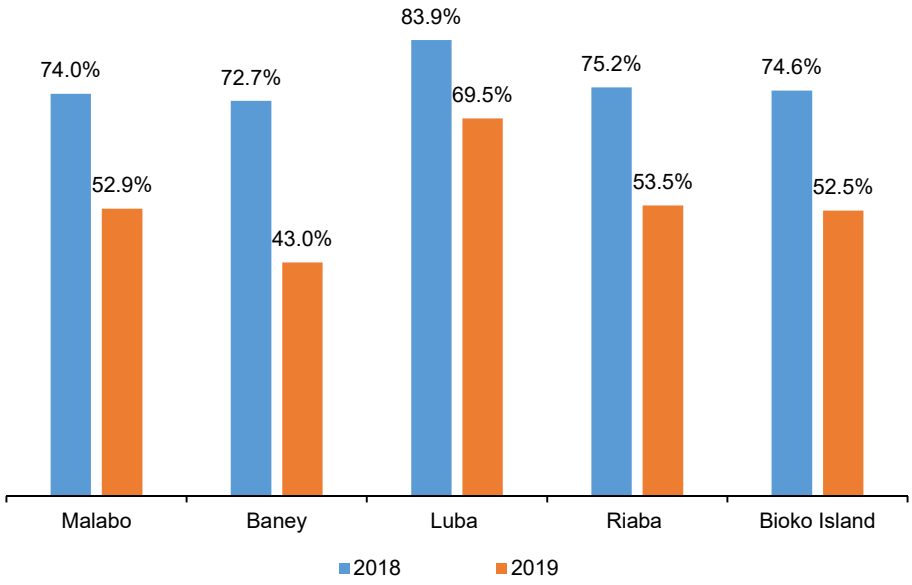

Figure 4.3 Trend in population access to ITN

4.5 Mosquito nets use

LLINs/ITNs are the main strategy to control malaria transmission and have been adopted worldwide in malaria endemic regions. The 2019 MIS questionnaire enquires about the use of mosquito nets by household members including vulnerable groups (pregnant women and children age less than five years) the night before the survey.

4.5.1 Mosquito nets use by persons in the household

Table 4.6 presents the percentage of the *de facto* household population that slept under a mosquito net of any type or under an ITN the night before the survey. Less than half (~40%) of the household population slept under an ITN the night before the survey. Sleeping under an ITN the night before the survey was highest amongst younger children (< 5 years old) and older household people (+50 years old). A slightly higher proportion of the female gender slept under an ITN the night before the survey, compared to the male gender. ITN use was highest in Luba and lowest in Baney. The percentage of household population that slept under an ITN the night before the survey decreased drastically with increasing household wealth.

Access to an ITN in the household seemed to increase the likelihood of use. About 6 in 10 (58.5%) members of households with at least one ITN slept under one the night before the survey, and 69% of the population living in households with at least one ITN for every two persons who slept in the house the night before the survey slept under one the night before the survey. Variations by background characteristics in ITN use among households that own at least one ITN or own at least one ITN for every two people that slept in the household the night before the survey were similar to those within the general population.

Table 4.6 Use of mosquito nets by persons in the household

Percentage of *de facto*[1] household population who: slept under a mosquito net the night before the survey; slept under an ITN the night before the survey; percentage who slept under an ITN among *de facto*[1] household population in households with at least one ITN, and percentage who slept under an ITN the night before the survey among de facto[1] household population in households with at least one ITN for every two persons who spent the night in the house; according to background characteristics.

	Household population				Population in households with at least 1 ITN		Population in households with at least 1 ITN for every 2 persons who slept in the household the night before the survey	
Background characteristics	(%) who slept under a mosquito net	(%) who slept under an ITN	(%) who slept under an ITN or in a house that received IRS within the past 12 months	Number of individuals	(%) who slept under an ITN	Number of individuals	(%) who slept under an ITN	Number of individuals
Age in years								
<5	47.9	47.5	63.7	2,749	67.2	1,943	79.2	720
5-14	38.0	37.9	57.2	4,915	55.1	3,382	71.9	1,371
15-34	32.5	32.3	49.6	6,857	52.7	4,205	61.1	2,249
35-49	42.4	42.4	56.6	2,687	63.4	1,794	70.2	1,137
50 +	52.1	51.9	64.9	1,630	67.1	1,262	72.3	905
Sex								
Male	36.9	36.8	54.3	9,487	56.2	6,204	65.9	3,293
Female	41.7	41.5	57.8	9,361	60.8	6,387	71.6	3,090
District								
Malabo	40.2	39.9	54.4	14,419	60.2	9,574	70.6	4,875
Luba	47.9	47.9	77.9	1,266	61.7	982	70.1	561
Baney	30.5	30.2	44.9	2,484	49.3	1,524	57.2	729
Riaba	36.4	36.4	89.4	679	48.3	511	61.1	218
Wealth quintile								
Lowest	40.3	40.0	63.4	2,139	61.1	1,403	66.7	895
Second	47.5	47.2	62.4	3,443	64.6	2,513	71.6	1,235
Middle	45.6	45.4	63.6	4,042	61.9	2,966	73.2	1,443
Fourth	41.5	41.3	60.5	4,329	60.1	2,979	72.7	1,514
Highest	26.0	25.9	37.9	4,895	46.4	2,730	57.6	1,296
Total	**39.3**	**39.1**	**55.9**	**18,848**	**58.5**	**12,591**	**68.7**	**6,383**

[1]household population who slept in the house the night before the survey

4.5.2 Mosquito nets use by children less than five years old

Children below five years old are mostly vulnerable to malaria. Antibodies acquired during pregnancy and those obtained through breast milk protect children from various diseases including malaria, for those born in malaria endemic regions. This immunity is gradually lost as children grow older. Children born and living in malaria endemic areas develop partial immunity depending on the level of exposure to malaria antigens through infection. It is believed that these children will attain high level of immunity by the age of five during which they may not experience severe and life threatening malaria episodes [12]. Therefore, community level protection with mosquito nets will help to reduce disease transmission and confer another level of protection to the most vulnerable groups.

Table 4.7 shows that almost half of the children slept under an ITN the night before the survey and that around 6 in 10 children slept under an ITN the night before the survey and /or in a household that have had IRS in the past 12 months. Sleeping under an ITN decreased with increasing age. ITN use in children varied with the level of education of the household head. Compared to children living in Malabo and Luba, those living in Baney and Riaba were less likely to sleep under an ITN. ITN use among children also decreased significantly with increasing wealth.

Not surprisingly, access to ITNs appears to influence use among children. In households with at least one ITN, 67% of children slept under an ITN the night before the survey; whereas almost 8 in 10

children in households having at least one ITN for every two people who slept in the house the night before the survey, slept under an ITN.

Table 4.7 Use of mosquito nets by children less than five years old

Percentage of *de facto*[1] household children who: slept under a mosquito net the night before the survey; who slept under an ITN the night before the survey; percentage who slept under an ITN among de facto[1] household children in households with at least on ITN, and percentage who slept under an ITN the night before the survey among de facto[1] household children in households with at least one ITN for every two persons who spent the night in the house; according to background characteristics

	Children age under 5 years in all households				Children age under 5 years in households with at least 1 ITN		Children age under 5 years in households with at least 1 ITN for every 2 persons who slept in the household the night before the survey	
Background characteristics	(%) who slept under a mosquito net	(%) who slept under an ITN	(%) who slept under an ITN or in a houses that received IRS within the past 12 months	Number of children	(%) who slept under an ITN	Number of children	(%) who slept under an ITN	Number of children
Age in months								
<12	64.4	63.5	72.6	537	79.1	431	81.0	153
12-23	49.2	48.6	64.8	549	68.3	391	78.9	157
24-35	45.2	44.6	60.4	560	64.1	390	77.2	145
36-47	41.3	41.1	62.3	547	62.7	359	78.5	149
48-59	40.3	40.1	58.8	556	59.9	372	80.2	116
Child gender								
Male	48.1	47.7	63.2	1,395	67.8	981	78.8	373
Female	47.9	47.3	64.3	1,354	66.5	962	79.5	347
Household head's education								
None	45.3	42.2	64.1	64	64.3	42	80.0	25
Primary	51.5	51.1	70.5	264	65.9	205	76.3	80
Secondary	50.6	50.3	68.3	904	68.8	661	79.8	253
Post-secondary	41.3	41.1	52.9	710	66.1	442	75.0	176
Unknown	50.1	49.2	65.9	807	66.9	593	83.3	186
District								
Malabo	50.4	49.8	64.2	2,079	70.7	1,466	81.9	576
Luba	53.2	53.2	79.8	188	66.7	150	73.2	56
Baney	34.5	34.2	46.6	380	52.2	249	63.0	73
Riaba	39.2	39.2	89.2	102	51.3	78	73.3	15
Wealth quintile								
Lowest	44.8	44.4	65.9	252	61.5	182	75.8	62
Second	57.4	56.8	71.4	542	73.2	421	80.0	145
Middle	53.6	53.1	70.1	603	68.7	466	80.9	162
Fourth	49.0	48.6	68.7	665	69.6	464	83.9	193
Highest	35.8	35.3	46.4	687	59.3	410	72.2	158
Total	**47.9**	**47.5**	**63.7**	**2,749**	**67.2**	**1,943**	**79.2**	**720**

Note: This table is based on children who slept in the household the night before the interview ([1]de facto household children)

4.5.3 Mosquito nets use in pregnant women

In malaria endemic areas, adults who are frequently exposed to malaria develop some degree of immunity to severe, life-threatening malaria. However, this acquired immunity can be depleted during pregnancy; therefore, leading to higher risks of malaria. During pregnancy women are encouraged to sleep under mosquito nets every night to reduce the risks of adverse malaria effects on both the mother and the fetus [13]

Table 4.8 shows that 38% of pregnant women slept under an ITN the night before the survey, and 64% slept under an ITN and / or in a house that have had IRS in the past 12 months. ITN use decreased with the age of the women and also with higher levels of education. Pregnant women living in Luba were

more likely to sleep under an ITN compared to those living in other districts. ITN use among pregnant women decreased significantly with increasing wealth.

Similarly, to the general population and children, owning at least one ITN and owning one ITN for every two persons who slept in the household the night before the survey increased the likelihood of sleeping under an ITN among pregnant women.

Table 4.8 Use of mosquito nets by pregnant women

Percentage of de facto[1] household pregnant women who: slept under a mosquito net the night before the survey; who slept under an ITN the night before the survey; percentage who slept under an ITN among de facto[1] household pregnant women in households with at least on ITN, and percentage who slept under an ITN the night before the survey among de facto[1] household pregnant women in households with at least one ITN for every two persons who spent the night in the house; according to background characteristics

	Pregnant women 15-49 years old in all households				Pregnant women 15-49 years old in households with at least 1 ITN		Pregnant women 15-49 years old in households with at least 1 ITN for every 2 persons who slept in the household the night before the survey	
Background characteristics	(%) who slept under a mosquito net	(%) who slept under an ITN	(%) who slept under an ITN or in a houses that received IRS within the past 12 months	Number of women	(%) who slept under an ITN	Number of women	(%) who slept under an ITN	Number of women
Age in years								
15-24	41.3	41.3	62.2	143	62.1	95	65.3	49
25-34	36.5	36.5	53.3	137	58.1	86	76.3	38
35-49	28.8	28.6	50.0	42	46.2	26	58.9	17
Education level								
None	50.0	50.0	70.0	10	62.5	8	80.0	5
Primary	38.5	38.5	64.1	39	57.7	26	60.0	10
Secondary	42.5	42.5	64.5	186	62.7	126	73.0	63
Post-secondary	19.7	19.7	29.5	61	38.7	31	43.8	16
Unknown	38.5	38.5	50.0	26	62.5	16	80.0	10
District								
Malabo	36.9	36.9	54.9	257	57.9	164	66.7	90
Luba	62.5	62.5	42.8	16	83.3	12	83.3	6
Baney	28.6	28.6	81.3	35	50.0	20	66.7	6
Riaba	42.8	42.8	100.0	14	54.5	11	100.0	2
Wealth quintile								
Lowest	42.4	42.4	57.6	33	60.9	23	76.9	13
Second	52.5	52.5	67.8	59	68.9	45	77.3	22
Middle	43.7	43.7	67.8	87	60.3	63	62.9	35
Fourth	35.5	35.5	57.9	76	58.7	46	73.7	19
Highest	16.4	16.4	31.3	67	36.7	30	53.3	15
Total	**37.5**	**37.5**	**58.6**	**322**	**58.5**	**207**	**62.3**	**104**

Note: This table is based on pregnant women who slept in the household the night before the interview ([1]*de facto* household pregnant women)

ITN use decreased by 8.2% between 2018 and 2019 in Bioko, by 14.4% among pregnant women and by 7.1% among children less than 5 years old (Figure 4.4).

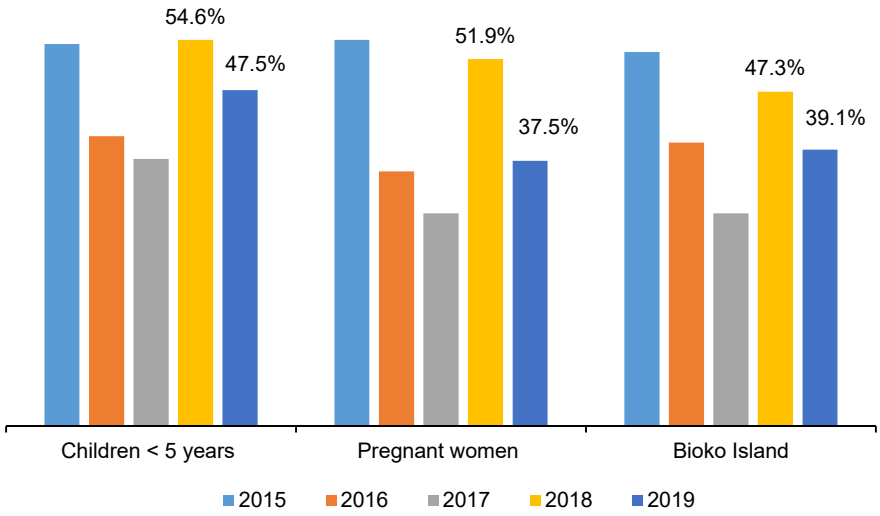

Figure 4.4 Trend in ITN use

4.6 Malaria prevention in pregnancy

Just like in other endemic settings, malaria in pregnancy remains an important public health problem in Equatorial Guinea and especially in Malabo. In high transmission areas where women have developed some degree of immunity that will prevent severe disease, malaria infection is more likely to contribute to maternal anemia and delivery of low birth-weight infants (<2,500g) which is a risk factor of death [13]. In low transmission areas, where women have not developed partial immunity to malaria, infection is more likely to result in severe malaria disease, maternal anemia, premature delivery, or fetal loss. These problems are very pronounced in women in their first and second pregnancies and in the presence of other infectious diseases, especially HIV [14].

The World Health organization (WHO) recommends a three approaches package to reduce the effect of malaria in pregnancy: prompt diagnosis and effective treatment of malaria infections, the use of LLINs, and IPTp with SP as part of ANC services [14]. IPTp has been demonstrated to be highly cost-effective in reducing maternal morbidity and poor birth weight [15]. WHO recommends to administer three or more doses of IPTp-SP to pregnant women living in moderate-to-high malaria transmission areas in Africa, starting as early as possible in the second trimester and at monthly intervals up to the time of delivery [16].

4.6.1 Coverage of Antenatal Care

Women attending ANC clinics get access to a full package of interventions to improve the outcome of their pregnancy. However, these services should ideally be provided by skilled health providers who can access the status of the pregnancy, deliver the package of interventions, and provide appropriate additional clinical management when necessary.

ANC attendance in general was optimal, with the highest proportion of women attending in hospitals, followed by private clinics, and health centers (Table 4.9). Private clinics in Bioko are not included in the free malaria prevention package offered by the NMCP. Older women were more likely to

receive ANC in private clinics. similarly, ANC attendance in private clinics increased with educational levels and wealth

Table 4.9 Antenatal Care Attendance

Percentage distribution of women 15-49 years old who had a live birth in the 2 years preceding the survey by antenatal care (ANC) provider during pregnancy , according to background characteristics

Background Characteristics	Antenatal care provider						No ANC	Number of women
	Hospital	Health Center	Private Clinic	Health agent	Traditional healer	Other		
Age in Years								
<25	56.7	21.8	18.3	0.0	0.0	0.8	2.4	372
25 to 34	49.5	18.9	28.7	0.0	0.0	0.6	2.2	535
≥35	41.9	23.3	29.1	0.0	0.0	2.3	3.5	172
Level of education								
None	58.1	12.9	19.4	0.0	0.0	0.0	9.7	31
primary	63.1	19.1	10.6	0.0	0.0	0.0	7.1	141
secondary	54.3	21.7	22.1	0.0	0.0	0.4	1.5	669
post-secondary	30.7	17.9	47.2	0.0	0.0	3.3	0.1	212
unknown	50.0	30.8	11.5	0.0	0.0	0.0	7.7	26
District								
Malabo	48.0	20.7	28.5	0.0	0.0	1.2	1.4	829
Luba	67.6	16.2	7.4	0.0	0.0	0.0	8.8	68
Baney	56.4	19.3	21.4	0.0	0.0	0.0	2.8	140
Riaba	59.5	26.2	2.3	0.0	0.0	0.0	11.9	42
Wealth Quintiles								
Lowest	56.4	26.5	9.4	0.0	0.0	0.0	7.7	117
Second	62.9	19.3	11.9	0.0	0.0	0.4	5.3	242
Middle	56.4	25.6	17.5	0.0	0.0	0.0	0.5	211
Fourth	49.4	20.9	28.5	0.0	0.0	0.0	1.2	253
Highest	33.3	14.5	48.2	0.0	0.0	3.5	0.4	255
Total	**50.8**	**20.6**	**25.2**	**0.0**	**0.0**	**0.1**	**2.5**	**1,079**

To assess the use of IPTp, women who had a live birth in the past 2 years prior to the survey and who indicated attending ANC, were asked if they had taken Fansidar during their pregnancy. Those reporting that they had taken the medication were asked how many doses they got.

Table 4.10 summarizes the proportion of women who had a live birth in the past two years prior to the survey, and who received IPTp according to the number of doses received. Therefore 64% of women received one or more doses, 50% received two or more doses, and only 36% received the recommended three or more doses. Women in Luba and Baney were more likely to receive 3 or more doses. Higher educational status and wealth also increased the likelihood of receiving three or more doses.

Table 4.10 Use of Intermittent Preventive Treatment in pregnancy

Percentage distribution of women age 15-49 who had a live birth in the 2 years preceding the survey who, during the pregnancy received 1 or more doses of SP/Fansidar, 2 or more doses of SP/Fansidar, and 3 or more doses of SP/Fansidar, according to background characteristics

Background characteristics	Percentage who received one or more doses	Percentage who received two or more doses	Percentage who received three or more doses	Number of women who had a live birth in the past two years preceding the survey
Age in Years				
<25	60.4	49.2	34.9	372
25 to 34	66.2	51.6	37.2	535
≥35	64.5	47.7	34.9	172
level of education				
none	58.1	41.9	38.7	31
primary	63.1	51.8	36.9	141
secondary	64.9	50.1	35.1	669
post-secondary	65.1	52.4	40.6	212
unknown	42.3	34.6	15.4	26
District				
Malabo	63.7	50.3	35.6	829
Luba	73.5	52.9	42.6	68
Baney	62.1	48.6	37.1	140
Riaba	59.5	47.6	30.9	42
Wealth Quintiles				
Lowest	61.5	49.6	31.6	117
Second	61.7	47.3	33.3	242
Middle	61.6	44.6	33.2	211
Fourth	67.6	52.6	38.3	253
Highest	65.4	55.3	40.8	255
Total	**63.9**	**50.1**	**36.1**	**1,079**

5 Case management

Malaria case management through prompt diagnosis and treatment using appropriate and effective medicines has always been one of the key strategies adopted by the NMCP to reduce malaria-associated morbidity and mortality in Bioko. The national malaria treatment guidelines of Equatorial Guinea recommend that all suspected cases of malaria be confirmed either by microscopy or RDT and treated with adequate antimalarial drugs. The 2019 revised guidelines recommend AL as first-line treatment of uncomplicated malaria instead of ASAQ as previously used.

This chapter presents results related to fever case management and malaria in children less than five years old. Findings are useful to design communication and social mobilization programs to support effective case management of malaria and fever in children.

5.1 Prevalence, diagnosis and treatment of fever in children

Fever is the most common malaria symptom and is also associated with other infections in young children. Respondents were asked if any household member, including children less than five years old, have had fever in the two weeks preceding the survey and if so, whether any treatment was sought. For those with fever, information on whether blood sample was obtained for testing and the type of treatment that was given was also collected.

Table 5.1 describes the percentage of children under five years old who had fever within the 2-weks preceding the survey, the percentage for whom advice or treatment was sought, the percentage from whom blood was taken from the finger or heel for testing (proxy for malaria testing), and the percentage who received ACTs.

Almost 9% of the children have had fever within 2-weeks preceding the survey and this was higher in Baney (14%) compared to the rest of the districts. Amongst those with fever, advice/care was sought for 67%, blood was drawn from 45% for testing and 5% received ACT. Seeking care increased significantly with wealth and was also higher in Malabo and Luba and lowest in Riaba.

Table 5.1 Prevalence, diagnosis and treatment of children with fever

Percentage of children under 5 years old with fever in the 2 weeks preceding the survey and, among those with fever, percentage for whom treatment was sought, percentage who had blood taken from the finger, vein or heel for testing, and percentage who took any ACT.

	Children under five years old		Children under five years old with fever			
Background characteristics	Percentage with fever in the 2 weeks preceding the survey	Number of children	Percentage for whom advice or treatment was sought[1]	Percentage who had blood taken for testing	Percentage who took any ACT	Number of children
Age in months						
<12	6.7	578	66.7	56.4	0.0	39
12 to 23	12.2	580	64.9	50.7	4.2	71
24 to 35	8.8	600	64.2	54.7	7.5	53
36 to 47	9.3	591	76.4	49.1	9.1	55
48 to 59	7.7	601	60.9	67.4	2.2	46
Gender						
Male	9.3	1,489	68.8	47.8	5.1	138
Female	8.6	1,461	64.3	42.1	4.8	126
Household head's education						
None	3.1	65	100.0	100.0	0.0	2
Primary	6.4	281	72.2	33.3	0.0	18
Secondary	8.8	989	68.9	42.5	3.4	87
Post-secondary	10.2	764	73.1	60.3	5.1	78
Unknown	9.3	851	55.7	34.2	7.6	79
District						
Malabo	8.4	2,235	70.6	51.3	6.4	187
Luba	6.3	207	69.2	30.8	0.0	13
Baney	13.7	401	56.4	29.1	0.0	55
Riaba	8.4	107	44.4	33.3	11.1	9
Wealth Quintiles						
Lowest	6.4	267	64.7	47.1	11.8	17
Second	9.9	577	57.9	33.3	3.5	57
Middle	9.9	645	56.3	31.3	6.3	64
Fourth	9.4	722	69.1	44.1	1.5	68
Highest	7.8	739	84.5	72.4	6.9	58
Total	**8.9**	**2,950**	**66.7**	**45.1**	**4.9**	**264**

[1] sought care does not include house, traditional healer and others

5.2 Source of advice or treatment

Information was collected on where treatment or advice was sought when the child had fever, and is presented in Table 5.2. Amongst children with fever in the two weeks preceding the survey, 36% received treatment in public hospitals, 7% in public health centers, 23% in private clinics and 22% in pharmacies. Receiving care in private clinics was highest among children living in wealthy households.

Table 5.2 Source of advice or treatment for children with fever

Percentage of children under 5 years old with fever in the 2 weeks preceding the survey for whom advice or treatment was sought from specific sources, by source and background characteristics

Background characteristics	House	Hospital	Health center	Private clinic	Family practitioner	Birth attendant	Pharmacy	Shop	Other	Number of children
Age in months										
<12	9.5	42.9	9.5	21.4	0.0	0.0	16.7	0.0	0.0	42
12-23	11.7	38.3	8.3	16.7	0.0	1.7	20.0	0.0	3.3	60
24-35	7.7	33.3	2.6	35.9	0.0	0.0	20.5	0.0	0.0	39
36-47	11.5	32.7	5.8	25.0	0.0	1.9	23.1	0.0	0.0	52
48-59	10.5	31.6	10.5	18.4	0.0	0.0	28.9	0.0	0.0	38
sex										
Female	9.7	31.5	6.5	29.8	0.0	1.6	20.2	0.0	0.8	124
Male	11.2	41.1	8.4	14.9	0.0	0.0	23.4	0.0	0.9	107
Household head's education										
None	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2
Primary	13.3	20.0	13.3	20.0	0.0	0.0	33.3	0.0	0.0	15
Secondary	10.5	30.3	10.5	21.1	0.0	0.0	27.6	0.0	0.0	76
Post-secondary	6.8	40.5	5.4	36.5	0.0	1.4	9.5	0.0	0.0	74
Unknown	14.1	39.1	4.7	10.9	0.0	1.6	26.6	0.0	3.1	64
District										
Malabo	8.6	36.0	51.4	25.1	0.0	0.0	23.4	0.0	0.6	175
Luba	10.0	50.0	10.0	0.0	0.0	0.0	30.0	0.0	0.0	10
Baney	19.0	26.2	16.7	21.4	0.0	1.1	14.3	0.0	2.3	42
Riaba	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4
Wealth Quintiles										
Lowest	14.3	50.0	14.3	14.3	0.0	0.0	7.1	0.0	0.0	14
Second	11.4	29.5	11.4	20.5	0.0	2.3	25.0	0.0	0.0	44
Middle	11.8	45.1	1.9	39.3	0.0	0.0	33.3	0.0	3.9	51
Fourth	9.7	29.0	9.7	22.6	0.0	1.6	27.4	0.0	0.0	62
Highest	8.3	36.7	5.0	43.3	0.0	0.0	6.7	0.0	0.0	60
Total	**10.4**	**35.9**	**7.4**	**22.9**	**0.0**	**0.9**	**21.6**	**0.0**	**0.9**	**231**

5.3 Type of antimalarial used

Table 5.3 describes specific types of antimalarial drugs that were given to children following the onset of fever. Only about 3 of every 10 children took ACTs. The use of Artemether was very frequent (48.8%). No child less than 12 months old received ACTs. Children living in households in which the household head had at least post-secondary education had more chances of receiving ACTs. ACT consumption was 36% in Malabo and no child in Luba and Baney received them. However, these results are based on very small numbers and may be inconclusive.

Table 5.3 Type of antimalarial drugs used by children with fever

Among children under age 5 years with fever in the 2 weeks preceding the survey who took any antimalarial medication, the percentage who took specific antimalarial drugs, by background characteristics

Background characteristics	Any ACT[1]	Artesunate	Amodiaquine	Chloroquine	Fansidar	Quinine	Artemether	Number of children
Age in months								
<12	0.0	20.0	0.0	20.0	0.0	0.0	60.0	5
12 to 23	25.0	8.3	8.3	8.3	8.3	8.3	58.3	12
24 to 35	40.0	20.0	10.0	10.0	0.0	10.0	30.0	10
36 to 47	38.5	23.1	0.0	7.7	0.0	7.7	46.2	13
48 to 59	33.3	0.0	0.0	0.0	0.0	0.0	66.7	3
sex								
Female	35.0	20.0	10.0	10.0	5.0	5.0	45.8	20
Male	26.1	13.1	0.0	8.7	0.0	8.7	52.2	23
Household head's education								
None	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
Primary	0.0	0.0	0.0	20.0	0.0	0.0	80.0	5
Secondary	17.6	23.5	5.9	5.9	5.9	11.8	70.6	17
Post-secondary	36.4	27.3	0.0	18.2	0.0	9.1	18.2	11
Unknown	60.0	0.0	10.0	0.0	0.0	0.0	30.0	10
District								
Malabo	36.4	21.1	3.1	3.1	0.0	9.1	45.5	33
Luba	0.0	0.0	33.3	33.3	33.3	0.0	66.7	3
Baney	0.0	0.0	0.0	33.3	0.0	0.0	66.7	6
Riaba	100.0	0.0	0.0	0.0	0.0	0.0	0.0	1
Wealth Quintiles								
Lowest	66.7	0.0	0.0	0.0	0.0	0.0	33.3	3
Second	25.0	12.5	0.0	12.5	12.5	0.0	62.5	8
Middle	33.3	0.0	8.3	8.3	0.0	8.3	41.7	12
Fourth	9.1	36.4	0.0	9.1	0.0	9.1	81.8	11
Highest	44.4	22.2	11.1	11.1	0.0	11.1	11.1	9
Total	**30.2**	**16.3**	**4.7**	**9.3**	**2.3**	**6.9**	**48.8**	**43**

Note: others was excluded because there was uncertainty on whether they represented other malaria drugs

[1] Any ACT (ASAQ, or AL)

6 Malaria and anemia

6.1 Prevalence of malaria

The major objective of the 2019 Bioko Island MIS was to assess the prevalence of malaria in the entire population. Malaria was tested on site using RDTs and results were available within twenty minutes. All individuals with positive RDTs were immediately given free treatment by the survey nurses according to standard treatment guidelines in Equatorial Guinea.

Overall, 13,939 were tested for malaria, of whom 13,918 had a valid test result (Table 6.1). The prevalence of malaria was 15.8% and almost all the cases were caused by *P. falciparum* (94%). Children 5 to 14 years old and individuals 15 to 34 years old had the highest prevalence of malaria (21% and 17.6%. respectively). Males were more likely to be positive than females (17.9% Vs. 13.9%). Malaria prevalence varied across districts and was highest in Riaba and lowest in Baney. Malaria decreased with increasing household wealth.

Table 6.1 Prevalence of Malaria in the general population

Prevalence of malaria, all species and *P. falciparum*, in the general population

Background Characteristics	Prevalence of malaria	Prevalence of P. *falciparum*	Total number with valid RDT
Age in years			
<5	9.8 (8.4 - 11.4)	9.1 (7.7 - 10.8)	2,262
5-14	21.1 (18.6 - 23.8)	20.1 (17.7 - 22.6)	4,083
15-34	17.6 (16.0 - 19.2)	16.6 (15.1 - 18.2)	4,764
35-49	11.7 (10.1 - 13.6)	10.7 (9.2 - 12.5)	1,628
50 +	7.4 (5.8 - 9.3)	6.1 (4.3 - 7.9)	1,181
Sex			
Male	17.9 (16.1 - 19.8)	16.8 (15.1 - 18.6)	6,570
Female	13.9 (12.5 - 15.5)	13.1 (11.8 - 14.6)	7,348
District			
Malabo	16.8 (15.2 - 18.6)	15.9 (14.3 - 17.5)	10,389
Luba	14.1 (8.5 - 22.5)	12.9 (7.7 - 20.7)	1,103
Baney	9.4 (6.6 - 13.2)	8.8 (6.2 - 12.4)	1,838
Riaba	20.7 (14.8 - 28.4)	19.0 (13.7 - 25.7)	588
Wealth Quintiles			
Lowest	18.2 (15.2 - 21.6)	16.9 (14.2 - 20.1)	1,790
Second	17.7 (15.2 - 20.5)	16.7 (14.4 - 19.4)	2,638
Middle	16.6 (14.5 - 19.0)	15.9 (13.8 - 18.3)	3,056
Fourth	14.6 (12.7 - 16.8)	13.5 (11.6 - 15.6)	3,131
Highest	13.3 (11.6 - 15.3)	12.4 (11.6 - 14.3)	3,303
Total	**15.8 (14.3 - 17.4)**	**14.8 (13.5 - 16.3)**	**13,918**

Results are presented as percentage (95% CI)

Figure 6.1 depicts malaria trend between 2015 and 2019, and by districts. Malaria prevalence plateaued between 2015 and 2018 before increasing significantly in 2019. The increase was evident in the four districts.

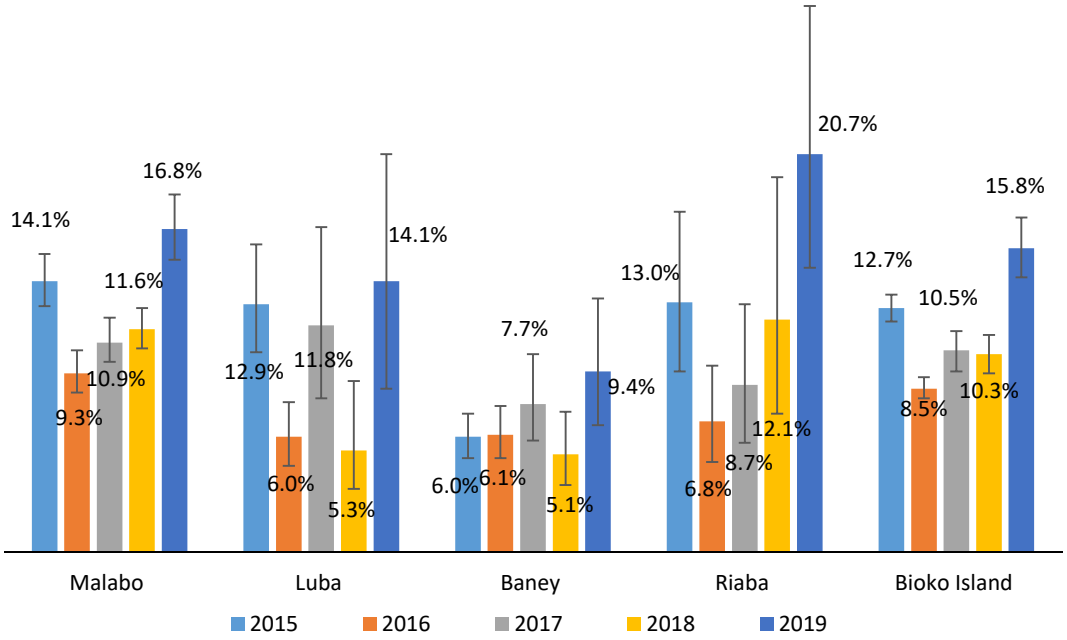

Figure 6.1 Trend in malaria prevalence by district

Figure 6.2 shows the distribution of malaria prevalence at map-area level. Malaria prevalence increased in most map-areas except for a few mostly in the North-Eastern part of the island. The increase was more pronounced in the North, North-West, and the South-East.

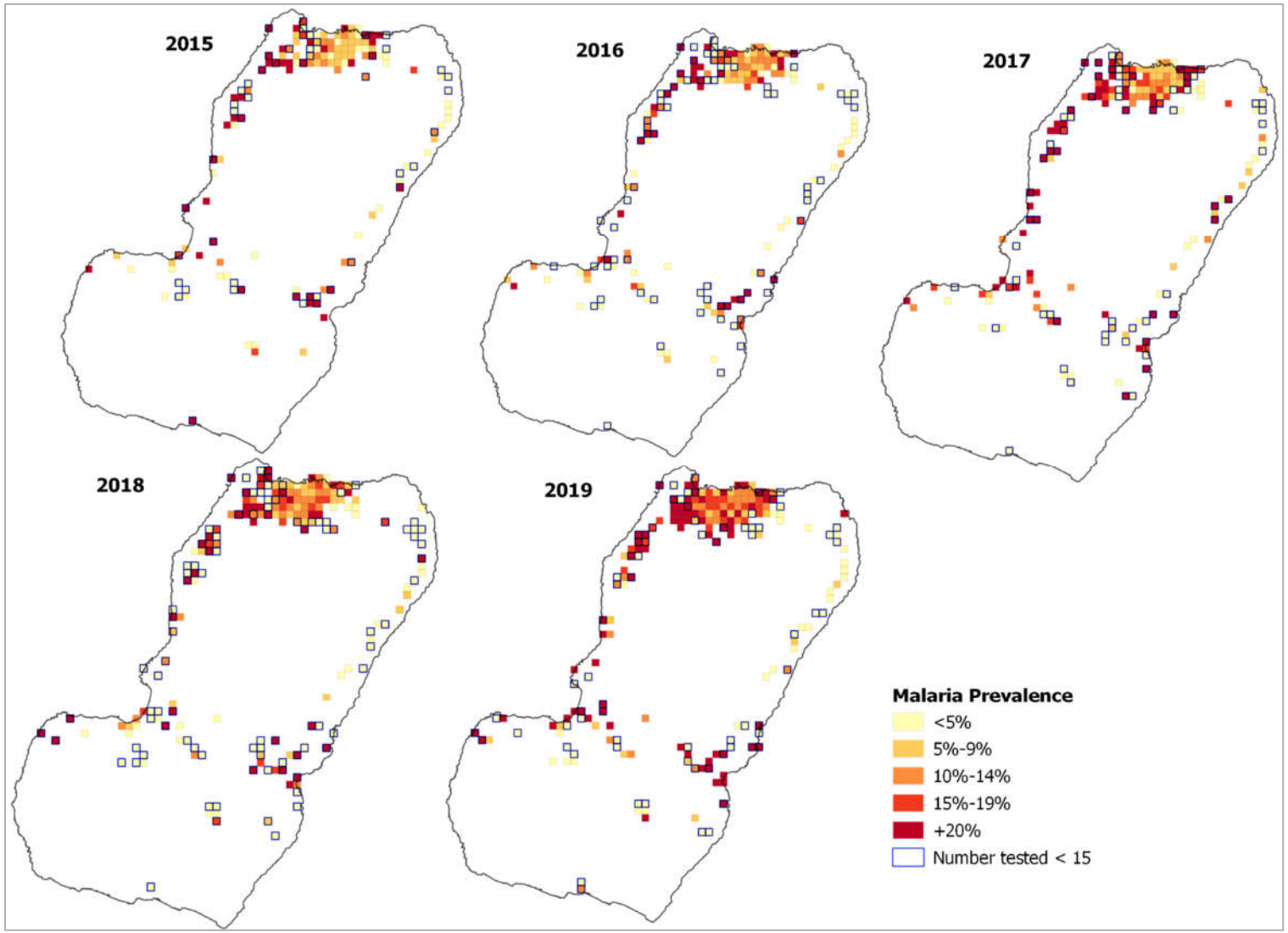

Figure 6.2 Spatial distribution of malaria prevalence by map-area

Malaria prevalence in children was 9.8% and increased with age (Table 6.2). girls had a higher prevalence compared to boys. Malaria decreased with the level of education of the household head. Children living in Riaba had the highest prevalence of malaria and those living in Baney had the lowest. Not surprisingly, malaria decreased significantly with increasing wealth.

Table 6.2 Prevalence of malaria in children

Percentage of RDT positivity in children age less than five-years old, according to background characteristics

Background characteristics	Prevalence of malaria	Prevalence of *P. falciparum*	Total children with valid RDT
Age in months			
<12	3.3 (1.9 - 5.8)	3.3 (1.9 - 5.8)	394
12-23	7.8 (5.6 - 10.6)	6.9 (4.9 - 9.7)	462
24-35	8.4 (6.2 - 11.4)	7.8 (5.7 - 10.7)	486
36-47	12.9 (9.9 - 16.8)	12.3 (9.3 - 16.2)	455
48-59	15.7 (12.5 - 19.4)	14.6 (11.6 - 18.2)	465
Sex			
Male	8.5 (6.8 - 10.6)	7.9 (6.2 - 9.9)	1,138
Female	11.1 (9.1 - 13.6)	10.4 (8.4 - 12.9)	1,124
Household head's education			
none	17.6 (9.9 - 29.5)	17.6 (9.9 - 29.5)	51
primary	13.2 (8.4 - 20.1)	12.8 (7.9 - 19.8)	227
secondary	11.1 (8.7 - 13.9)	10.1 (7.9 - 12.8)	759
post-secondary	5.3 (3.5 - 7.8)	4.6 (2.9 - 7.1)	548
not sure	10.3 (7.5 - 14.1)	9.9 (7.2 - 13.5)	677
District			
Malabo	10.4 (8.7 - 12.3)	9.8 (8.1 - 11.8)	1,698
Luba	10.5 (6.3 - 16.9)	9.3 (5.3 - 15.8)	172
Baney	4.3 (2.4 - 7.5)	4.0 (2.3 - 6.9)	298
Riaba	15.9 (9.8 - 24.7)	13.8 (8.9 - 20.8)	94
Wealth Quintiles			
Lowest	18.9 (14.2 - 24.7)	17.9 (13.3 - 23.8)	217
Second	13.5 (10.3 - 17.5)	12.7 (9.3 - 16.9)	457
Middle	10.5 (8.1 - 13.6)	9.9 (9.3 - 12.9)	523
Fourth	7.3 (5.4 - 9.9)	6.9 (5.0 - 9.6)	544
Highest	4.6 (2.9 - 7.2)	3.8 (2.3 - 6.2)	521
Total	**9.8 (8.4 - 11.4)**	**9.1 (7.7 - 10.8)**	**2,262**

Results are presented as percentage (95% CI)

Historically, the MIS assessed malaria among children 2-14 years old in sentinel sites of entomological interest up till 2012, in all ages from 2013, and in all ages and on the entire island from 2015.

Figure 6.3 depicts the historical trend of *P. falciparum* among children 2 to 14 years old in sentinel sites, and on the entire island. The biggest achievement of the BIMEP has been the tremendous reduction of *P. falciparum* in children age 2 to 14 years by over 60% from the onset of the project till 2015, in historical sentinel sites. However, the prevalence plateaued in the next four years, and then increased significantly in 2019 to 16.6%. Similarly, *P. falciparum* increased significantly from 10.9% to 17.9% in 2019 in the same age group.

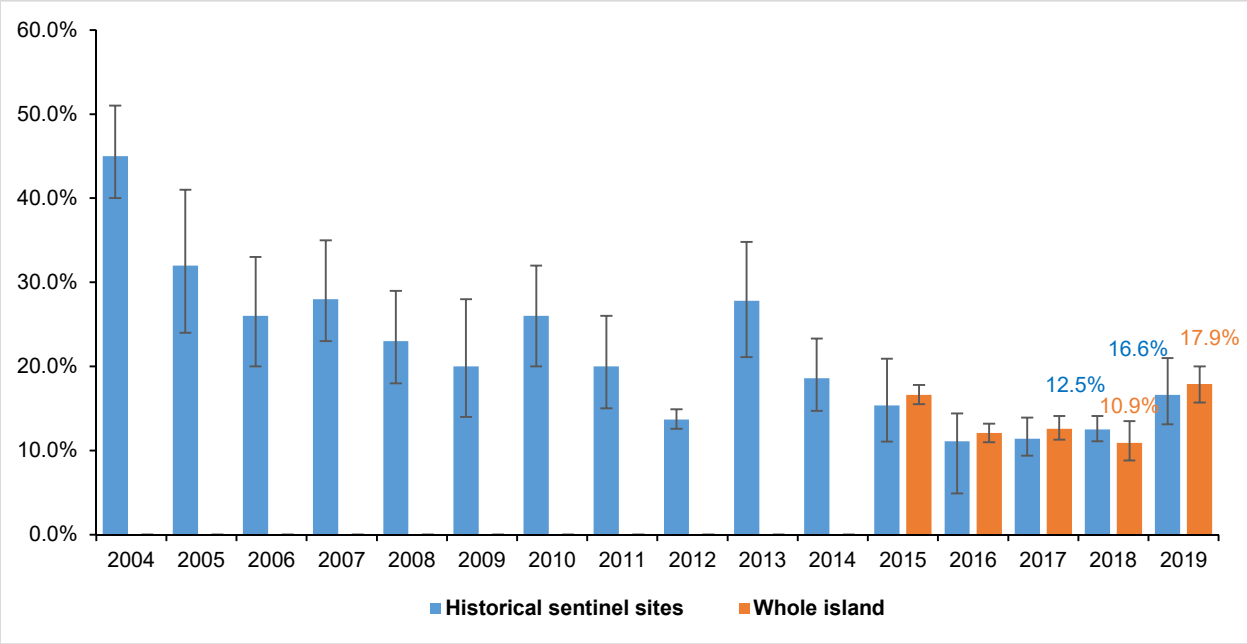

Figure 6.3 *P. falciparum* prevalence trend in children 2-14 years old

The prevalence of malaria was 8.2% among pregnant women 15 to 49 years old, and almost all of the cases were due to *P. falciparum* (Table 6.3). Both all malaria and *P. falciparum* decreased significantly with the age of the women. Malaria prevalence was lowest amongst women with primary education. Luba had the highest proportion of malaria among pregnant women, followed by Baney, Riaba, and Malabo.

Table 6.3 Prevalence of malaria in pregnant women

Prevalence of all malaria and *P. falciparum* malaria in pregnant women 15-49 years old, according to background characteristics

Background characteristics	Prevalence of malaria	Prevalence of *P. falciparum*	Total women with valid RDT
Age in Years			
<25	13.8 (8.0 - 22.6)	13.8 (8.0 - 22.6)	109
25 to 34	4.8 (2.0 - 10.8)	3.8 (1.4 - 9.6)	104
≥35	0.0	0.0	30
Level of education			
none	0.0	0.0	6
primary	3.6 (0.5 - 22.5)	3.6 (0.5 - 22.5)	27
secondary	10.1 (6.4 - 15.5)	9.4 (5.9 - 14.7)	159
post-secondary	6.9 (2.2 - 20.1)	6.9 (2.2 - 20.1)	43
not sure	0.0	0.0	8
District of residence			
Malabo	7.3 (4.4 - 11.9)	6.8 (4.0 - 11.3)	191
Luba	14.3 (4.1 - 39.4)	14.3 (4.1 - 39.4)	13
Baney	11.1 (3.8 - 28.3)	11.1 (3.8 - 28.3)	27
Riaba	8.3 (1.2 - 40.9)	8.3 (1.2 - 40.9)	12
Wealth Quintiles			
Lowest	6.9 (1.8 - 23.5)	6.9 (1.8 - 23.5)	29
Second	6.3 (1.9 - 18.9)	4.2 (1.0 - 16.3)	48
Middle	9.2 (4.4 - 18.3)	9.2 (4.4 - 18.3)	65
Fourth	9.8 (4.5 - 20.3)	9.8 (4.5 - 20.3)	61
Highest	7.3 (2.5 - 19.4)	7.3 (2.5 - 19.4)	41
Total	**8.2 (5.5 - 12.1)**	**7.8 (5.1 - 11.7)**	**243**

Results are presented as Percentage (95% CI)

6.2 Prevalence of anemia in children and pregnant women

The WHO recommended that anemia be used as an additional indicator to monitor malaria burden at the community level in malaria endemic countries. Increasing access to effective malaria prevention was associated with a reduced burden of anemia in young Malawian children [17]. A quantitative review across 29 studies in malaria-endemic parts of Africa revealed that the prevention or treatment of malaria infection is likely to increase mean hemoglobin values substantially and reduce the prevalence of anemia in children age under five years [18].

Almost no child had severe anemia, 13.8% had moderate anemia and 23.9 had mild anemia (Table 6.4). Both moderate and mild anemia were higher in younger children. The proportions of moderate and mild anemia were lowest among children living in a house with the household head having post-secondary education level. Malabo and Riaba had the highest proportions of anemia compared to Luba and Baney. Mild and moderate anemia were lowest in the highest wealth category.

Table 6.4 Prevalence of anemia in children <5 years old

Percent distribution of children 6 to 59 months old by hemoglobin level, according to background characteristics

Background characteristics	severe anemia	moderate anemia	mild anemia	no anemia	number of children tested
Age in months					
6-11	0.5	15.2	30.4	53.8	210
12-23	0.7	17.3	27.5	54.7	444
24-35	0.6	17.3	24.5	57.5	473
36-47	0.5	11.3	23.3	65.0	443
48-59	0.4	8.5	17.8	73.2	456
Sex					
Male	0.8	15.6	23.7	59.9	1,016
Female	0.3	12.1	24.2	63.5	1,010
Household head's education					
None	0.0	14.6	29.2	56.3	48
Primary	0.5	15.9	33.0	50.7	209
Secondary	0.4	14.4	23.0	62.1	691
Post-secondary	0.6	10.4	20.9	68.1	483
Not sure	0.7	15.1	23.9	60.3	595
District					
Malabo	0.7	14.2	24.9	60.1	1,518
Luba	0.6	12.6	16.9	69.8	159
Baney	0.0	10.4	22.3	67.3	260
Riaba	0.0	19.1	23.6	57.3	89
Wealth Quintiles					
Lowest	0.5	15.1	26.6	57.8	199
Second	0.2	17.4	23.5	58.9	409
Middle	1.3	13.9	25.2	59.5	472
Fourth	0.4	13.1	25.4	61.0	480
Highest	0.2	10.7	20.4	69.7	466
Total	**0.5**	**13.8**	**23.9**	**61.7**	**2,026**

Adults living in malaria endemic areas generally develop some level of immunity to the disease, however pregnancy render women more susceptible to infection, and parasite sequester in the placenta, which increase the risk of severe anemia and the risk of low birth weight [19]. A trial conducted in Kenya revealed that intermittent preventive treatment with SP is an effective, practical strategy to lower the risk of severe anemia among primigravidae living in malarious areas [20]. The NMCP offers free SP and iron supplements to all pregnant women attending ANC clinics in public health facilities in Bioko.

Table 6.5 describes anemia among pregnant women. Moderate and mild anemia were respectively 20.8% and 25%. Moderate anemia was more prevalent in Baney and Luba, and lowest among women belonging to the highest wealth group.

Table 6.5 Prevalence of anemia in pregnant women

Percent distribution of pregnant women by anemic status, according to background characteristics

Background characteristics	severe anemia	moderate anemia	mild anemia	no anemia	number of pregnant women tested
Age in Years					
<25	0.0	18.7	34.4	47.3	107
25 to 34	0.0	22.8	18.8	58.4	101
≥35	3.6	21.7	10.7	64.3	28
Education					
none	0.0	0.0	33.3	66.7	6
primary	0.0	32.1	14.3	53.6	28
secondary	0.7	19.1	26.3	53.9	152
post-secondary	0.0	21.4	21.4	57.1	42
not sure	0.0	25.0	50.0	25.0	8
District					
Malabo	0.5	19.5	26.5	53.5	185
Luba	0.0	21.4	14.3	64.3	14
Baney	0.0	32.0	20.0	48.0	25
Riaba	0.0	16.7	25.0	58.3	12
Wealth Quintiles					
Lowest	0.0	27.6	13.8	58.6	29
Second	0.0	14.9	34.0	51.1	47
Middle	0.0	25.4	23.8	50.8	63
Fourth	1.8	25.0	28.6	44.6	56
Highest	0.0	9.8	19.5	70.7	41
Total	**0.4**	**20.8**	**25.0**	**53.8**	**236**

7 Malaria and travel

Previous analyses have shown strong associations between human travel to mainland EG and risk of malaria infection in individuals in Bioko [6, 9, 10]. Among the 21,012 de jure surveyed population, 8.7% responded having travelled off the island and 14.1% within Bioko in the preceding 8 weeks. There were 1,932 individual trips made to mainland EG, with almost half (49%) made to Bata district (Figure 7.1A). On average, travelers spent 15.5 and a maximum of 60 nights away in mainland EG (Figure 7.1B); the more time spent in high transmission mainland, the higher the risk of acquiring a malaria infection while traveling [21]. The mean age of travelers to mainland EG was 28.9 years (Figure 7.1C).

Among the 13,918 individuals with a valid RDT test, 8.2% reported traveling off the island and 6.5% traveling to mainland EG, of whom 25.6% (291) and 30.2% (273) were positive for P. falciparum, respectively. By way of contrast, amongst the on-island travelers who had a valid RDT test, 14.4% (308) tested positive for P. falciparum.

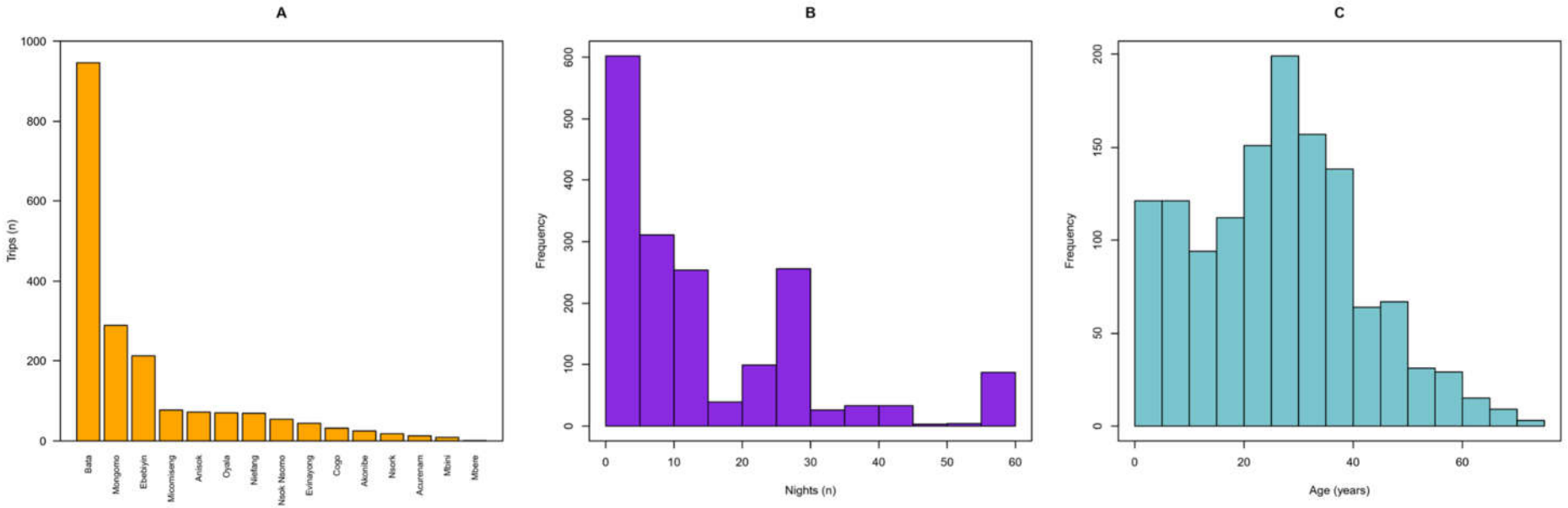

Figure 7.1 Trips to mainland Equatorial Guinea

A. Number of trips according to district of destination. B. Frequency distribution of nights spent in mainland EG. C. Frequency distribution of age of travelers.

8 Conclusion and recommendations

A total of 5,074 households were surveyed in which 13,939 individuals were tested for malaria and 12,475 for anemia.

Almost all the households had access to electricity (90.7%), and access to improved source of drinking water was almost optimal (92%). Flush toilets were the main type of facility, even though 22% of the households used shared toilet/latrine facilities. The Bioko population is very young with children age less than five years representing 14% and those age less than fifteen years representing 40%. The mean household size was 4, and 70% of the households were headed by men. One in two survey respondents had secondary education.

Exposure to malaria related message was low, as only 43% of respondents acknowledged to have heard or seen a malaria related message within the past six-months preceding the survey. The main source of exposure to malaria related messages was the Television. The NMCP has been using local TV channels and radio programs to reach the population with information and education messages on malaria; however, access to satellite and foreign TV channels might have caused the population not to tune constantly to local programs, therefore reducing the outreach of malaria messages to the population. Other routes of exposure should be exploited, especially with the advent of smartphones and access to the internet, text messaging and / or social media stand as good options.

Eight in ten (83%) respondents cited mosquitos as the cause of malaria, 75% cited sleeping under mosquito nets as a way of avoiding malaria while only 18% cited IRS. It is rather unfortunate that after fifteen years of malaria control on the island of Bioko, the population still doesn't associate IRS to malaria. There is an urgent need to design robust messages and educational programs regarding IRS in order to raise knowledge in the population, which obviously should improve perception and practice towards IRS.

Sixty-one percent of households had at least one ITN, and 41% had at least one ITN for every two persons who slept in the house the night before the survey (universal coverage). Fifty-tree percent of the household population had access to an ITN and only 31.9% slept under an ITN the night before the survey. ITN use in children age less than 5 years and pregnant women were respectively 47.5% and 37.5%. household access to ITN was proven to be a determinant of use, as the latter increased in households with at least one ITN, and even more in households with universal ITN coverage. There is a gap of ~20% between ITN access and use. Therefore, emphasis should be put on the development of educational and sensitization messages to promote ITN use in the population. Strategies should be developed to increase the number of nets in high risk areas, and vulnerable populations.

ANC attendance was optimal (97.2%) amongst women who reported to have had a live birth within the past two years preceding the survey. However, only 36.1% took the recommended three doses of Fansidar. Twenty-five percent of the women attended ANC in private clinics; which cannot be neglected, given that the private sector is not included in the free prevention in pregnancy package offered by the NMCP. Therefore, there should be more advocacy to somehow involve the private sector in the malaria prevention in pregnancy policy of the NMCP. Moreover, the government should continue to prioritize free ANC services; ensure SP availability for IPTp; provide continuous training and capacity building for health providers; and develop enhanced advocacy, communication, and social mobilization efforts to increase community demand for malaria prevention and control measures.

About 9% of children age less than five years were reported to have had fever within the two weeks preceding the survey. Of the children with fever, care was sought for 66%, and blood was taken from 45.1% for testing. Amongst those who were treated with antimalarial drugs, only 30.2% too ACTs. Care was

soughed for 23% in private clinics. There is a need to advocate for the involvement of the private sector in the malaria prevention policy of the NMCP. Therefore, the NMCP should improve training of health practitioners on malaria diagnosis, and proper case management, scale-up community case management of malaria and enhance the adherence to malaria treatment guidelines among health practitioners, and increase awareness of ACT/AL in the population.

Malaria prevalence was 15.8%, 9.8%, and 8.2 respectively in the general population, children age less than five years, and pregnant women. Prevalence continued to be much higher in the South-Eastern part of the island (Riaba district), and lower in the North-Eastern part of the island (Baney district). Overall malaria prevalence increased significantly between 2018 and 2019. In a similar manner, *P. falciparum* increased among children age two to fourteen years in historical sentinel sites, from 12.5% in 2018 to 16.6% in 2019. Severe anemia was almost absent among children (0.5%) and pregnant women (0.4%). Malaria prevention and control interventions should be intensified on the island. It is critical to improve ITN coverage and especially use, and IRS coverage in order reduce malaria transmission. The introduction of innovative control strategies, such as seasonal chemoprophylaxis, using Mass Drug Administration (MDA) in children should be considered, especially in Riaba and Malabo. Malaria surveillance through routine HIS should be enhanced to inform decision making with accurate data. Accurate diagnosis and treatment should be promoted among health practitioners as not all cases of fever are due to malaria. Given evidences of malaria importation from the mainland part of the country to the island, it is critical to advocate for the implementation of control interventions in the continental part of the country, in order to weaken and break the chain of importation.

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Appendices

Appendix 1: Persons involved in the 2019 Bioko island MIS

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