ANNUAL MALARIA INDICATOR SURVEY (MIS), 2018

Bioko Island Malaria Control Project (BIMCP)

MEDICAL CARE DEVELOPMENT INTERNATIONAL (MCDI), EQUATORIAL GUINEA

Ministerio de Sanidad y Bienestar Social

Ministerio de Minas, Industria y Energía

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ACRONYMS

ACT	Artemisinin-based Combination Therapy
AL	Artemether-Lumefantrine
ANC	Antenatal Care
AS-AQ	Artesunate-Amodiaquine
ASFR	Age-specific Fertility Rate
BIMCP	Bioko Island Malaria Control Project
CIMS	Campaign Information Management System
GDP	Gross Domestic Product
GNI	Gross National Income
IMR	Infant Mortality Rate
IPTp	Intermittent Preventive Treatment in Pregnancy
IRS	Indoor Residual Spraying
ITN	Insecticide-Treated Net
LLIN	Long-Lasting Insecticidal Bed Net
LSHTM	London School of Hygiene and Tropical Medicine
LSM	Larval Source Management
MAC	Mean Age at Childbearing
MCDI	Medical Care Development International
MIS	Malaria Indicator Survey
MoHSW	Ministry of Health and Social Welfare
NMCP	National Malaria Control Program
ODK	Open Data Kit
PCA	Principal Component Analysis
PPS	Probability Proportional to Size
RBM-MERG	Roll Back Malaria Monitoring and Evaluation Working Group
RDT	Rapid Diagnostic Test
SBCC	Social Behavior Change Communication
SDG	Sustainable Development Goal

SP	Sulfadoxine-Pyrimethamine
SSA	Sub-Saharan Africa
TAG	Technical Advisory Group
TFR	Total Fertility Rate
U5MR	Under-five Mortality Rate
WHO	World Health Organization

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SUMMARY

The year 2018 marks 15 years, and the end of phase III, of the Bioko Island Malaria Control project (BIMCP). Since its inception in 2004, the BIMCP in conjunction with the National Malaria Control Program (NMCP) of the government of Equatorial Guinea (EG) and support from donors has been providing quality malaria interventions with the goal of substantially reducing morbidity and mortality attributable to malaria. As part of the Monitoring and Evaluation plan, a yearly Malaria Indicator Survey(MIS) is carried out to evaluate the project's impact and effectiveness as well as to guide decision-making and policy elaboration/implementation.

The 2018 MIS was conducted, under international ethical principles and guidelines provided by the Helsinki declaration, on a sample of targeted households selected in all communities across Bioko Island. During a two-months period, a team of 36 surveyors accomplished the following tasks: collected valid data on 4,774 households with 20,012 inhabitants, performed 13,852 valid malaria rapid tests, and collected valid information on the conditions of 10,597 bed nets. Answers to the questionnaire were provided primarily, by an adult member of each household who had the right to respond for the whole group, and secondarily, by each woman at childbearing age for specific birth-related questions.

Some of the core questions asked in the MIS involved the following topics:

- ***Malaria knowledge***: 1 on every 2 household respondent heard or saw a malaria-related message in the past six months preceding the survey, and the main source of exposure was the television. However, television exposure to malaria messages dropped between 2015 and 2018. Survey results pointed out that malaria knowledge was not optimal, as only 78% of respondents knew mosquitos transmit malaria; 74% cited bed nets and 17.5% cited IRS as malaria preventive measures; 72% cited fever as the main malaria symptom; 48% knew about free antimalarial treatment in public health facilities on the island; and 19% of female respondents knew the number of doses of Fansidar required during pregnancy.
- ***Bed nets ownership and use***: 84% of the households had at least 1 Insecticide-Treated bed net (ITN), and 61% had 1 ITN for every two people. Seventy-five percent of the households

had at least 1 ITN for every two people or had received IRS in the past 12-months. Overall 74% of the population had access to an ITN, even though only 47% were reported to have slept under one the night before the interview. The use of ITN in children age less than 5 years and in pregnant women were 54% and 52% respectively.

- ***Prevention in pregnancy***: amongst women who had a live birth in the past two years preceding the survey, 96.7% reported attending ANC visits. The majority attended public health facilities even though 23% attended private facilities. Optimal IPTp was very low as only 36% of women reported that they had taken at least 3 doses of Fansidar during their last pregnancy that resulted in a live birth.
- ***Fever management in children***: out of 2,994 children younger than 5 years, 5.9% (178) were reported to have had a fever two weeks prior to the survey and care was sought for only 66% (119) of them. A total of 41 were treated with antimalarials of which, only 31% received ACTs. Care was mostly sought in public hospitals (43.7%) even though for 29.4% it was done in private clinics. However, attendance to private facilities increased over time.
- ***Malaria prevalence***: malaria prevalence in the general population, in children aged less than 5 years, and in pregnant women were 10.3%, 6.6%, and 7.2% respectively. Malaria prevalence was higher in Malabo and Riaba compared to Luba and Baney. *Plasmodium falciparum* prevalence amongst children age 2 - 14 years was 12.5% in old historical sentinel sites and 10.9% across the whole island. Overall, age specific and district level malaria prevalences did not change significantly since 2015.
- ***Fertility and child mortality rates***: Over the last five years preceding the MIS, all-cause mortality amongst infants and children age less than 5 were 35.1 and 57.4 per 1000 live births respectively. Total fertility rates amongst women at childbearing age, calculated for the 1-year period preceding the survey was 3.9; the mean age at childbearing was 32 years.

Despite the remarkable reduction of malaria transmission on the island of Bioko, tremendous efforts still need to be deployed to improve interventions and anticipate elimination. Malaria prevalence has been plateauing since 2015 and could become distracting. Stakeholders need to advocate for other control measures, especially strategies to control malaria importation from the mainland of the country.

CHAPTER 1. INTRODUCTION

1.1. Demographics of Equatorial Guinea

Equatorial Guinea (EG) is located in Central Africa and borders the Bight of Biafra between Cameroon and Gabon. The country became independent in 1968 after nearly 200 years of Spanish rule. Composed of a mainland portion and five islands, it is one of the smallest countries on the African continent with a total land surface of 28,051 km^2. The insular region consists of the island of Bioko, formally Fernando Po, in the Gulf of Guinea; and Annobon, a small volcanic island situated south of the equator. The mainland region is bordered by Cameroon to the north and Gabon to the south and east and also includes several small offshore Islands. Administratively, the country is divided into seven provinces including Bioko Norte, Bioko Sur and Annobon (insular region); and Litoral, Wele Nzas, Centro Sur, and Kie-Ntem (continental region). Table 1.1 presents summary statistics of selected development indicators for EG. In 2017, the population was estimated at 1,3 Million **[1]** and life expectancy was below 66 years for females and 64 years for males. Total expenditure on health as percentage Gross Domestic Product (GDP) in 2014 was 3.8 and the Gross National Income (GNI) per capita in 2017 was $27,059.

Table 1.1 Equatorial Guinea summary statistics of selected development indicators

Total population (2017)	1,300,000
Population median age (2013)	20.6
Total fertility rate per women (2017)	3.9
Life expectancy at birth M/F (years, 2015)	57/60
Neonatal mortality rate (per 1000 live births, 2015)	32.6 (19.6 - 50.8)
Probability of dying under 1 (per 1000 live births, 2017)	38.3
Probability of dying under 5 (per 1000 live births, 2017)	54.2
Maternal mortality ratio (per 100 000 live births, 2015)	342 (207 - 542)
Probability of dying between 15 and 60 years M/F (per 1000 population, 2015)	346/291
Total expenditure on health as % of GDP (2014)	3.8
Gross National Income per Capita (PPP int. $, 2017)	27,059

GDP: Gross Domestic Product, PPP: Purchasing Power Parity

The Bioko Island is the northernmost part of EG and harbors the country's capital Malabo. The island has a surface area of 2000 km^2 for an estimated population of 339,695 **[2]**; and is divided in two provinces (Bioko Norte and Bioko Sur), harboring four districts (Malabo, Luba, Baney and Riaba) (Figure 1.1).

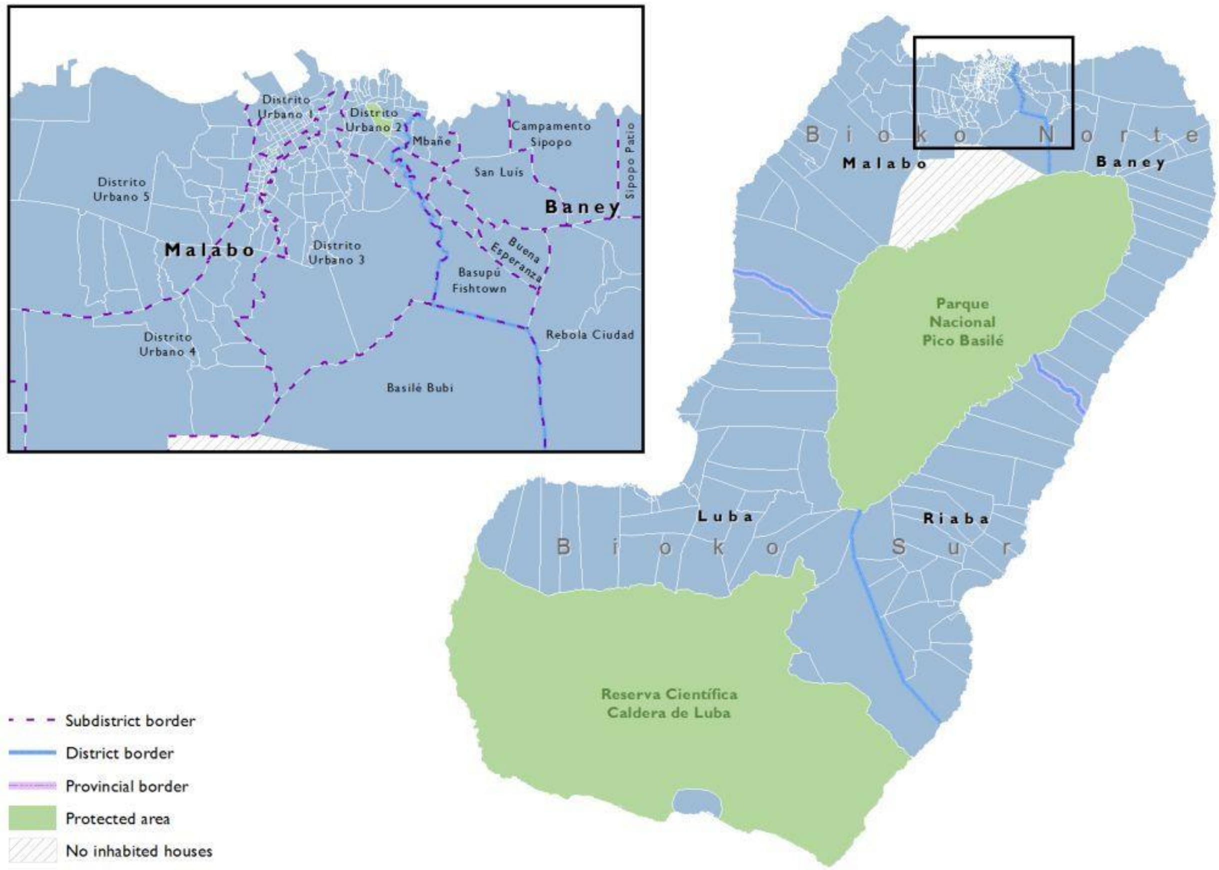


Figure 1.1 Map of the Bioko Island

1.2. Geography of Equatorial Guinea

Equatorial Guinea is located in the West African sub-region and the continental part is located between latitude 1°51' north and longitude 9°45' east. The Bioko Island is located between latitude 3°45' north and longitude 8°46 east', and is situated approximately 37 km southwest of the coast of Cameroon and approximately 160 km of the continental part of the country. Equatorial Guinea has a typical equatorial climate with high temperatures, high humidity, and heavy rainfall. The temperature on the island, 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; while the continental part is somewhat drier. The main wet season lasts between April and October, when the African monsoon blows from the southwest, bringing moist air from the ocean. However, the dry and the wet seasons show some different patterns in the insular and the continental regions. On the island, the dry season spans from November to April and the wet season from May to October, whereas, the continent generally has two dry periods from December to February and from June to August and two wet periods from March to May and from September to November.

1.3. Malaria epidemiology and policies of Equatorial Guinea

Information on malaria epidemiology and management guidelines for EG were adapted from the WHO mortality and disease burden database **[3]**. The country can be designated as a high transmission area for malaria, with more than one case per 1000 population. The major malaria vectors species found in this country are *Anopheles gambiae* and *Anopheles melas* and the majority of malaria cases analyzed are caused by *Plasmodium falciparum*. In 2015, the total number of reported malaria cases in health facilities was 147,714 (estimated to 291,700) while the total number of reported malaria deaths was 109 (estimated to 800).

Malaria intervention policies and strategies in EG include the following:

- Free distribution of Insecticide Treated bed Nets (ITNs)/Long Lasting Insecticide Treated bed Nets (LLINs) (adopted in 2007)
- Indoor Residual Spraying (IRS) (adopted in 2005)
- Intermittent Preventive Treatment in pregnancy (IPTp)
- Prompt malaria testing in all age groups and free of charge in the public sector (adopted in 2005)
- Free Artemisinin based combination Therapy (ACT) for all age groups in the public sector
- Mass screening
- Routine admission of uncomplicated *P. falciparum* cases.

The following treatment guidelines were adopted in 2004:

- Artesunate-Amodiaquine (AS-AQ) as first-line treatment of uncomplicated malaria cases caused by *P. falciparum*
- Quinine (QN) for the treatment failures of *P. falciparum* cases and Artesunate solo (AS) for the treatment of severe malaria.

1.4. The Bioko Island Malaria Control Project (BIMCP)

The BIMCP was implemented by Medical Care Development International (MCDI), a U.S. Non-Governmental Organization (NGO), with support of Equatorial Guinea's Ministry of Health and Social Welfare (MoHSW). This project was funded by a consortium led by Marathon Oil Corporation, Noble Energy, Atlantic Methanol Production Company, and other donors. To this day, the BIMCP has had three Phases: Phase I (2004 - 2008), Phase II (2009 - 2013, and Phase III (2013 – Dec 2018). In 2004, an integral malaria control platform was initiated on the Island of Bioko. At its inception, the main interventions were focused around Indoor Residual Spraying (IRS), and case management (which included definitive diagnosis and effective treatment with ACT, and IPTp) **[4]**. One year after the beginning of the project, the prevalence of malaria in children ages 2 to 14 years dropped by 15 percentage points **[5]**. Throughout the years, other interventions were added to the package and these included: Long-lasting Insecticidal Nets (LLINs) distribution, vector monitoring, Larval Source Management (LSM), and Social Behavioral Change Communication (SBCC). Consequently, 12 years of intervention contributed to the drastic reduction of malaria prevalence in children age 2 to14 years from over 40% in 2004 to 10.5% in 2016 **[6]**. The high collaboration and engagement maintained between MCDI, the MoHSW as well as donors, resulted in the drafting of key elements for the Phase III strategic plan, some of which included the following points:

- Sustaining prevention of malaria transmission through IRS, LLINs, LSM, and IPTp.
- Strengthening early malaria diagnosis and appropriate treatment while monitoring therapeutic efficacy and drug resistance.
- Extending focal community-based control intervention while supporting the development of the local health system.

- Sustaining, adapting and continuing the strengthening of Monitoring and Evaluation (M&E).
- Continuing implementation of SBCC and advocacy activities
- Preventing malaria importation to the Bioko Island

1.5. The annual Malaria Indicator Survey (MIS)

The MIS was developed by the Monitoring and Evaluation Working Group (MERG) of Roll Back Malaria (RBM), an international partnership developed to coordinate global efforts to fight malaria **[7]**. Thus, the MIS is a surveillance tool recommended by the WHO to assess the effectiveness of malaria control interventions. Prior to the BIMCP inception, a baseline MIS was conducted on Bioko island and Since then, it has been conducted annually to evaluate the effectiveness of the project's interventions. Before 2014, the MIS was conducted only in historical sentinel sites of entomological interests, as of 2015, the survey was expanded to all communities on the Island.

The BIMCP MIS questionnaire is an adaptation of the RBM questionnaire, designed mainly, to gather information on households characteristics, malaria prevention (IRS, LLIN, malaria knowledge, and prevention in pregnancy), and malaria case management (care-seeking behavior in children, parasitemia, and anemia) **[7]**. However, questions and modules can be added as needed. The 15th annual BIMCP MIS was implemented throughout the third quarter of 2018 and received external support from the London School of Hygiene and Tropical Medicine (LSHTM).

1.5.1. Objectives of the Annual MIS

The main objective of the MIS is to measure key outcome and impact indicators of the BIMCP; more specifically, the 2018 MIS was intended to assess the following areas:

- Indicators of vector control coverage (IRS; LLINs/ITNs), and access (LLIN/ITN)
- Malaria knowledge in the population
- LLIN/ITN use, especially in children age less than 5 years and pregnant women

- Attendance to Antenatal Care clinics (ANC) during pregnancy and IPTp consumption
- Health-seeking behaviors in children with fever
- Malaria and anemia in the population with a special focus on children age less than 5 years and pregnant women
- Exceptionally every 5-years Under 5 Mortality Rate (U5MR), and Infant Mortality rate (IMR).

1.5.2. Survey organization and implementation

The 2018 MIS was implemented by MCDI personnel, with the support of Equatorial Guinea's MoHSW. It was carried out between August and October on a representative sample of households selected from all communities across the island. MCDI home and field offices provided administrative, financial and logistical support, while the LSHTM provided technical assistance on the survey design, sample size estimation, and sampling frame, and contributed in the questionnaire adaptation from the RBM original questionnaire. An external consultant programmed the survey questionnaire and oversaw training of field workers.

The survey was managed by the BIMCP M&E officer, assisted by 3 survey coordinators, and an office support team of 6 members. The data collection team was composed of 36 surveyors and 6 supervisors; divided in 6 groups of 6 surveyors and 1 supervisor each (Appendix 1). Two nurses were hired and trained to deliver treatment to people who were tested positive for malaria during the survey. Valuable assistance was also provided by 2 interns, and transportation was assured by 6 BIMCP drivers. Surveyors were hired from the open labor market on a competitive selection process, and trained for three weeks, whereas coordinators and supervisors from other components of the project assisted as needed.

During the survey, any adult (age above 18) permanent resident, who slept in the house the previous night, was eligible to answer questions for the rest of the household members. Additionally, any available and consenting permanent resident's women at childbearing ages (15 to 49 years) were also interviewed on live births history, ANC clinics attendance, and IPTp. All adults (permanent residents or short-term visitors) were tested for malaria and anemia, after obtaining their consent, and were informed on the outcome of the tests at the end of the interviews. Authorization to test children and people who were not able to decide for themselves was gotten from parents or guardians. Individuals who had positive malaria tests were immediately administered treatment and those with anemia were referred to competent facilities for further investigations of the cause of anemia.

1.5.3. Survey design, sample size, and household selection

The 2018 MIS was designed to include households from all communities on the island, contrary to previous years when only households in historical sentinel sites were included (2014 downwards). After the BIMCP Technical Advisory Group (TAG) gave recommendations, a change in methodology was adopted in 2015 with the objective to identify clusters of transmission throughout the island and improve targeted control interventions.

A modified stratified sampling method was used for the 2018 MIS, where the number of targeted households per community depended on if the latter belonged to a historical sentinel site or not. In 2014, the MIS sample size was estimated to 4,694 households to detect a change in malaria prevalence of 30% in 18 historical sentinel sites. However, because the sampling was expanded to the whole island starting on 2015, it was important to keep statistical power in sentinel sites for historical comparison purposes; therefore, explaining why an original sampling using Probability Proportional to Size (PPS) of communities (enumeration areas) was not straightforward. Henceforth, the targeted number of households in communities belonging to small sentinel sites was artificially boosted to 100 to maintain statistical power, those belonging to big sentinel sites were maintained as in 2014, and those not belonging to sentinel sites were calculated as the difference between the total sample of 2014 and the sum of all households in sentinel sites. Therefore, communities were stratified (depending if they belonged to one of the 18 sentinel sites or not) producing 19 strata (18 sentinel sites and 1 none sentinel site). The sampling frame for each community was then calculated as the ratio of the number of households in that community to the total number of households in the strata to which the household belonged

$$SF_i = \frac{nHH_i}{NHH\ startum_i}$$

SF_i: Sampling Frame of the i^th community

nHH_i: Number of households in the i^th community

NHH stratumi: Number of households in the stratum to which belongs the i^th community

Finally, the number of households for sampling in each community was calculated as follows

$$n = \frac{target\ HH_i \times SF_i}{100}$$

n: number of households to sample in the i^th community

target HH_i: number of targeted households in the i^th community

SF_i: Sampling Frame of the i^th community

The number of households to be visited in each community was further boosted by 30% to account for uninhabited and/or destroyed houses.

1.5.4. The 2018 MIS questionnaire

The 2018 MIS questionnaire is built on the backbone of the RBM-MERG questionnaire; which is being widely used to measure key malaria control targets and indicators in malaria-endemic regions. However, additional questions were added when necessary to answer specific questions of interest to the BIMCP. The questionnaire was written and programmed on XLS forms to run on the Open Data Kit (ODK) collect platform through the BIMCP Campaign Information Management System (CIMS) software on Android tablets; and was structured as follows: a household section, a count repeat section for individuals (permanent residents and short-term visitors[1]), and a bed nets count repeat section.

[1] For short term visitors, only information on age, gender, original place of residence, parasitemia, anemia, and temperature are recorded.

The Household section was used to collect basic sociodemographic[2] information, such as household size (number of permanent residents), number of short-term visitors, housing construction materials, access to electricity and drinking water, household sanitation facilities, household's possessions etc. Additionally, this section was used to capture information on household bed net ownership, IRS in the past 12 and 6 months, exposure to malaria-related messages within the past 6 months, and malaria knowledge amongst survey respondents. Exceptionally every 5 years (end of project phase), additional questions[3] are added to estimate the cost of household expenditures; with the purpose of inferring and contrasting expenditures on assets with health-related expenditures.

The individuals count repeat section was used to gather information on every permanent household resident. These include amongst others: gender; age; relation to household head; bed net use the night before the interview; fever and care seeking for children[4]; pregnancy status, ANC clinic attendance and IPTp, and live births history[5] amongst women at childbearing age; and malaria test outcome and hemoglobin measurement. In light of understanding the influence of importation of cases on malaria control on the island, supplementary questions were added to record information on individuals' movements in and out of the island. These questions addressed travels inside the island (to other communities) and spending at least one night within the past 8 weeks, travels out of the island and spending at least one night within the past 2 and 8weeks respectively, the various travel destinations (for travels inside the island and to the mainland of EG), and transportation means.

The final part of the MIS questionnaire was the bed nets count repeat section. The latter was used to collect information on: the type of bed nets and their conditions; the individuals who spent the night under them; if they were purchased or not; and their using frequencies. Linking

[2] Sociodemographic data are important to stratify and interpret malaria indicators; and household possessions are used to derive a proxy of socioeconomic status by Principal Component Analysis (PCA).
[3] Additional questions on expenditure on household assets, food, drinks, education, leisure, transport, and health amongst others were added to the 2018 MIS questionnaire and were intended to a random 10% of targeted households.
[4] In the original RBM questionnaire, information on care seeking, diagnostics testing and access to prompt treatment with antimalarials is gathered only for children aged less than 5 years, and from their respective mothers or caregivers; not from a household respondent, who might not be the parent or caregiver of the child, as it is the case in the BIMCP MIS questionnaire.
[5] The BIMCP MIS records information on live birth history in women at child bearing ages only every 5 years; which is used to estimate U5MR, and Annual Fertility Rates (AFR), and Total Fertility Rates (TFR).

users to particular bed nets is important for the assessment of bed net use, by type (e.g. the proportion sleeping under any type of bed nets, or under ITNs).

1.5.5. Malaria and Anemia testing

Surveyors were trained to use a Rapid Diagnostic Test (RDT) for malaria assessment, and the HemoCue® system to measure hemoglobin while on the field (Photography 1.1).

Photography 1.1 Surveyor (Melodia Roca) performing malaria testing and hemoglobin measurement

Malaria was diagnosed with the CareStart™ Malaria HRP2/pLDH (*pf/PAN*) combo test (ACCES BIO, Inc. 65 Clyde Road Somerset, NJ 08873 U.S.A); which qualitatively detects the *Plasmodium falciparum* Histidine-rich protein II (HRP-II) and the *Plasmodium vivax* specific Lactate Dehydrogenase (LDH) in whole blood. The kit has a disposable sample applicator and a solvent that come in the standard package and has been shown to be highly sensitive and specific in detecting *P. falciparum* when compared to gold standard microscopy and Polymerase chain reaction (PCR) **[8–10]**. Technically, a small sample of blood (5µl) obtained by finger prick was captured on an applicator and placed into the well of the testing device. Two drops of solvent were added in the corresponding well. After migration, results were available for interpretation and dissemination in less than 20 minutes.

For hemoglobin measurement, finger-pricked blood was collected in sterile HemoCue Hb301 microcuvettes and read using a HemoCue Hb301 analyzer (HEMOCUE AB, ANGELHOLM SWEEDEN). Anemia was defined using the WHO classification **[11]**.

All household members who were tested positive for malaria were offered free first-line antimalarial treatment (Artesunate-Amodiaquine) by survey nurses (Photography 1.2), and those who were diagnosed with anemia were immediately referred and advised to visit the nearest health facility for follow-up.

Photography 1.2 Survey nurse (Silverio Okenve) administering malaria treatment to a woman

1.5.6. Field staff training

The call for surveyor candidature opened in mid-June, and over 300 applications were received. One hundred and fifty outstanding applications were screened and the candidates were invited to take a preselection exam. Finally, 46 successful applicants (including 2 nurses) were invited to participate in a three-week training that took place at the Spanish Cultural Center in Malabo (Photography 1.3).

Photography 1.3 Candidate surveyors attending lectures

Week 1 lectures included the following core topics: general introduction to the BIMCP, introduction to malaria and anemia, purpose of the MIS, ethics in surveys, ITN and IRS as vector control methods, SBCC, malaria case management, malaria and anemia testing, the use of Android tablets to capture survey data on the field, and map reading.

Week 2 was mostly dedicated to practical topics including survey practice on Android tablets, malaria testing and hemoglobin measurement, and map reading. Moreover, 16 candidate surveyors with good calculation skills were selected and further trained in strategies to estimate the cost of items using a customized cost guide booklet.

Week 3 was dedicated to general revision, fine-tuning of malaria testing and anemia measurement as well as map reading. Supervisors received further training on the following areas: survey objectives; survey organigram and Terms of References (TOR); supervision material and procedures; and Quality Control (QC) and data validation plan.

1.5.7. Data collection

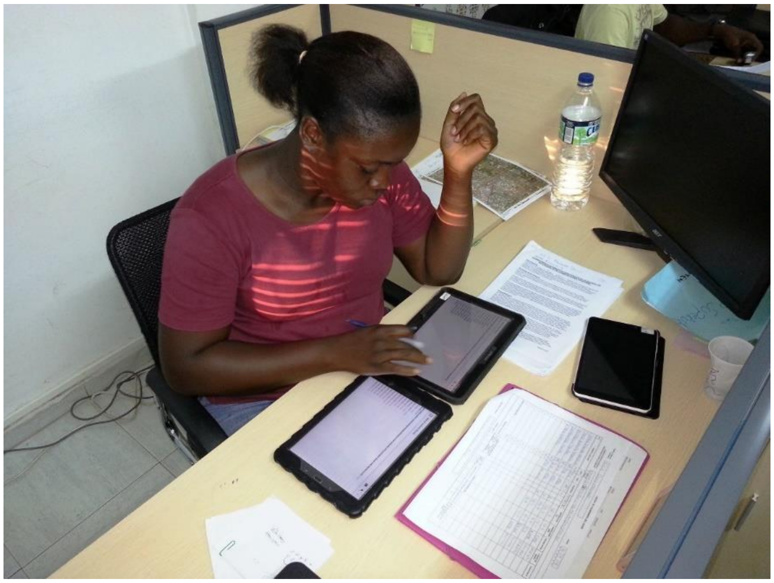
The 2018 MIS data collection was officially launched at the Municipality of Rebola. The Survey was completed in consenting households that were randomly chosen from all communities on the island. Data were collected from Mondays to Saturdays between 8 AM and 4 PM; and as work progressed, household visiting strategies were modified to include Sundays[6], and sometimes from 9 AM to 5 PM. Surveyors had to visit each targeted household at least four times (morning, and evening), and on two different days before declaring the latter to be either uninhabited or closed. Close neighbors were also questioned on the status of closed houses, to find out at what time the occupants could be at home. Revision teams were formed when needed and left behind to revise closed houses while other teams were moved forward. Houses that were destroyed, uninhabited or remained closed after at least four visits in two separate days were eligible for replacement; which were mostly done on Saturdays and Sundays. Targeted households were replaced by the closest and inhabited one to the right, or by the inhabited one with the closest door, in the same community, map area and map sector. Replacement decisions were made under the close supervision of either the survey manager, the field coordinators, or the field supervisors. Data were captured on Android tablets through ODK Collect (Photography 1.4). Exclusively for this year, malaria RDTs of consenting individuals were barcoded, processed, and shipped to a partner laboratory for confirmation by quantitative Polymerase Chain Reaction (qPCR).

[6] When Sundays were included for data collection, Mondays were reserved for resting and planning

Photography 1.4 Surveyor (Leonardo Roku) conducting and interview, under the close supervision of the BIMCP M&E Officer (Olivier Tresor Donfack)

1.5.8. Data quality control and validation

At the end of every working day, the data were verified, and validated by the supervisors before being uploaded to the server (Photography 1.5). Quality control process was done using: the household members and reproductive history rosters, and the barcoded RDTs. All barcoded RDTs were revised and contrasted against the information on the household members roster. Subsequently, all information on the household members and live births history rosters were carefully revised and contrasted with the information in the tablets. Mistakes were investigated and discussed with the survey manager and coordinators to find the most appropriate solution. Cases of duplicate houses were thoroughly investigated to declare if data were collected for the same household twice or if two different survey questionnaires were launched under the same household location on the CIMS. Errors, household replacements, daily problems/challenges, and work progress were discussed prior to plan work for the next day. Surveyors who showed deficiencies on the field (map reading, malaria testing, mistakes on various rosters and on data capture) were called back to the BIMCP office for coaching and further training.



Photography 1.5 Field supervisor (Charity Okoro) performing quality control and data validation

1.5.9. Data management and analyses

The data were downloaded from the server using ODK briefcase as Comma Separated Value (CSV) files. Various CVS files were each further imported in STATA 15.1 and merged to each other when necessary before analysis. The final dataset was declared to be a survey in STATA using the “svyset command”. Results were presented as percentages with their 95% Confidence Intervals (CI) where necessary, and were stratify by selected baseline characteristics.

1.5.10. Ethics

The 2018 MIS was conducted in accordance with the ethical standards of the Helsinki declaration and was approved by the MoHSW of Equatorial Guinea and the LSHTM ethical committees. Administrative authorizations were granted by the Ministry of Interior of Equatorial Guinea, administrative authorities, and community leaders. The information sheet was read and explained to each respondent and who had to sign the consent form (Appendix 2) before the interview. For malaria and anemia testing, parents or caregivers had to give approval for children and every adult household member willing to be tested had to also sign the consent form before. The Data were treated confidentially and positive malaria cases were treated free of charge.

CHAPTER 2. HOUSEHOLDS CHARACTERISTICS

This chapter presents a summary of socio-demographic characteristics of the households, that will be further used to stratify and interpret calculated indicators.

2.1. Population by age and gender

The distribution of the population of Bioko by 5-years age groups and according to gender and district of residence is shown in Table 2.1. Information was collected for a total of 20,012 individuals inhabiting 4,774 selected households. Two individuals had missing information on age, leaving a total of 20,010 with valid age and gender information. Gender distribution was balanced showing a male to female ratio of 0.98. Overall, population size declined with increasing age; children less than 5 years old accounted for the largest population category (14.9%).

Table 2.1 Household Population by age, gender, and district of residence

Percent distribution of the household population by 5-years age groups, according to gender and residence, MIS Bioko 2018

	Malabo			Baney			Luba			Riaba			Total		
Age	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total
<5	15.3	14.8	15.0	15.4	14.7	15.0	12.9	14.5	13.7	15.0	16.1	15.5	15.1	14.8	14.9
5 to 9	13.8	13.2	13.5	13.9	14.3	14.2	13.7	14.9	14.3	11.9	18.2	14.9	13.8	13.6	13.7
10 to 14	10.5	11.6	11.1	11.9	11.4	11.7	13.6	11.8	12.7	13.1	8.5	10.9	11.1	11.5	11.3
15 to 19	9.6	9.9	9.8	9.9	10.6	10.3	9.0	8.1	8.6	4.1	7.6	5.8	9.4	9.8	9.6
20 to 24	8.8	9.8	9.4	8.6	8.1	8.3	4.7	5.8	5.2	5.7	4.4	5.1	8.4	9.2	8.0
25 to 29	9.4	10.9	10.2	6.6	8.2	7.4	6.4	4.3	5.4	7.4	6.7	7.1	8.7	9.9	9.4
30 to 34	9.9	9.5	9.7	9.5	8.5	8.9	6.2	4.3	5.3	6.5	6.5	6.5	9.4	8.9	9.2
35 to 39	7.2	5.9	6.5	6.0	5.9	5.9	5.5	5.4	5.5	5.9	4.1	5.1	6.9	5.8	6.3
40 to 44	5.3	3.7	4.5	4.1	3.3	3.7	5.5	4.7	5.1	6.8	5.3	6.1	5.3	3.7	4.5
45 to 49	3.3	2.3	2.8	3.3	3.1	3.2	4.6	4.8	4.7	5.7	4.1	4.9	3.5	2.7	3.1
50 to 54	2.5	2.8	2.7	3.3	2.1	2.7	4.7	5.7	5.1	4.1	4.1	4.1	2.9	3	2.9
55 to 59	1.5	1.7	1.6	2.7	3.3	2.9	3.2	4.6	3.9	3.8	2.9	3.4	1.9	2.2	2.0
60 to 64	1.2	1.3	1.3	2.3	2.3	2.3	4.7	3.2	3.9	4.1	4.1	4.1	1.8	1.7	1.7
65 to 69	0.7	0.9	0.8	1.4	1.2	1.3	1.8	2.7	2.2	1.9	2.6	2.3	0.9	1.1	1.0
70 to 74	0.3	0.6	0.5	0.5	1.1	0.8	1.6	2.4	1.9	1.9	2.4	2.1	0.5	0.9	0.7
75 to 79	0.3	0.4	0.3	0.2	0.7	0.5	1.1	1.3	1.2	1.1	1.2	1.1	0.4	0.5	0.5
80+	0.08	0.3	0.2	0.3	1.2	0.7	0.8	1.5	1.1	0.8	1.2	0.9	0.2	0.5	0.4
Total Number	**7,465**	**7,691**	**15,156**	**1,280**	**1,289**	**2,569**	**833**	**744**	**1,577**	**367**	**341**	**708**	**9,945**	**10,065**	**20,010***

* The total was 20,010 because 2 individuals had missing information on age

The age and sex pyramid shown in Figure 2.1 is illustrative of a young population (flat base and sharp summit); which is very common in developing countries with high fertility rates and low life expectancies.

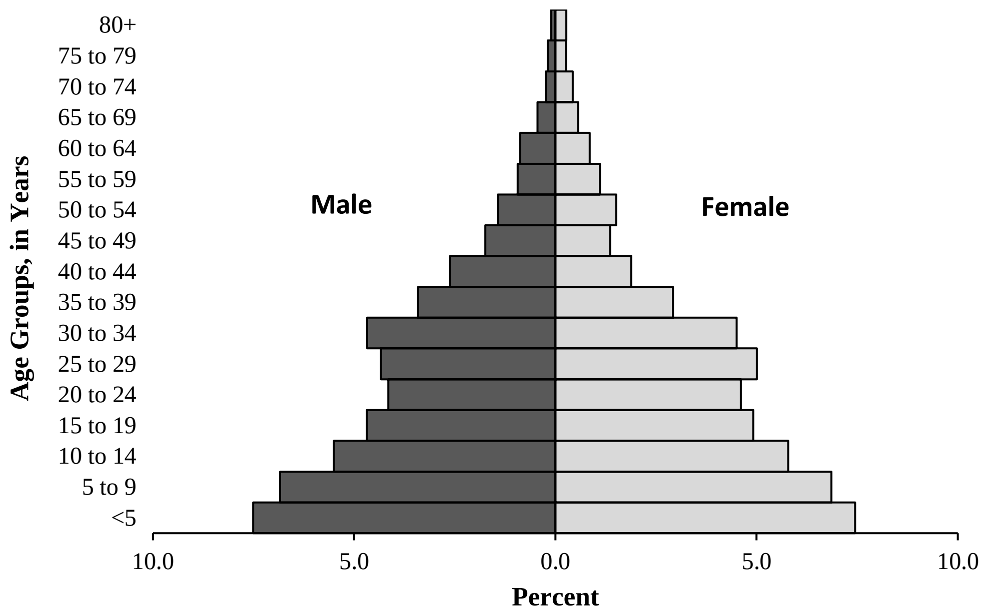


Figure 2.1 Age and Sex pyramid, Bioko 2018

2.2. Household composition

Table 2.2 describes household size and household leadership, by the district of residence. The majority of the households (69.2%) were headed by men across all four districts. Of those headed by women (30.8%), the largest number was found in Malabo. The mean household size was 4.2 persons; and was higher in Malabo and Baney (4.3) compared to Luba and Riaba (3.5). When comparing all four districts, the proportion of households with more than 9 occupants was the highest in Riaba and Malabo respectively. Bigger households observed in Malabo could be attributed to the rural migration in quest of jobs.

Table 2.2 Household composition

Percent distribution of households by gender of household head, and household size by the district of residence

Characteristics	Malabo	Baney	Luba	Riaba	Total
Household headship					
Male	68.5	71.6	70.3	73.1	69.2
Female	31.5	28.5	29.7	26.9	30.8
Number of residents					
1	15.7	16.1	30.1	27.5	17.6
2	15.9	17.5	16.2	25.5	16.5
3	14.3	11.4	13.8	12.0	13.8
4	12.6	12.3	9.6	6.5	12.1
5	12.2	11.6	10.7	5.5	11.7
6	9.9	10.6	7.4	8.5	9.7
7	6.9	8.6	5.0	2.0	6.7
8	4.4	4.2	2.4	5.5	4.2
9+	8.0	7.7	4.8	7.0	7.7
Mean size of households	4.3	4.3	3.5	3.5	4.2
Total number of households	**3,521**	**595**	**458**	**200**	**4,774**

Results are presented as percentage or otherwise stated

2.3. Household Environment

Households characteristics are important to describe the socio-economic status and can also impact the health of members, especially children. Amongst other things, respondents were questioned on the source of drinking water and electricity. The type of roofing, walls, and flooring materials were also observed and the information recorded.

2.3.1. Drinking water

According to the United Nations Sustainable Development Goal (SDG) 6, access to clean water is essential to prevent millions of people, mostly children, from dying from water-borne diseases **[12]**. Table 2.3 shows the percent distribution of drinking water source, classified as improved or unimproved, by districts of residence.

Ninety-three percent of households surveyed had an improved source of drinking water. Households in Malabo and Baney had more access to improved source of drinking water than those surveyed in Luba and Riaba. The single most common improved source of drinking water type was piped water in public taps (55.6%) and it was mostly reported in Riaba when compared to those in the other districts. Piped water in the house and bottled water were most commonly reported in Malabo and Baney compared to Luba and Riaba. Generally, drinking water from unimproved sources was mostly encountered in Luba and Riaba than in Malabo and Baney.

Table 2.3 Source of drinking water

Percent distribution of households by source of drinking water

Source of drinking water	Malabo	Baney	Luba	Riaba	Total
Improved source of drinking water	**95.9**	**91.6**	**84.1**	**88.0**	**93.9**
piped water in house	11.1	10.4	7.4	3.5	10.4
piped water in compound (yard)	5.5	5.8	9.2	5.0	5.9
piped water in public tap	54.8	55.1	55.0	73.5	55.6
protected well in compound	1.7	0.5	0.2	0.0	1.3
protected well outside compound	1.6	1.5	2.2	1.0	1.6
borehole inside compound	0.3	0.0	0.2	0.0	0.2
borehole outside compound	2.2	3.2	1.5	0.0	2.2
bottled water	18.8	14.5	7.9	4.0	16.3
rain water in cistern	0.0	0.5	0.4	1.0	0.2
Unimproved source of drinking water	**4.0**	**8.4**	**15.9**	**12.0**	**6.0**
unprotected well inside compound	0.5	0.2	0.0	0.5	0.4
unprotected well outside compound	0.4	0.2	0.2	1.5	0.4
river/stream	1.2	6.1	15.5	9.0	3.5
water truck	0.1	0.0	0.0	0.0	0.1
other rain water	0.2	0.2	0.0	1.0	0.2
other	1.6	1.9	0.2	0.0	1.5
Total number of households	**3,521**	**595**	**458**	**200**	**4,774**

2.3.2. Housing characteristics

Table 2.4 shows dwelling characteristics, including access to electricity, and construction materials (floor, roofs, and walls). Overall, 90% of houses had access to electricity and were more common in Malabo and Baney compared to Luba and Riaba. Fifty-three percent of the houses had cement walls, while 48% had wood walls. Woodhouses were more common in Riaba and Baney while cement houses were more common in Malabo and Luba. The two most common flooring materials were cement (mostly in Luba and Riaba), and tiles/stone (mostly in Malabo and Baney). Tin sheeting was the most used roofing material (85%).

Table 2.4 Housing Characteristics

Percent distribution of households by housing characteristics, according to districts

Housing Characteristics	Malabo	Baney	Luba	Riaba	Total
Electricity[1]					
yes	95.1	85.7	69.7	59.0	90.0
no	2.2	10.4	28.2	36.5	7.1
Walls material					
brick	0.1	0.3	0.7	0.0	0.2
wood	43.7	50.6	45.6	65.0	45.6
cement	55.6	46.7	52.8	31.5	53.2
mud	0.0	0.0	0.0	0.0	0.0
thin sheeting	0.5	2.4	0.9	3.5	0.9
other	0.0	0.0	0.0	0.0	0.0
Floor material					
earth/dust/sand	1.7	5.4	6.9	18.5	3.4
wood	0.3	0.2	1.7	1.5	0.4
cement	45.1	49.9	60.7	61.5	47.9
tile or stone	51.4	44.2	29.7	17.0	46.9
marble	0.3	0.0	0.0	0.0	0.2
parquet of polished wood	0.0	0.0	0.0	0.0	0.0
other	1.3	0.3	0.9	1.5	1.1
Roof material					
tin sheeting	82.6	89.2	89.5	94.5	84.6
cement	11.1	5.0	5.4	4.0	9.5
tiles	0.0	0.0	0.2	0.0	0.0
wood	2.9	2.5	4.1	0.0	2.9
palm or thatch	0.0	0.0	0.0	0.0	0.0
asphalt tiles	1.3	0.7	0.0	0.0	1.0
pitch	0.1	0.0	0.0	0.0	0.1
other	1.8	2.5	0.7	1.5	1.8
Total households	**3,521**	**595**	**458**	**200**	**4,774**

[1]for electricity, responses such as "others" and "don't know" are not shown in the table; and Category "no" includes wood fire, candles, gas/kerosene, and none.

2.3.3. Wealth Index

A weighted socio-economic score was derived by Principal Component Analysis (PCA), from household assets; which was further divided into five quintiles (lowest to highest), and used as a proxy for socio-economic status (Wealth Index). This background characteristic was further used to stratify malaria indicators. Table 2.5 shows the percentage distribution of households by, assets and Wealth Index, according to the district of residence.

Luba and Riaba had the highest percentages of households belonging to the lowest and second lowest Wealth Index categories, while Malabo and Baney had the highest percentages of households belonging to the highest Wealth Index categories.

Table 2.5 Household assets and Wealth Index

Percentage of households possessing various amenities and percent distribution of households by wealth index[1] by district

Characteristics	Malabo	Baney	Luba	Riaba	Total
Possessions					
Radio	40.7	38.9	51.1	47.5	41.8
Television	90.0	81.5	67.2	54.0	85.3
VCR/DVD	41.7	43.2	43.0	40.5	42.0
Computer	29.7	26.4	9.4	6.5	26.4
Camera	7.3	7.7	3.9	1.0	6.8
Telephone	97.4	85.7	82.9	78.5	93.8
Clock	33.4	37.6	29.0	20.5	32.9
Watch	69.5	63.5	50.4	40.0	65.7
Sofa	82.7	77.3	66.6	45.0	78.9
Table	79.5	81.8	75.9	71.5	79.1
Armoire	76.5	68.7	57.2	39.5	72.1
Cabinet	27.6	27.7	18.8	11.0	26.1
Fans	76.1	47.4	24.9	22.0	65.3
Air conditioner	25.1	20.5	3.5	1.0	21.4
Refrigerator	84.3	76.1	60.0	51.0	79.5
Stove	51.9	47.4	39.3	32.5	49.3
Washing machine	29.5	30.3	14.6	5.5	27.1
car	26.2	27.4	15.3	9.5	24.6
Wealth Index					
lowest	14.8	24.7	38.6	56.0	20.0
second	19.6	18.3	24.0	21.5	19.9
middle	21.5	16.6	17.0	12.5	20.1
fourth	21.6	17.6	14.4	9.0	19.9
highest	22.5	22.7	5.9	1.0	20.0
Total households	**3,521**	**595**	**458**	**200**	**4,774**

[1] Wealth Index was generated using data on households' assets ownership that relates to socio-economic status, by Principal component analysis. A weighted socio-economic score was generated based on the amount of variation of the factor (wealth index) that was explained by all the assets in the correlation matrix, and further divided in quintiles; with the lowest representing the poorest category and the highest representing the richest category

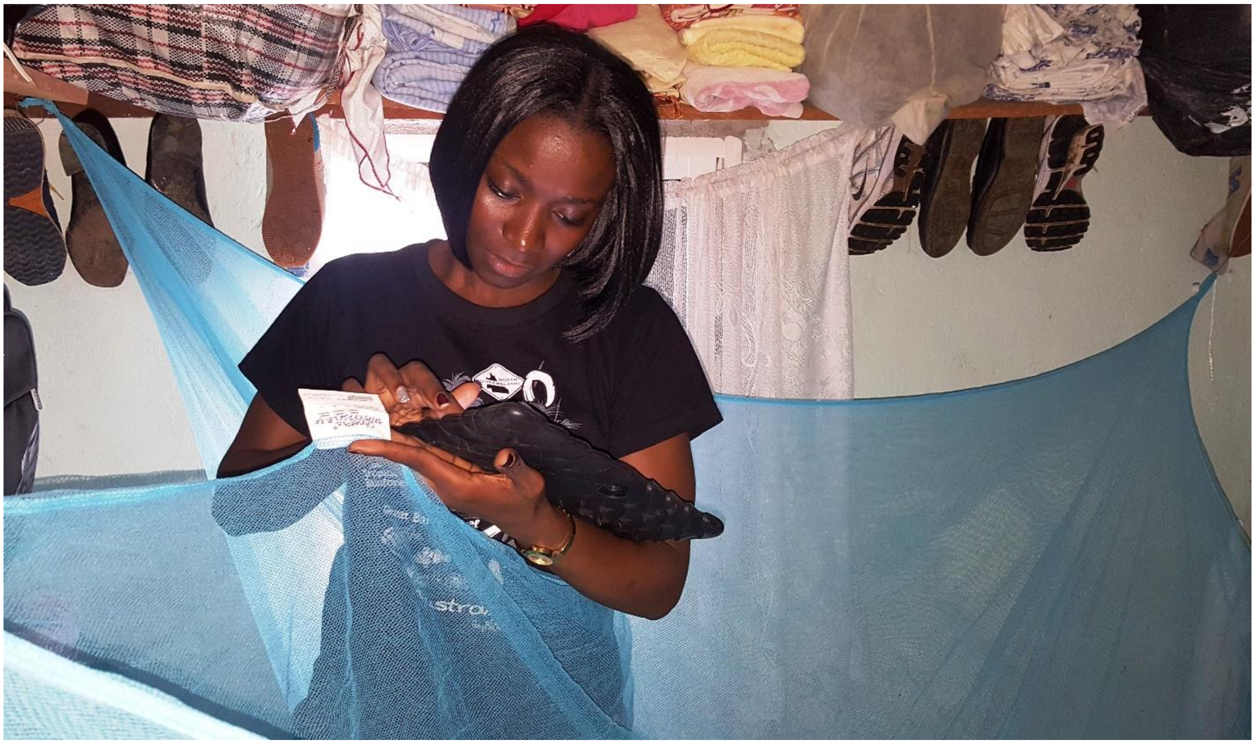
2.3.4. Characteristics of respondents

Table 2.6 describes the distribution of survey respondents by 10-years age groups, gender, and relation to household head; according to the district of residence. The highest proportion of respondents were between the ages of 20 and 29 years, followed by those age 30 to 39 years and by those age 40 to 49 years. Luba and Riaba had older respondents compared to those in Malabo and Baney. Fifty-six percent of the respondents were women, although a larger number of male respondents were met in Luba and Riaba. Overall, the majority of the respondents were household heads (56.9%), followed by their spouses (24.4%).

Table 2.6 Characteristics of survey respondents
Percent distribution of respondents by districts, according to selected background characteristics

Background Characteristics	Malabo	Baney	Luba	Riaba	Total
Age					
<20	5.1	6.4	5.0	3.0	5.1
20-29	37.4	27.1	15.1	20.0	33.2
30-39	32.5	31.3	20.1	22.0	30.7
40-49	12.3	13.4	16.8	17.5	13.1
50-59	7.1	10.6	18.9	14.5	9.0
60-69	4.1	8.3	13.8	14.5	5.9
>70	1.4	3.0	10.3	8.5	2.8
Gender					
Male	42.2	41.5	52.6	54.5	43.7
Female	57.8	58.5	47.4	45.5	56.3
Relation to head					
household head	54.2	55.6	72.7	72.0	56.9
wife/husband	25.4	26.6	17.5	16.0	24.4
son/daughter	8.9	9.4	5.2	6.5	8.6
son/daughter in law	0.3	0.0	0.0	1.0	0.2
niece/nephew	0.9	1.0	1.1	1.5	0.9
parent	0.4	0.3	0.2	0.0	0.3
other relative	9.1	6.6	2.8	2.5	7.9
other non-relative	0.7	0.5	0.4	0.5	0.7
Total households	**3,521**	**595**	**458**	**200**	**4,774**

CHAPTER 3. MALARIA PREVENTION



3.1. Malaria knowledge

Social Behavioral Change Communication (SBCC), which evolved from Information, Education and Communication (IEC) strategy, uses targeted messages and well-designed approaches to promote healthy behaviors and practices. It encompasses health communication and social & community mobilization **[13]**. Studies have reported a net increase in bed nets use amongst populations after exposure to various forms of malaria sensitization messages **[14–17]**. The BIMCP has fully integrated SBCC as part of its intervention strategies.

During the MIS, respondents were asked if they heard or saw a malaria-related message six months prior to the interview, if they answered: “yes”; they were asked to cite the various sources of the messages they heard or saw. Furthermore, they were also asked about malaria transmission routes, malaria symptoms, malaria prevention methods, and on the knowledge of free ACT at government health facilities. Female respondents were also questioned on their knowledge on the number of IPT dosages required during pregnancy.

3.1.1. Exposure to malaria-related messages

Table 3.1 shows a summary of exposure to malaria-related messages and the source of exposure (stratified by selected background characteristics). Overall, 51% of the respondents reported to have seen or heard a malaria-related messages six months before the interview. Exposure increased with age and socio-economic status; while it remained comparable throughout the four districts. Television was the most reported source of exposure with highest reports in Malabo compared to the other districts. Similarly, television exposure was higher amongst respondents living in wealthier households compared to those living in less wealthy ones. Radio exposure was 26.8% and increased with age. Men were more likely to be exposed to malaria messages through the radio than Women; radio exposure was higher in Luba and Riaba when compared to Malabo and Baney.

Television exposure decreased significantly between 2015 and 2018, while radio exposure did not change that much (Figure 3.1). The arrival of numerous and increasing accessibility to foreign Television channels could be a plausible explanation for the drop in TV exposure to malaria-related messages on the island of Bioko.

Table 3.1 Exposure to malaria-related messages

Percentage of respondents who reported hearing or seeing a malaria-related messages in the past 6 months before the survey; and 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 or saw malaria-related messages in the past 6 months												
Background characteristics	Heard or saw message	Total	Radio	TV	Home visit by a volunteer [1]	Home visit by IRS/LLIN teams[2]	Theater show	Pamphlet /Poster	Group discussion	Health provider	Event /Sport	Community	Other	Don't remember	Total
Age in years															
<20	47.3	247	18.8	42.7	3.4	6.8	0.0	8.5	8.5	7.7	2.5	4.3	14.5	0.0	117
20-29	46.7	1,587	19.8	48.5	5.7	11.1	0.9	7.0	11.1	9.9	0.1	1.8	7.0	2.2	741
30-39	52.0	1,468	24.8	54.3	4.8	10.3	0.3	4.3	9.0	5.6	0.3	2.5	4.5	1.6	764
40-49	55.6	626	27.9	59.8	4.3	9.5	0.6	4.3	8.3	6.3	0.0	1.7	3.4	0.8	348
50-59	56.9	430	38.7	56.7	2.9	7.8	0.0	4.1	8.9	3.2	0.5	1.6	2.9	0.8	245
60-69	59.1	284	41.7	50.0	4.2	6.5	0.6	4.8	9.5	5.4	0.0	0.6	4.8	0.0	168
>70	46.9	132	56.5	33.9	3.2	6.5	0.0	1.6	11.3	3.2	0.0	0.0	0.0	3.2	62
Gender															
Male	50.6	2,084	32.7	53.0	4.1	7.4	0.6	5.9	8.0	3.7	0.4	1.6	4.1	1.0	1,056
Female	51.6	2,690	22.4	51.6	5.0	11.4	0.4	4.8	10.8	9.2	0.2	2.2	6.2	1.7	1,389
District															
Malabo	50.8	3,521	22.3	55.2	5.1	10.3	0.4	5.1	8.8	6.2	0.2	1.9	5.9	1.3	1,787
Luba	53.9	458	42.9	46.1	4.0	8.5	0.0	4.5	10.1	7.7	0.0	1.6	2.0	2.0	245
Baney	50.9	595	33.9	46.5	3.3	7.3	1.3	7.3	10.9	9.2	0.6	2.9	5.3	1.9	303
Riaba	54.0	200	45.4	32.4	2.8	8.3	0.0	3.7	18.5	8.3	0.9	1.9	1.9	0.9	108
Wealth Quintiles															
Lowest	38.8	955	31.8	33.9	3.7	13.7	0.0	6.5	11.3	7.3	0.3	2.9	1.9	1.6	371
Second	46.8	955	25.7	50.8	4.5	9.4	1.1	4.7	10.9	6.7	0.0	1.8	5.8	2.0	447
Middle	52.1	960	23.8	54.9	5.2	8.4	0.2	4.6	10.8	8.2	0.2	2.6	5.8	1.8	501
Fourth	56.3	950	27.8	57.4	5.2	8.4	0.6	4.7	7.3	5.6	0.4	0.7	5.4	1.3	535
Highest	61.9	954	26.2	57.9	4.4	9.5	0.5	6.1	8.6	6.6	0.5	2.0	6.6	0.7	591
Total	51.2	4,774	26.8	52.2	4.6	9.7	0.5	5.3	9.6	6.8	0.3	1.9	5.3	1.4	2,445

[1]volunteers are the BIMCP SBCC team members who go in communities to educate the population on malaria.
[2]IRS/LLIN teams are Indoors Residual Spraying / Long-lasting Insecticidal Nets teams
Results are presented as percentages

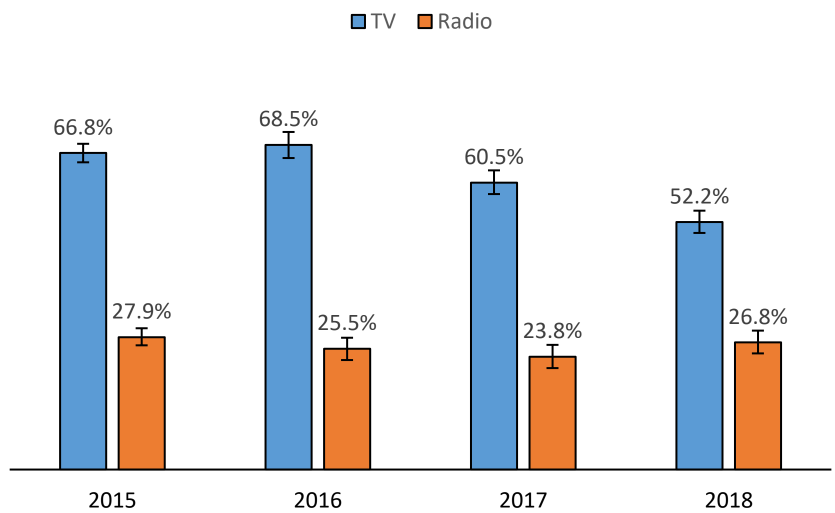


Figure 3.1 Variation of TV and radio exposures to malaria-related messages (2015 – 2018)

3.1.2. Knowledge of malaria transmission

Table 3.2 shows malaria transmission knowledge amongst survey respondents. Respondents provided the following, as causes of malaria: mosquitos (78%), poor hygiene (4.7%), drinking contaminated water (1.9%), eating contaminated food (3.2%), and "don't know" (16.2%). Knowledge of mosquitos as the cause of malaria was highest in Malabo and lowest in Riaba. Respondents living in households with higher socio-economic status were more likely to cite mosquitos as the cause of malaria. Similarly, younger respondents were more likely to know that mosquitos cause malaria. In general, malaria knowledge did not change significantly between 2015 and 2018 (data not shown).

Table 3.2 Knowledge of malaria transmission

Percentage of respondents who cited specific ways by which malaria could be transmitted, according to background characteristics

Background characteristics	Person to person	Mosquitos	Poor hygiene	Drinking contaminated water	Eating contaminated food	Via stagnant water	Traditional disease	Other	Don't know	Total
Age in years										
<20	0.8	78.5	5.3	1.6	2.4	3.2	0.0	5.3	15.3	247
20-29	0.4	77.8	4.9	1.5	2.4	4.1	0.0	5.4	16.8	1,587
30-39	0.4	80.1	5.0	2.3	4.3	4.8	0.0	5.4	14.1	1,468
40-49	0.3	78.6	4.7	2.6	3.0	4.2	0.2	6.1	14.4	626
50-59	1.1	76.3	4.2	1.4	3.0	4.7	0.0	3.5	18.8	430
60-69	0.3	74.3	4.6	2.5	3.5	4.9	0.0	5.9	20.1	284
>70	0.0	71.9	2.2	1.5	3.0	3.0	0.8	1.5	25.0	132
Gender										
Male	0.6	76.8	4.6	1.9	3.7	3.7	0.1	6.2	16.5	2,084
Female	0.4	79.2	4.9	1.9	2.8	4.8	0.1	4.5	15.9	2,690
District										
Malabo	0.5	80.3	2.9	2.2	3.6	4.8	0.0	4.9	14.1	3,521
Luba	0.7	75.7	3.3	1.1	1.5	2.8	0.2	4.8	18.9	458
Baney	0.7	71.6	5.4	1.3	2.4	3.4	0.0	5.4	23.0	595
Riaba	0.0	64.5	3.0	1.0	2.5	2.5	0.0	10.5	26.5	200
Wealth Quintiles										
Lowest	0.6	66.6	4.2	1.3	3.0	4.3	0.1	5.8	26.5	955
Second	0.6	75.6	5.3	1.8	2.6	3.5	0.2	3.9	19.1	955
Middle	0.3	78.3	5.5	2.4	4.9	4.8	0.0	5.9	15.0	960
Fourth	0.0	83.3	4.7	2.0	3.3	4.3	0.1	5.1	11.4	950
Highest	0.8	87.1	4.3	2.3	2.2	4.8	0.0	5.5	8.9	954
Total	0.5	78.2	4.7	1.9	3.2	4.3	0.1	5.3	16.2	4,774

3.1.3. Knowledge of malaria prevention

Respondents were asked to cite the different malaria prevention methods that they know, and results are presented in Table 3.3; by age, gender, district of residence and socioeconomic level of the household. Overall 73.9% of the respondents cited the use of mosquito nets to prevent malaria, while 17.5% cited IRS, and 25.9% cited the elimination of solid waste. Knowledge of mosquito nets and IRS to prevent malaria decreased with increasing age. Female respondents had a better knowledge of mosquito nets to prevent malaria when compared to male respondents (77% Vs. 69%). Respondents living in Malabo were more likely to cite mosquito nets and IRS as malaria preventive measures compared to respondents living in other districts, and those living in Riaba had the lowest knowledge of malaria prevention methods. Citing mosquito nets or IRS as malaria preventive measures also increased markedly with increasing wealth status of the household.

Table 3.3 Knowledge of malaria prevention methods
Percentage of respondents who cited specific ways of preventing malaria, according to background characteristics

Background characteristics	Can't be prevented	Use mosquito nets	Use insecticide	Preventive medication	Eliminate solid waste	Don't know	Other	Total respondents
Age in years								
<20	0.4	74.5	21.5	6.5	23.1	9.7	20.6	247
20-29	1.4	76.4	19.3	5.4	24.6	10.3	17.2	1,587
30-39	0.8	77.3	17.9	4.9	29.9	8.9	20.6	1,468
40-49	0.9	72.4	16.5	5.3	27.3	10.7	18.5	626
50-59	0.7	68.6	13.7	8.4	22.3	12.1	20.5	430
60-69	0.4	63.1	12.7	6.4	21.8	15.8	22.2	284
>70	0.8	54.5	12.1	12.1	15.9	18.2	22.7	132
Gender								
Male	0.9	69.2	16.9	5.7	26.4	11.9	21.5	2,084
Female	1.0	77.6	18.0	5.9	25.3	9.6	17.6	2,690
District								
Malabo	1.1	76.3	17.9	4.8	26.7	9.4	18.5	3,521
Luba	1.1	68.1	16.2	10.0	21.8	12.4	18.3	458
Baney	0.2	69.9	19.2	7.7	26.4	14.3	23.7	595
Riaba	0.5	57.5	9.5	8.5	20.5	17.0	22.5	200
Wealth Quintiles								
Lowest	1.4	62.3	11.9	7.4	16.9	18.5	18.4	955
Second	1.2	72.4	14.0	5.6	23.9	11.4	17.8	955
Middle	0.4	76.0	17.6	5.1	27.0	10.2	18.9	960
Fourth	1.4	77.9	18.3	5.2	30.5	8.0	18.3	950
Highest	0.5	81.0	25.7	5.8	31.3	4.9	23.1	954
Total	0.9	73.9	17.5	5.8	25.9	10.6	19.3	4,774

Figure 3.2 depicts the trend of malaria prevention knowledge over time. Knowledge of mosquito nets to prevent malaria was highest in 2015 and 2018 compared to 2016 and 2017 (U-shape). An explanation for this could be the mass distribution campaigns of LLINs that were done in 2015 and 2018, during which SBCC and distribution teams flooded communities to convey messages on bed nets; which in some ways might have contributed to improving knowledge at those time periods. Both elimination of solid wastes and IRS, as malaria prevention methods, dropped after 2015, but both remained comparable from 2016 to 2018.

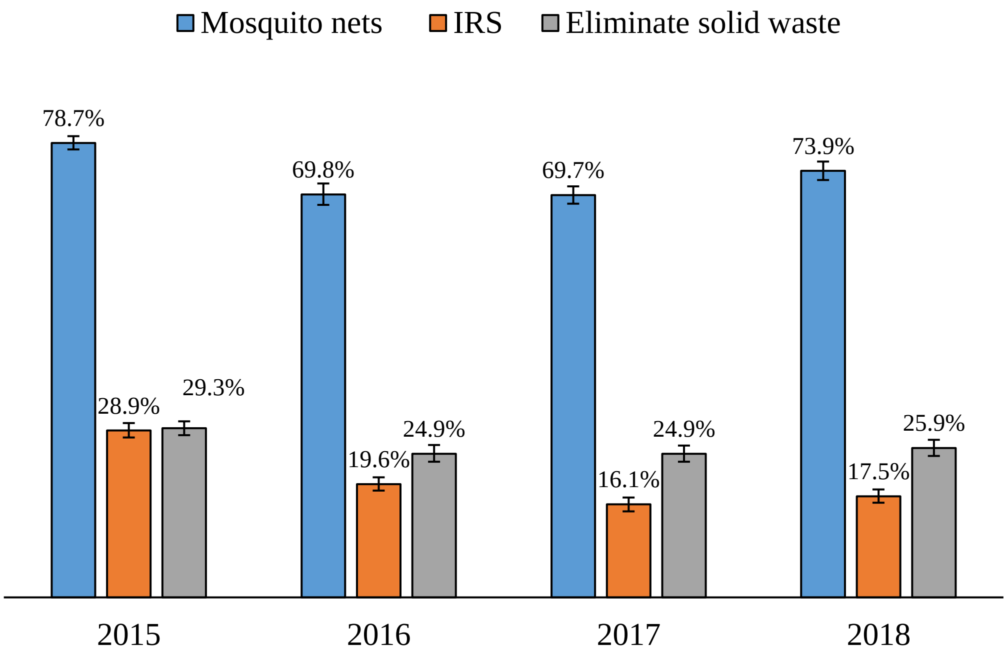


Figure 3.2 Trend in malaria prevention knowledge between 2015 and 2018

3.1.4. Knowledge of malaria symptoms

Knowledge of malaria symptoms has been reported to be a determinant of health-seeking behavior **[18–20]**. Respondents were asked to name various malaria symptoms that they know, and results are presented in Table 3.4. Overall, 72% cited fever, and this was higher in Malabo, while lowest in Riaba and Luba. Female respondents had better knowledge of malaria symptoms compared to male respondents. Similarly, respondents living in households with higher socioeconomic status had better knowledge of malaria symptoms. Working-age groups (20 to 59 years) respondents had better knowledge of malaria symptoms compared to older respondents. Knowledge of malaria symptoms did not change between 2015 and 2018 (data not shown).

Table 3.4 Knowledge of malaria symptoms

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

Background characteristics	fever	headache	vertigo	circulatory pain	chills	cough	diarrhea	pallor	seizures	vomiting	Loss of appetite	Skin problems	Earache	sweating	Don't know	other	number
Age in years																	
<20	65.6	21.9	2.5	0.4	1.2	1.2	7.3	21.1	0.0	19.8	5.3	1.6	0.0	0.4	19.4	14.5	247
20-29	75.8	25.2	2.8	3.7	3.6	0.8	6.2	21.4	0.6	25.8	6.3	1.3	0.1	0.4	11.5	8.8	1,587
30-39	75.5	24.6	2.0	4.3	3.9	1.2	5.4	24.3	0.9	23.4	8.9	0.9	0.0	0.5	9.5	9.6	1,468
40-49	73.5	22.7	3.7	5.4	5.4	1.9	5.8	26.8	0.5	21.5	8.9	0.2	0.0	0.8	8.1	9.7	626
50-59	66.9	22.1	3.7	6.0	4.4	1.1	4.4	29.3	2.1	17.7	12.3	0.7	0.0	1.1	8.6	10.5	430
60-69	64.8	21.5	4.2	7.4	6.7	0.7	3.9	20.1	0.7	13.0	13.4	1.1	0.0	0.7	13.0	12.3	284
>70	53.0	19.7	1.5	9.1	6.1	0.0	2.3	23.5	0.8	10.6	6.8	0.8	0.8	0.0	20.5	6.8	132
Gender																	
Male	65.5	22.2	3.0	4.9	3.6	0.7	4.4	23.2	0.7	15.4	6.8	1.0	0.0	0.4	15.3	10.1	2,084
Female	78.5	25.1	2.6	4.2	4.5	1.4	6.4	24.1	0.9	27.7	9.6	0.9	0.1	0.7	7.6	9.5	2,690
District																	
Malabo	76.7	25.3	2.8	4.8	3.8	0.9	5.8	22.7	0.8	23.7	7.3	1.0	0.1	0.6	10.1	8.9	3,521
Luba	57.6	18.9	3.9	5.7	6.9	1.3	3.5	27.7	0.7	18.1	12.0	0.9	0.0	0.9	13.3	12.0	458
Baney	66.4	20.5	1.7	2.6	3.4	2.7	6.4	27.4	1.0	19.2	11.6	1.0	0.2	0.2	13.4	11.9	595
Riaba	56.0	19.0	4.0	4.5	4.5	0.0	4.5	21.5	0.5	16.0	9.0	0.5	0.0	1.0	13.5	12.0	200
Wealth Quintiles																	
Lowest	58.0	17.3	2.3	4.2	4.6	1.0	3.8	22.1	0.8	14.9	7.2	0.9	0.1	0.4	19.1	10.7	955
Second	70.4	23.1	3.1	5.0	3.6	1.5	4.2	21.0	0.3	20.0	7.1	1.4	0.0	0.8	11.6	10.4	955
Middle	77.2	23.5	3.2	3.6	3.9	0.8	7.2	24.3	1.0	23.8	8.0	0.4	0.1	0.8	8.2	9.7	960
Fourth	77.3	26.9	2.8	4.8	4.3	1.2	6.0	26.1	1.2	26.9	9.5	1.1	0.1	0.2	8.9	9.1	950
Highest	81.0	28.4	2.5	5.0	4.3	0.9	6.6	24.8	0.6	25.8	10.1	1.0	0.0	0.5	6.9	8.8	954
Total	72.8	23.8	2.8	4.5	4.1	1.1	5.6	23.7	0.8	22.3	8.4	0.9	0.1	0.6	10.9	9.7	4,774

3.1.5. Knowledge of free antimalarial treatment and IPTp dosage

The BIMCP in collaboration with the NMCP have made available free antimalarial treatment for all, free IPTp and bed nets for pregnant women attending ANC clinics, available at all government health facilities across the island of Bioko. Respondents were asked if they were aware of free antimalarial treatment in government health facilities. In addition, female respondents were further asked if they knew the number of IPT doses required during pregnancy.

Table 3.5 describes free antimalarial treatment knowledge, and IPTp dosage knowledge amongst female respondents, by background characteristics. Overall 48% of the respondents knew ACTs are free in public health facilities, and female respondents were more likely to know that compared to male respondents. Knowledge of free ACT decreased with age and increased with household wealth status. Respondents living in Riaba and Luba were more aware of free ACT compared to those living in Malabo and Baney.

Regarding IPTp, only 19.9% of female respondents could cite 3 doses of Fansidar required during pregnancy while56% stated not knowing. Knowledge of IPTp was higher amongst women aged 20 to 49 years; and higher amongst women living in Luba and Riaba compared to the other districts.

Table 3.5 Knowledge of free ACT and knowledge of IPTp doses

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

	Knowledge of free ACT in public health facilities				Knowledge of IPTp dosage amongst female respondents						
	Free	Paid	Not sure/don't know	Total respondents	zero	One	two	three	Four or more	Not sure/don't know	Total women
Age in years											
<20	48.9	22.3	28.7	247	0.6	6.7	5.4	1.0	11.4	65.8	149
20-29	53.3	24.3	22.2	1,587	0.7	8.1	8.8	21.1	11.7	49.6	958
30-39	47.7	29.9	22.3	1,468	0.5	9.4	8.5	25.9	7.1	48.6	802
40-49	43.7	30.4	25.8	626	0.7	3.6	8.5	19.3	7.2	60.8	306
50-59	47.2	31.8	20.9	430	0.4	1.7	7.4	10.7	5.4	74.5	242
60-69	44.7	34.2	21.1	284	0.0	2.5	5.0	11.9	5.0	75.5	159
>70	44.7	25.7	29.5	132	0.0	1.6	4.1	8.1	2.7	83.8	74
Gender											
Male	40.8	28.8	30.2	2,084	-	-	-	-	-	-	-
Female	55.1	27.4	17.5	2,690	-	-	-	-	-	-	-
District											
Malabo	48.2	26.9	24.9	3,521	0.6	7.2	8	18.4	8.6	57.1	2,034
Luba	53.3	27.5	19.2	458	0.4	4.1	7.4	26.3	6.5	55.3	217
Baney	47.2	35.3	17.5	595	0.3	7.2	8.6	23.3	10.3	50.3	348
Riaba	55.5	27.5	17.0	200	0.0	2.2	6.6	24.2	7.7	59.3	91
Wealth Quintiles											
Lowest	46.0	25.1	31.8	955	0.2	5.5	7.6	19.1	8.1	59.3	418
Second	47.6	29.1	23.2	955	0.9	8.7	5.6	19.1	6.6	59.1	575
Middle	49.1	29.2	21.6	960	0.3	6.4	9.8	19.4	8.9	55.2	582
Fourth	52.4	27.5	20.0	950	0.5	7.5	7.5	20.2	9.9	54.4	575
Highest	51.9	29.2	18.7	954	0.7	5.6	9.4	21.5	9.3	53.5	540
Total	48.8	28.0	23.1	4,774	0.6	6.8	7.9	19.9	8.6	56.2	2,690

Knowledge of availability of free ACT in government hospitals remained the same over time (data not shown), while knowledge of IPTp doses required, amongst female respondents, decreased significantly over time (Figure 3.3).

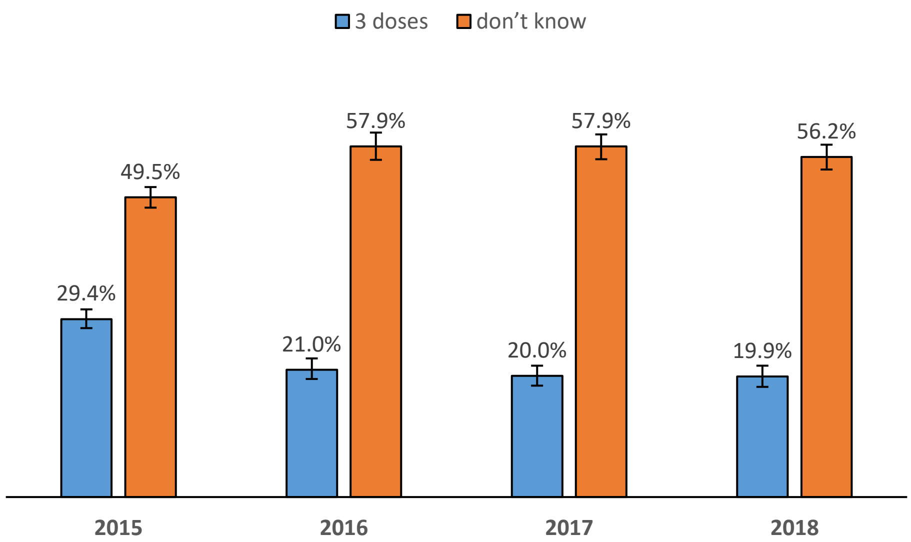


Figure 3.3 Trend in IPTp dosage knowledge amongst women

3.2. Vector control

The BIMCP has been implementing vector control interventions on the island since 2004. IRS started in 2004, targeting all communities; with 1 or 2 rounds of spraying every year. As from 2015, a stratification strategy was developed to spray only communities at high risk of malaria. In 2018, 121 communities with 21,184 inhabited houses were targeted for round 25 IRS using an organophosphate (ACTELIC 300cs). At the end of the exercise, 16,613 houses were sprayed for a total spray coverage of 78%. Bed nets were introduced in 2008, during which the BIMCP under the MoHSW of EG massively distributed PermaNet 2.0 LLINs impregnated with Deltamethrin Island-wide. Following the latter, a 3-years periodicity for mass distribution campaigns of LLINs was adopted; coupled to other distribution channels (e.g. ANC clinics, and schools distributions) as recommended by WHO **[21]**. As such, in 2015 a second mass distribution campaign of PermaNet 3.0 LLINs, treated with Deltamethrin and Piperonyl Butoxide (PBO), was conducted. In 2016, a catch-up distribution of LLINs was conducted in all primary schools of the island to maintain coverage. The latest mass distribution campaigns occurred in 2018; during which Olyset Plus LLINs treated with Permethrin and PBO were widely distributed on the island. As such 155,855 LLINs were distributed across 70,527 households, for a total distribution coverage of 85%.

This section describes bed nets ownership, access, and usage in Bioko 2018

3.2.1. Bed nets ownership

Respondents were asked if they own a net in their households and if the answer was "yes", then they were asked on the source and the type of net. Surveyors also observed the nets when possible and classified them based on type and condition.

Table 3.6 shows bed net ownership and the average number of nets per household, by the district of residence and socio-economic status. It was observed that 84.8% of households owned at least one ITN while 87.0% owned at least one net of any type. The average number of ITNs owned per households was 2.1; this number was higher in Luba compared to the other districts. The average number of ITNs per household also increased with household wealth status. Household ownership of at least one ITN was significantly higher in Luba compared to the other districts.

Table 3.6 Bed nets ownership, MIS Bioko 2018

Percentage of Households owning at least one mosquito net (treated or untreated), and percentage of households owning at least one ITN[1], stratified by Background characteristics

Background Characteristics	Own at least 1 Net: Percent (95% CI)	Own at least 1 Net: Average	Own at least one ITN[1]: Percent (95% CI)	Own at least one ITN[1]: Average	Total households
District					
Malabo	86.7 (85.0 - 88.2)	2.2	84.3 (82.5 - 85.9)	2.1	3,521
Luba	92.3 (89.0- 94.7)	2.5	90.8 (87.2 - 93.5)	2.5	458
Baney	85.0 (81.2 - 88.2)	2.2	83.1 (79.2 - 86.5)	2.2	595
Riaba	87.5 (79.9 - 92.4)	2.1	85.5 (77.9 - 90.8)	2.1	200
Wealth Quintiles					
Lowest	81.8 (79.1 - 84.4)	1.5	79.6 (76.7 - 82.3)	1.4	955
Second	88.3 (85.8 - 90.5)	2.0	86.5 (83.9 - 88.7)	1.9	955
Middle	90.4 (88.2 - 92.2)	2.4	88.2 (85.9 - 90.2)	2.3	960
Fourth	89.2 (86.6 - 91.2)	2.5	86.9 (84.4 - 89.1)	2.5	950
Highest	85.3 (82.2 - 87.9)	2.8	82.7 (79.6 - 85.4)	2.6	954
Total	**87.0 (85.6 - 88.3)**	**2.2**	**84.8 (83.3 - 86.2)**	**2.1**	**4,774**

[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 month. Results are presented as percentage (95% CI).

Ninety-seven percent of all the bed nets were ITNs (Table 3.7), and 93% were obtained through mass distribution campaigns (data not shown). Of the total 5,345 bed nets that were directly observed by surveyors, 85% were reported to be in good condition (no holes), while 4.3% had thumb-sized holes, 2.7% head-sized holes and 7.1% were never used. Malabo and Riaba had the highest percentage of torn nets when compared to those in the other two districts.

Table 3.7 Bed nets type and condition, MIS Bioko 2018

Percentage of ITNs, percentage of untreated nets, and percentage of other kinds of nets reported; and Percentage of nets with no holes, percentage of nets with thumb-sized holes, percentage of nets with head-sized holes, percentage of nets never used, and percentage of nets with uncertain conditions observed by surveyors; all by background characteristics

	Net Type				Conditions of observed nets					
Background characteristics	ITN[1]	Untreated	Other	Total number reported	No Holes	Thumb-sized hole	Head-sized hole	Never used	Not sure	Total number observed
District										
Malabo	96.1	3.4	0.5	7,689	84.1	4.8	3.3	7.7	0.6	4,069
Luba	98.3	0.3	1.4	1,151	90.1	2.7	0.9	5.3	0.0	442
Baney	97.9	1.2	0.7	1,337	91.2	2.3	0.3	5.5	0.0	651
Riaba	98.8	0.9	0.2	420	92.3	4.4	1.1	2.2	0.0	183
Wealth Quintiles										
Lowest	97.1	2.1	0.8	1,415	89.5	3.2	2.0	5.3	0.1	742
Second	97.7	1.6	0.6	1,889	88.9	3.1	3.0	4.9	0.0	1,064
Middle	96.3	2.9	0.7	2,257	87.1	4.4	2.9	5.4	0.1	1,180
Fourth	96.9	2.7	0.3	2,399	83.7	5.1	2.8	8.3	0.2	1,199
Highest	95.9	3.5	0.6	2,637	81.5	5.3	2.5	10.1	0.1	1,160
Total	**96.7**	**2.7**	**0.6**	**10,597**	**85.1**	**4.3**	**2.7**	**7.1**	**0.1**	**5,345**

[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.
Results are presented as percentages

3.2.2. Universal bed net coverage

Universal bed net coverage was defined as having one net or one ITN for every 2 household members, and results are presented in Table 3.8. Overall, 63% of households had universal bed net coverage whereas 61% had universal ITN coverage. These figures are far below the 80% target for ownership set by the WHO. Even though not significant, both universal coverages based on any net and ITN were highest in Luba, followed by Riaba and Lowest in Baney and Malabo. There was a linear trend in the decrease of universal any nets and ITNs coverages with increasing wealth status of the households.

Table 3.8 universal bed net coverage, MIS Bioko 2018

Percentage of households with at least one net (treated or untreated) for every two people, and the percentage of households with at least one ITN[1] for every two people, stratified by background characteristics

Background characteristics	one net for every 2 people	one ITN[1] for every 2 people	Total households
District			
Malabo	62.1 (59.8 - 64.3)	59.6 (57.4 - 61.8)	3,521
Luba	77.1 (72.4 - 81.1)	75.5 (71.1 - 79.5)	458
Baney	59.3 (53.7 - 64.7)	57.6 (52.1 - 62.9)	595
Riaba	68.0 (60.7 - 74.5)	66.0 (59.1 - 72.3)	200
Wealth Quintiles			
Lowest	68.9 (65.6 - 72.0)	66.6 (63.2 - 69.9)	955
Second	64.6 (61.2 - 67.8)	63.0 (59.7 - 66.2)	955
Middle	64.3 (60.8 - 67.6)	61.4 (57.9 - 64.7)	960
Fourth	61.0 (57.6 - 64.4)	59.2 (55.7 - 62.5)	950
Highest	58.2 (54.5 - 61.7)	55.7 (52.2 - 59.1)	954
Total	**63.4 (61.4 - 65.4)**	**61.2 (59.1 - 63.1)**	**4,774**

[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. Results are presented as percentage (95% CI)

3.2.3. Bed net access

Bed net access at the individual level is used to estimate the proportion of the population that could potentially be covered by existing ITNs, assuming that each ITN in a household can be used by two people within that household **[22]**. This indicator is important to estimate the proportion of the population with access to ITNs but not using them, and could be decisive in informing malaria control programs in whether they should focus on achieving higher ITN coverage, promoting ITN use or both **[22]**. In a recent publication, it was shown that measuring ITN access at the level of the individuals gives a more complete picture of personal protection and success of an ITN distribution program, compared to universal ITN coverage at the level of the household; therefore promoting population access to ITN as a better indicator for universal coverage **[23]**.

Table 3.9 describes bed nets access at the population level. As such, 75% of the population had access to ITNs, which was highest in Luba and lowest in Baney. Population access to ITNs decreased with increasing wealth status of the household.

Table 3.9 Access to bed nets, MIS Bioko 2018

Percentage of the population who could have slept under a bed net (treated or untreated) the night before the interview, and percentage of the population who could have slept under an ITN the night before the interview, stratified by district and by Wealth Quintiles

Background characteristics	Access[1] to any type of net	Access to an ITN	Total population
District			
Malabo	76.2 (74.4 - 78.1)	74.0 (72.1 - 75.9)	15,158
Luba	84.6 (81.4 - 87.9)	83.9 (80.8 - 87.2)	1,577
Baney	74.4 (70.9 - 77.9)	72.7 (68.9 - 76.4)	2,569
Riaba	76.1 (69.2 - 82.9)	75.2 (68.3 - 82.2)	708
Wealth Quintiles			
Lowest	74.1 (71.3 - 77.1)	72.1 (69.1 - 75.2)	2,349
Second	78.2 (75.9 - 80.5)	76.8 (74.4 - 79.2)	3,398
Middle	78.6 (76.2 - 81.1)	76.5 (73.9 - 78.9)	4,174
Fourth	77.4 (74.7 - 80.1)	75.6 (72.8 - 78.4)	4,720
Highest	74.5 (71.6 - 77.5)	72.2 (69.2 - 75.3)	5,371
Total	**76.6 (75.1 - 78.2)**	**74.6 (73.0 - 76.3)**	**20,012**

[1]Percentage of the household population who could sleep under a net or an ITN if each Net/ITN in the household were used by up to two people. Results are presented as percentage (95% CI)

3.2.4. Vector control coverage

Calculated as the proportion of households with at least one ITN or that received IRS during the past 12 months, this indicator assesses the extent to which the two main vector control activities are available to the population **[22]**.

Results for reported IRS restricted only to communities that were targeted during round 25, vector control and universal vector control coverages are presented in Table 3.10. Reported spray coverage in communities that were targeted during round 25 IRS was 79% and was comparable to the general coverage reported after spraying (78%). This coverage was higher in the Bioko Sur province than in the Bioko Norte province. Vector control coverage based on ITN+IRS was 88.7% overall while universal vector control coverage based on ITN+IRS was 76%. Both vector control coverage and universal vector control coverages were significantly higher in Luba and Riaba compared to Malabo and Baney.

Table 3.10 Vector control coverage, MIS Bioko 2018

Indoor Residual Spraying (IRS) coverage[1]; percentage of households with at least one net (treated or not) and that received IRS during the past 12 months , percentage of households with at least one ITN and that received IRS during the past 12 months; percentage of households with at least one net (treated or not) for every 2 people and that received IRS during the past 12 months; and percentage of households with at least one ITN for every 2 people and that received IRS during the past 12 months; by background characteristics

	IRS coverage[1]		Vector Control Coverage			Universal Vector Control coverage		
Background characteristics	Percentage sprayed in round 25	Total households targeted	Households with at least 1 net + IRS	Households with at least 1 ITN + IRS	Total households surveyed	Households with at least 1 net for every 2 people + IRS	Households with at least 1 ITN for every 2 people + IRS	Total households sprayed
District								
Malabo	77.2 (74.4 - 79.9)	1,114	89.6 (88.2 - 91.0)	88.0 (86.3 - 89.6)	3,521	75.2 (72.5 - 77.6)	73.5 (70.7 - 76.0)	3,521
Luba	83.5 (79.1 - 87.1)	340	95.6 (90.6 - 98.0)	94.5 (89.1 - 97.3)	458	91.7 (84.1 - 95.9)	90.6 (82.7 - 95.1)	458
Baney	77.9 (66.4 - 86.3)	118	88.7 (85.0 - 91.6)	87.2 (83.3 - 90.3)	595	72.4 (65.9 - 78.1)	71.1 (64.5 - 76.8)	595
Riaba	83.0 (75.0 - 88.8)	200	94.0 (88.8 - 96.8)	93.0 (87.1 - 96.3)	200	91.5 (84.2 - 95.6)	90.5 (82.4 - 95.1)	200
Wealth Quintiles								
Lowest	75.0 (70.3 - 79.2)	496	87.3 (84.8 - 89.5)	85.9 (83.2 - 88.2)	955	80.1 (76.7 - 83.1)	78.6 (75.1 - 81.8)	955
Second	82.4 (77.8 - 86.2)	352	91.2 (88.7 - 93.1)	89.9 (87.4 - 91.9)	955	79.1 (75.6 - 82.1)	77.9 (74.4 - 81.0)	955
Middle	81.4 (77.2 - 85.1)	345	92.7 (90.6 - 94.3)	91.0 (88.9- 92.8)	960	77.9 (74.7 - 80.9)	75.6 (72.3 - 78.7)	960
Fourth	81.3 (76.3 - 85.4)	331	92.3 (90.2 - 93.9)	90.7 (88.5 - 92.5)	950	76.5 (73.3 - 79.5)	75.3 (71.8 - 78.4)	950
Highest	77.0 (71.9 - 81.5)	248	88.1 (85.1 - 90.5)	86.3 (83.3 - 88.8)	954	72.0 (67.8 - 75.9)	70.2 (66.1 - 74.0)	954
Total	79.2 (76.8 - 81.3)	1,772[¶]	90.3 (89.0 - 91.5)	88.7 (87.3 - 90.0)	4,774	77.1 (74.8 - 79.2)	75.5 (73.2 - 77.7)	4,774

[1]IRS coverage was calculated including only households in communities that were eligible for round 25.
[¶]only 1,772 households surveyed belonged to communities that were eligible for round 25 IRS.
Results are presented as Percentage (95% CI).

3.2.5. Bed nets use

Survey respondents were questioned about the use of mosquito nets by each household member that slept in the house the night before the interview (Table 3.11). Information was collected for each net separately, including for those that were used the night before the interview. A list of household members who slept under each was recorded. Overall, 47% of the population was reported to have slept under an ITN the night before the interview. There was a U-shape relationship between ITN use and age, as individuals aged 20 to 29 years had the lowest percentage of net use, while those belonging to the extreme age groups (<10 and >50) had the highest net use proportions. Women were more likely to sleep under ITNs when compared to men. Net use, was highest in Luba, followed by Riaba, then Malabo and lowest in Baney. There was a linear decrease in bed net use with increasing wealth status of the household.

Table 3.11 Bed nets use in the general population, MIS Bioko 2018
Percentage of people who, the night before the survey, slept under a bed net (treated or untreated) or slept under an Insecticide-Treated Net (ITN); data by age, gender and location.

Background characteristics	Slept under any net	Slept under an ITN	Total population
Age in years [1]			
<10	52.1 (49.3 - 54.9)	51.9 (49.1 - 54.8)	5,736
10 to 19	42.6 (39.8 - 45.4)	42.5 (39.7 - 45.3)	4,180
20 to 29	39.2 (36.8 - 41.7)	39.1 (36.6 - 41.6)	3,623
30 to 39	46.4 (43.4 - 49.4)	46.1 (43.2 - 49.2)	3,104
40 to 49	52.5 (49.3 - 55.7)	52.4 (49.2 - 55.6)	1,522
≥50	58.4 (55.3 - 61.4)	58.1 (55.0 - 61.1)	1,845
Gender			
Male	45.1 (42.8 - 47.3)	44.9 (42.6 - 47.3)	9,947
Female	49.9 (47.4 - 52.4)	49.6 (47.1 - 52.2)	10,065
District			
Malabo	47.3 (44.6 - 50.0)	47.1 (44.4 - 49.8)	15,158
Luba	52.6 (47.3 - 57.9)	52.6 (47.3 - 57.9)	1,577
Baney	45.0 (38.1 - 52.2)	44.9 (37.9 - 52.0)	2,569
Riaba	49.3 (40.9 - 57.7)	49.3 (40.9 - 57.7)	708
Wealth Index			
Lowest	51.8 (48.1 - 55.5)	51.3 (47.6 - 55.1)	2,349
Second	54.8 (51.6 - 58.1)	54.9 (51.5 - 58.1)	3,398
Middle	51.9 (48.5 - 55.4)	51.8 (48.4 - 55.2)	4,174
Fourth	48.5 (45.0 - 51.9)	48.3 (44.9 - 51.8)	4,720
Highest	36.7 (32.9 - 40.5)	36.5 (32.7 - 40.3)	5,371
Total	47.5 (45.2 - 49.8)	47.3 (45.1 - 49.6)	20,012

[1] the total valid data for age in years was 20,010 as 2 individuals had unknown ages. Results are presented as Percentage (95% CI).

Table 3.12 shows bed nets use amongst children younger than 5 years, according to some demographic factors. Of the total 2,994 children, 54.6% were reported to have slept under an ITN the night before the interview. The usage of both, any net and ITN, decrease consistently with increasing age. The use of ITN was higher for children living in houses in which the head had either none or primary level of education than on those households where the head had a higher level of education. Even though, ITN use seemed lowest in children living in Riaba compared to those living in other districts, the differences appeared to be non-significant. The use of ITN decreased significantly amongst children living in households with high wealth status.

Table 3.12 Bed nets use amongst children, MIS Bioko 2018
Percentage of children under age 5 who, the night before the survey, slept under a mosquito net (treated or untreated) and under an insecticide-treated net (ITN); according to background characteristics.

Background characteristics	Slept under any net	Slept under an ITN	Total children who slept in the house
Age in months			
<12	59.7 (55.4 - 63.9)	59.4 (55.1 - 63.5)	638
12 to 23	56.0 (50.8 - 61.1)	56.0 (50.8 - 61.0)	566
24 to 35	57.2 (52.6 - 61.9)	56.9 (52.3 - 61.3)	580
36 to 47	51.6 (47.0 - 56.0)	51.4 (46.8 - 55.9)	605
48 to 59	49.7 (45.2 - 54.3)	49.6 (45.0 - 54.1)	605
Child gender			
Male	53.2 (49.7 - 56.7)	53.1 (49.6 - 56.6)	1,503
Female	56.5 (52.7 - 60.2)	56.2 (52.4 - 59.9)	1,491
Level of education of the household head			
None	61.5 (40.4 - 79.1)	61.5 (40.5 - 79.0)	39
Primary	59.4 (51.8 - 66.6)	59.4 (51.8 - 66.6)	281
Secondary	55.9 (51.8 - 59.9)	55.6 (51.6 - 59.8)	1,169
Post-secondary	48.4 (42.7 - 54.2)	48.5 (42.7 - 54.3)	759
Unknown	57.6 (52.6 - 62.5)	57.2 (52.2 - 62.1)	746
District			
Malabo	55.3 (51.8 - 58.7)	55.0 (51.5 - 58.5)	2,282
Luba	53.2 (44.0 - 62.3)	53.2 (44.0 - 62.3)	216
Baney	55.2 (44.5 - 65.3)	54.9 (44.3 - 65.1)	386
Riaba	49.1 (39.1 - 59.6)	49.0 (39.0 - 59.2)	110
Wealth Quintiles			
Lowest	59.2 (51.5 - 66.5)	58.2 (50.1 - 65.5)	304
Second	65.1 (59.7 - 70.1)	65.1 (59.7 - 70.1)	516
Middle	60.0 (54.5 - 65.3)	59.9 (54.3 - 65.2)	658
Fourth	53.5 (48.3 - 58.7)	53.4 (48.1 - 58.5)	723
Highest	43.5 (37.9 - 49.2)	43.4 (37.8 - 49.0)	793
Total	54.8 (51.8- 57.9)	54.6 (51.6 - 57.7)	2,994

Results are presented as Percentage (95% CI)

Table 3.13 shows mosquito net use amongst pregnant women, by background characteristics. Overall, 52% of pregnant women were reported to have slept under an ITN the night before the interview. Sleeping under any net and under an ITN both decreased with the age of the women, and were lowest in Baney when compared to the other districts. Women living in households with higher wealth status were less likely to sleep under ITNs compared to those women living in households with low wealth status.

Table 3.13 Bed nets use amongst pregnant women, MIS Bioko 2018

Percentage of pregnant women age 15-49 who, the night before the survey, either slept under a mosquito net (treated or untreated) or under an ITN; according to background characteristics.

Background characteristics	Slept under any net	Slept under an ITN	Total pregnant women
Age in Years			
15 to 25	58.0 (49.2 - 66.3)	58.0 (49.2 - 66.3)	131
25 to 34	48.9 (40.6 - 57.4)	48.3 (39.8 - 56.8)	145
35 to 49	43.7 (27.0 - 61.5)	43.7 (27.4 - 61.5)	32
District			
Malabo	53.7 (47.2 - 60.2)	53.4 (46.7 - 59.8)	238
Luba	53.3 (32.2 - 73.3)	53.3 (32.2 - 73.6)	15
Baney	44.6 (28.8 - 61.8)	44.7 (28.8 - 61.6)	47
Riaba	50.0 (22.9 - 77.1)	50.0 (22.9 - 77.1)	8
Wealth Quintiles			
Lowest	56.0 (41.9 - 69.1)	54.0 (39.4 - 67.3)	50
Second	61.4 (47.2 - 73.9)	61.4 (47.2 - 73.9)	57
Middle	61.7 (49.3 - 72.8)	61.7 (49.3 - 72.8)	68
Fourth	51.4 (38.6 - 64.1)	51.4 (38.6 - 64.1)	68
Highest	32.3 (22.1 - 44.5)	32.3 (22.1 - 44.5)	65
Total	52.3 (46.4 - 58.0)	51.9 (46.0 - 57.7)	308

Results are presented as Percentage (95% CI)

When looking at the last three years (2015 – 2018), the trend of ITN use amongst children, pregnant women, and in the general population, had a U-shape (highest in 2015 and in 2018) (Figure 3.5). It could be inferred that mosquito nets are being used by the population more frequently, immediately after mass distribution campaigns; however, the frequency may decrease with time.

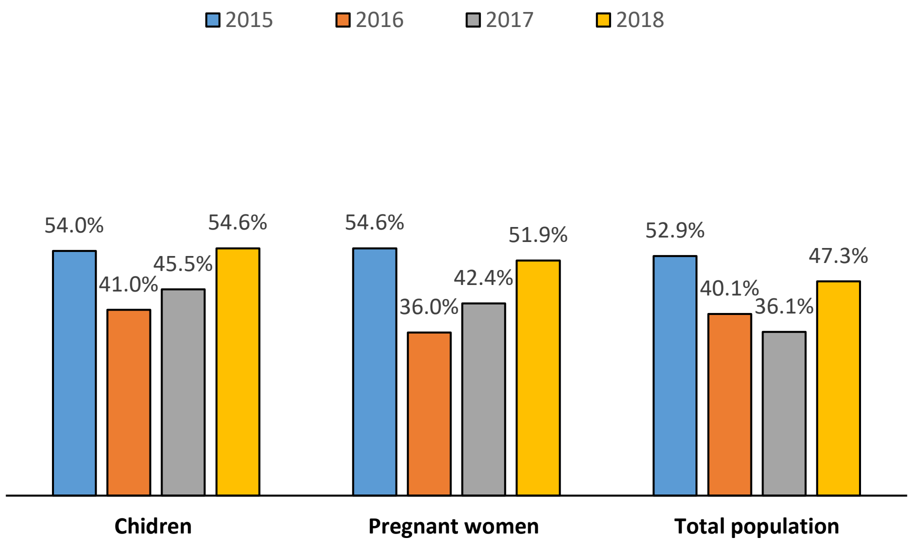


Figure 3.4 Trend in ITN use, MIS Bioko 2015-2018

3.3. Prevention in pregnancy

WHO recommends that each pregnant woman living in areas with moderate to high transmission of malaria in Africa should receive at least 3 doses of Sulfadoxine-Pyrimethamine (SP)/Fansidar, starting as earlier as possible in the second trimester, and with a one-month period interval between doses **[24]**.

Table 3.14 shows ANC attendance and IPTp amongst women who were pregnant within the last 2 years and who gave birth to a live baby. ANC clinics' attendance were optimal (96.7%) and were higher in Malabo while comparable in Luba, Riaba, and Baney. There was no significant difference in ANC clinics' attendance amongst age groups. However, ANC clinics' attendance increased with household wealth index. Thirty-six percent of the women were reported to have taken at least 3 doses of SP; and this was not different across age groups. Consuming at least 3 doses of SP during pregnancy was higher in Luba, followed by Baney, and lower in Riaba and Malabo.

Table 3.14 Prenatal care and IPT in pregnancy

Percentage of available women age 15-49 who had a live birth in the 2 years preceding the survey who, during the pregnancy that resulted in the last live birth, attended Antenatal Care (ANC) clinics, and received three or more doses of SP[1]/Fansidar, according to background characteristics

Background characteristics	Attended prenatal care	Took at least 3 doses of Fansidar (SP)	Total available
Age in Years			
<25	95.8 (93.5 - 97.5)	37.7 (32.9 - 42.7)	374
25 to 34	97.4 (95.3 - 98.6)	36.2 (31.9 - 40.7)	473
≥35	95.8 (90.4 - 98.2)	35.8 (27.5 - 45.2)	120
District			
Malabo	97.3 (95.7 - 98.2)	32.9 (29.6 - 36.6)	752
Luba	94.5 (86.5 - 99.2)	59.7 (43.6 - 73.8)	57
Baney	94.2 (87.3 - 97.4)	49.2 (40.4 - 57.9)	120
Riaba	94.7 (82.5 - 98.5)	36.8 (23.5 - 52.6)	38
Wealth Quintiles			
Lowest	93.3 (85.3 - 97.1)	36.2 (27.4 - 46.0)	105
Second	95.1 (91.4 - 97.4)	32.9 (26.2 - 40.5)	185
Middle	96.5 (92.7 - 98.4)	37.6 (31.3 - 44.3)	234
Fourth	97.2 (94.0 - 98.7)	36.6 (30.2 - 43.5)	216
Highest	99.1 (96.5 -100)	39.2 (32.9 - 45.9)	227
Total	96.7 (95.3 - 97.6)	36.7 (33.4 - 40.1)	967

[1]SP: Sulfadoxine-Pyrimethamine.
Results are presented as Percentage (95% CI)

Figure 3.5 shows that the majority of the women attended ANC in government facilities, while a non-negligible percentage of them attended private clinics.

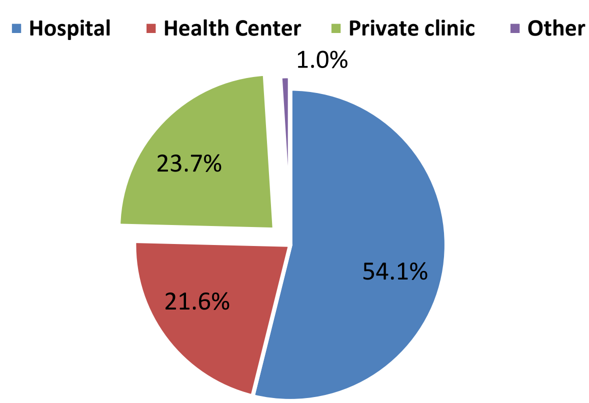


Figure 3.5 Places where women attended ANC visits

CHAPTER 4.   MALARIA CASE MANAGEMENT

4.1. Fever management in children

4.1.1. Prevalence, diagnosis and prompt treatment of fever in children

Table 4.1 shows fever management in children age below 5 years by selected background characteristics. Prevalence of fever among children was 5.9% and was higher in Riaba (10.9%) and Baney (9.6%) compared to Malabo and Luba. The highest proportion of fever was observed in children age 12 to 23 months. Out of the total 178 children with fever, care was sought for 66.9% and this was highest in Riaba and Baney compared to the other districts. Overall, 41 children were treated with antimalarials of which 31.7% took ACTs.

Table 4.1 Prevalence, diagnosis, and prompt treatment of children with fever

Percentage of children age below 5 with fever in the 2 weeks preceding the survey, Percentage for whom treatment was sought, Percentage who had blood taken from the finger, vain or heal for testing, and the percentage who received ACTs; by background characteristics

Background Characteristics	Children below 5		Children below 5 with fever		Children for whom care was sought		Children who took antimalarial treatment	
	Fever Prevalence	Total	Care sought	Total	Blood drawn	Total	Took ACT[1]	Total
Age in months								
<12	5.0 (3.6 - 7.0)	638	71.9	32	65.2	23	0.0	3
12 to 23	9.2 (6.9 - 12.0)	566	71.2	52	70.3	37	15.4	13
24 to 35	6.4 (4.7 - 8.6)	580	59.5	37	63.4	22	22.2	9
36 to 47	4.8 (3.4 - 6.7)	605	65.2	29	57.8	19	50.0	8
48 to 59	4.6 (3.1 - 6.9)	605	64.3	28	66.6	18	62.5	8
Gender								
Male	6.6 (5.3 - 8.1)	1,503	69.7	99	63.8	69	44.0	25
Female	5.3 (4.2 - 6.7)	1,491	63.3	79	68.0	50	12.5	16
Level of education of the household head								
None	5.1 (1.2 - 19.1)	39	100.0	2	0.0	2	0.0	1
Primary	3.6 (1.9 - 6.7)	281	90.0	10	77.8	9	33.3	3
Secondary	7.5 (5.9 - 9.5)	1,169	62.5	88	63.4	55	15.7	19
Post-secondary	5.4 (3.9 - 7.5)	759	73.2	41	73.3	30	57.1	14
Unknown	4.9 (3.5 - 6.9)	746	62.2	37	60.8	23	25.0	4
District								
Malabo	5.3 (4.3 - 6.5)	2,282	65.3	121	64.5	79	28.6	28
Luba	3.7 (2.0 - 6.6)	216	50.0	8	0.0	4	100.0	1
Baney	9.6 (7.0 - 12.9)	386	72.9	37	74.1	27	27.2	11
Riaba	10.9 (5.3 - 21.2)	110	75.0	12	33.3	9	100.0	1
Wealth Quintiles								
Lowest	7.2 (4.2 - 12.2)	304	63.6	22	42.8	14	33.3	3
Second	6.2 (4.2 - 9.1)	516	62.5	32	65.0	20	30.0	10
Middle	5.6 (4.0 - 7.8)	658	51.3	37	57.8	19	50.0	2
Fourth	5.5 (3.9 - 7.6)	723	62.5	40	56.0	25	0.0	8
Highest	5.9 (4.4 - 7.9)	793	87.2	47	82.9	41	44.4	18
Total	**5.9 (5.1 - 7.0)**	**2,994**	**66.9**	**178**	**65.6**	**119**	**31.7**	**41**

[1]ACT: Artesunate-Amodiaquine; Arthemeter-Lumefantrine

4.1.2. Treatment seeking locations

Table 4.2 describes the places where care was sought for children below 5 years with fever 2 weeks before the interview. Care was sought in public hospitals for 43%, in public health centers for 7.5%, in private clinics for 29%, and in pharmacies for 10.9% of the children. Care seeking behaviors varied with wealth index of the household and with the level of education of the head of the household. Seeking care in hospitals was lowest in Malabo, while private clinics attendance was highest.

Table 4.2 Places where care was sought for children with fever
Percent distribution of treatment locations for children below 5 having fever within 2 weeks preceding the interview

Background characteristics	House	Hospital	Health center	Private clinic	Family practitioner	Birth attendant	Pharmacy	Other	Number
Age in months									
<12	4..3	60.8	8.7	21.7	0.0	4.3	0.0	0.0	23
12 to 23	2.7	43.2	8.1	29.7	2.7	0.0	10.8	2.7	37
24 to 35	4.5	36.4	9.1	27.3	0.0	0.0	22.7	0.0	22
36 to 47	5.3	42.1	10.5	31.6	0.0	5.3	5.3	0.0	19
48 to 59	11.1	33.3	0.0	38.9	0.0	0.0	16.7	0.0	18
Level of education of the Household head									
None	0.0	50.0	0.0	0.0	0.0	0.0	50.0	0.0	2
Primary	0.0	22.2	11.1	44.4	0.0	0.0	22.2	0.0	9
Secondary	5.4	40.0	10.9	32.7	0.0	1.8	7.3	1.8	55
Post-secondary	3.3	60.0	0.0	30.0	0.0	0.0	6.7	0.0	30
Unknown	8.7	39.1	8.7	17.4	4.3	4.3	17.4	0.0	23
District									
Malabo	3.8	34.2	7.6	36.7	1.3	1.3	13.9	1.3	79
Luba	0.0	75.0	0.0	25.0	0.0	0.0	0.0	0.0	4
Baney	3.7	59.3	11.1	18.5	0.0	0.0	7.4	0.0	27
Riaba	22.2	66.6	0.0	0.0	0.0	11.1	0.0	0.0	9
Wealth Quintiles									
Lowest	7.4	64.3	7.1	14.3	0.0	0.0	7.1	0.0	14
Second	0.0	45.0	10.0	35.0	0.0	0.0	10.0	0.0	20
Middle	21.1	42.1	0.0	10.5	0.0	5.3	21.1	0.0	19
Fourth	4.0	32.0	8.0	36.0	0.0	4.0	12.0	4.0	25
Highest	0.0	43.9	9.8	36.6	2.4	0.0	7.3	0.0	41
Total	**5.0**	**43.7**	**7.5**	**29.4**	**0.8**	**1.7**	**10.9**	**0.8**	**119**

Figure 4.1 shows the trend of the type of facilities where care is sought for children below age 5. Hospitals and health centers were categorized under public facilities, and the rest (house/home, private clinic, family practitioner, birth attendant, ad pharmacy) under private

facilities. Care seeking at public health facilities substantially decreased by almost 18% over time, from 69% (2015) to 51% (2018); while care seeking in private facilities increased from 30% (2015) to 48% (2018).

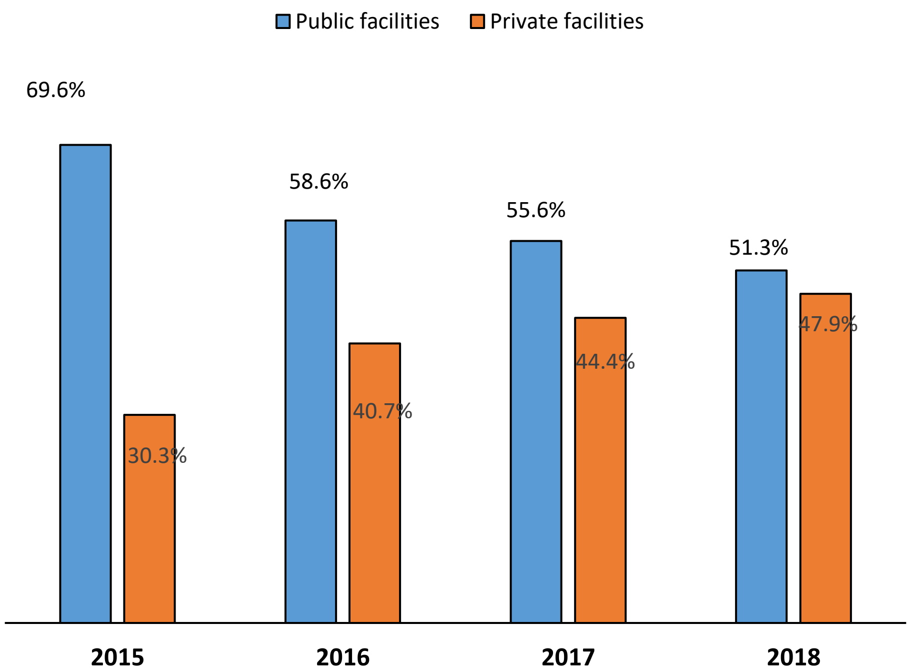


Figure 4.1 Trend in care seeking locations for children with fever

4.2. Malaria and anemia

Table 4.3 describes malaria prevalence and malaria prevalence by *P. falciparum*, in the general population. Malaria and *P. falciparum* prevalences were respectively 10.3% and 9.9%. malaria and *P. falciparum* prevalences were significantly higher in Malabo and Riaba compared to Luba and Baney. Malaria was significantly more prevalent in individuals age 10 to 19, compared to other age groups, with the lowest prevalence observed in individuals age above 50. However, prevalence remained comparable between wealth quintiles.

Table 4.3 Prevalence of malaria in the general population

Prevalence of Malaria, and Prevalence of Malaria caused by *Plasmodium Falciparum*, in the general population, according to background characteristics

Background characteristics	Prevalence of malaria	Prevalence of malaria by *P. falciparum*	Number tested
Age in years			
<10	9.6 (8.4 - 10.9)	9.3 (8.1 - 10.6)	4,597
10 to 19	15.9 (14.0 - 17.9)	15.6 (13.8 - 17.5)	3,052
20 to 29	9.2 (7.9 - 10.7)	9.1 (7.8 - 10.5)	2,353
30 to 39	8.3 (7.0 - 9.9)	7.9 (6.7 - 9.5)	1,827
40 to 49	8.0 (6.3 - 10.2)	7.8 (6.1 - 9.9)	808
50 +	5.3 (4.0 - 7.1)	4.9 (3.6 - 6.5)	1,215
Gender			
Male	10.9 (9.9 - 12.8)	10.6 (9.5 - 11.7)	6,389
Female	9.7 (8.7 - 10.8)	9.5 (8.4 - 10.6)	7,463
District			
Malabo	11.6 (10.6 - 12.7)	11.3 (10.2 - 12.4)	10,407
Luba	5.3 (3.3 - 8.9)	5.0 (3.2 - 7.8)	1,138
Baney	5.1 (3.5 - 7.3)	5.0 (3.5 - 7.2)	1,752
Riaba	12.1 (7.2 - 19.5)	11.9 (7.1 - 19.2)	555
Wealth Quintiles			
Lowest	10.2 (8.5 - 12.3)	9.9 (8.2 - 11.9)	1,787
Second	10.5 (8.8 - 12.6)	10.3 (8.6 - 12.3)	2,419
Middle	10.8 (9.4 - 12.6)	10.5 (9.1 - 12.2)	2,905
Fourth	10.7 (9.1 - 12.4)	10.3 (8.8 - 11.9)	3,255
Highest	9.2 (7.8 - 10.8)	9.0 (7.5 - 10.7)	3,486
Total	10.3 (9.3 - 11.3)	9.9 (9.0 - 10.9)	13,852¶

¶Invalid cases were removed from the denominator before calculating prevalence. Results are presented as percentage (95% CI)

Malaria and severe anemia in children below age 5 are presented in Table 4.4. Malaria and *P. falciparum* prevalences were 6.6% and 6.3% respectively; these were higher in Malabo and Riaba compared to Baney and Luba. Both malaria and *P. falciparum* prevalences increased linearly with the age of the children and decreased with increasing household wealth index. The prevalence of severe anemia amongst children below age 5 was 1.5%; this number decreased with both, increasing wealth status and age. The highest proportion of severe anemia was observed in the districts of Luba and Malabo.

Table 4.4 Prevalence of malaria and severe anemia in children

Percentage of children age below 5 months classified by Rapid Diagnostic Test as having malaria, and the percentage of children aged 6-59 months classified as having severe anemia, according to background characteristics

	Malaria in children aged less than 5 years			Anemia in children aged less than 5 years	
Background Characteristics	Prevalence of malaria	Prevalence of malaria by *P. falciparum*	Total tested	Prevalence of severe anemia	Total tested
Age in months					
<12	1.3 (0.5 - 3.0)	1.1 (0.5 - 2.4)	476	2.5 (1.4 - 4.5)	475
12 to 23	6.4 (4.4 - 9.2)	5.7 (3.9 - 8.6)	466	1.1 (0.4 - 2.6)	467
24 to 35	6.0 (4.3 - 8.5)	6.0 (4.3 - 8.5)	496	1.4 (0.7 - 2.9)	497
36 to 47	8.7 (6.5 - 11.6)	8.5 (6.4 - 11.4)	492	1.6 (0.8 - 3.4)	493
48 to 59	10.4 (7.8 - 13.6)	9.8 (7.3 - 12.9)	491	1.0 (0.4 - 2.4)	495
Sex					
Male	7.0 (5.5 - 8.8)	6.5 (5.1 - 8.4)	1,214	1.6 (1.1 - 2.5)	1,220
Female	6.2 (4.7 - 8.2)	5.9 (4.4 - 7.9)	1,207	1.4 (0.8 - 2.3)	1,207
District					
Malabo	7.7 (6.3 - 9.2)	7.3 (5.9 - 8.8)	1,843	1.6 (1.1 - 2.4)	1,844
Luba	2.8 (1.1 - 7.6)	2.8 (1.0 - 7.6)	177	2.8 (1.1 - 6.9)	180
Baney	2.3 (0.9 - 5.9)	2.3 (0.9 - 5.9)	299	0.7 (0.2 - 2.6)	300
Riaba	6.9 (2.9 - 15.6)	5.9 (1.9 - 16.1)	102	0.0	103
Wealth Quintiles					
Lowest	6.8 (4.1 - 11.1)	6.0 (3.5 - 10.0)	265	2.2 (1.0 - 4.8)	268
Second	6.7 (4.4 - 10.0)	6.7 (4.4 - 10.0)	420	1.4 (0.6 - 3.6)	420
Middle	7.3 (5.1 - 10.3)	6.7 (4.7 - 9.7)	549	1.3 (0.6 - 2.6)	550
Fourth	7.1 (5.0 - 9.9)	6.8 (4.8 - 9.5)	591	2.0 (1.1 - 3.8)	593
Highest	5.4 (3.4 - 8.3)	5.2 (3.3 - 8.1)	596	1.0 (0.5 - 2.2)	596
Total	6.6 (5.4 - 7.9)	6.3 (5.2 - 7.6)	2,421[¶]	1.5 (1.1 - 2.7)	2,427

[1]Severe anemia is defined as Hemoglobin level < 8g/dl.
[¶]Invalid cases were removed from the denominator before calculating prevalence.
Results are presented as percentage (95% CI)

Table 4.5 shows the proportion of RDT positive test results, and severe anemia amongst pregnant women, stratified by background characteristics. Overall, malaria caused by *P. falciparum* was 7.2% and was highest amongst pregnant women age 35 years and older. Similarly, to that observed in the general population, malaria amongst pregnant women was more prevalent in the districts of Malabo and Riaba compared to Luba and Baney. However, none of the 52 pregnant women living in the houses belonging to the highest wealth categories tested positive for malaria. The general prevalence of severe anemia was 3.2%; this number was higher in Riaba and Baney compared to what was found in the other districts. Again, women living in households belonging to the highest wealth category did not have severe anemia.

Table 4.5 Prevalence of Malaria and severe anemia in pregnant women

Prevalence of Malaria, Prevalence of Malaria caused by *Plasmodium Falciparum*, and Prevalence of severe Anemia in Pregnant Women age 15-49 years, according to background characteristics

Background characteristics	Prevalence of malaria	Prevalence of malaria by *P. falciparum*	Prevalence of severe anemia	Total tested
Age in Years				
< 25	6.4 (3.1 - 12.7)	6.4 (3.1 - 12.7)	3.7 (1.4 - 9.3)	109
25 to 34	4.3 (1.8 - 10.2)	4.3 (1.8 - 10.2)	2.6 (0.8 - 7.8)	115
≥ 35	24.0 (10.0 - 47.2)	24.0 (10.0 - 47.2)	4.0 (0.5 - 24.1)	25
District				
Malabo	8.2 (5.0 - 13.2)	8.2 (5.0 - 13.2)	2.6 (1.1 - 5.80	194
Luba	0.0	0.0	0.0	10
Baney	2.7 (0.4 - 17.7)	2.7 (0.4 - 17.7)	5.4 (0.7 - 3.1)	37
Riaba	12.5 (1.5 - 57.1)	12.5 (1.5 - 57.1)	12.5 (1.5 - 57.1)	8
Wealth Quintiles				
Lowest	13.6 (3.2 - 27.3)	13.6 (3.2 - 27.3)	4.5 (1.1 - 16.8)	44
Second	8.3 (3.1 - 20.6)	8.3 (3.1 - 20.6)	2.1 (0.3 - 13.2)	48
Middle	5.2 (1.2 - 19.8)	5.2 (1.2 - 19.8)	3.4 (0.9 - 12.8)	58
Fourth	10.6 (4.4 - 23.5)	10.6 (4.4 - 23.5)	6.4 (2.1 - 17.9)	47
Highest	0.0	0.0	0.0	52
Total	7.2 (4.5 - 11.4)	7.2 (4.5 - 11.4)	3.2 (1.5 - 6.7)	249

[1]Severe anemia is defined as Hemoglobin level < 8g/dl. Results are presented as Percentage (95% CI)

Figure 4.2 shows the trend of malaria positivity between 2015 and 2018 (Data by districts). Despite dropping significantly between 2015 and 2016, the general prevalence of malaria in 2018 was not different from that in 2017. Malaria positivity appeared to have increased in Malabo and Riaba, and decreased in Luba and Baney, despite the lack of statistical evidence to support the change.

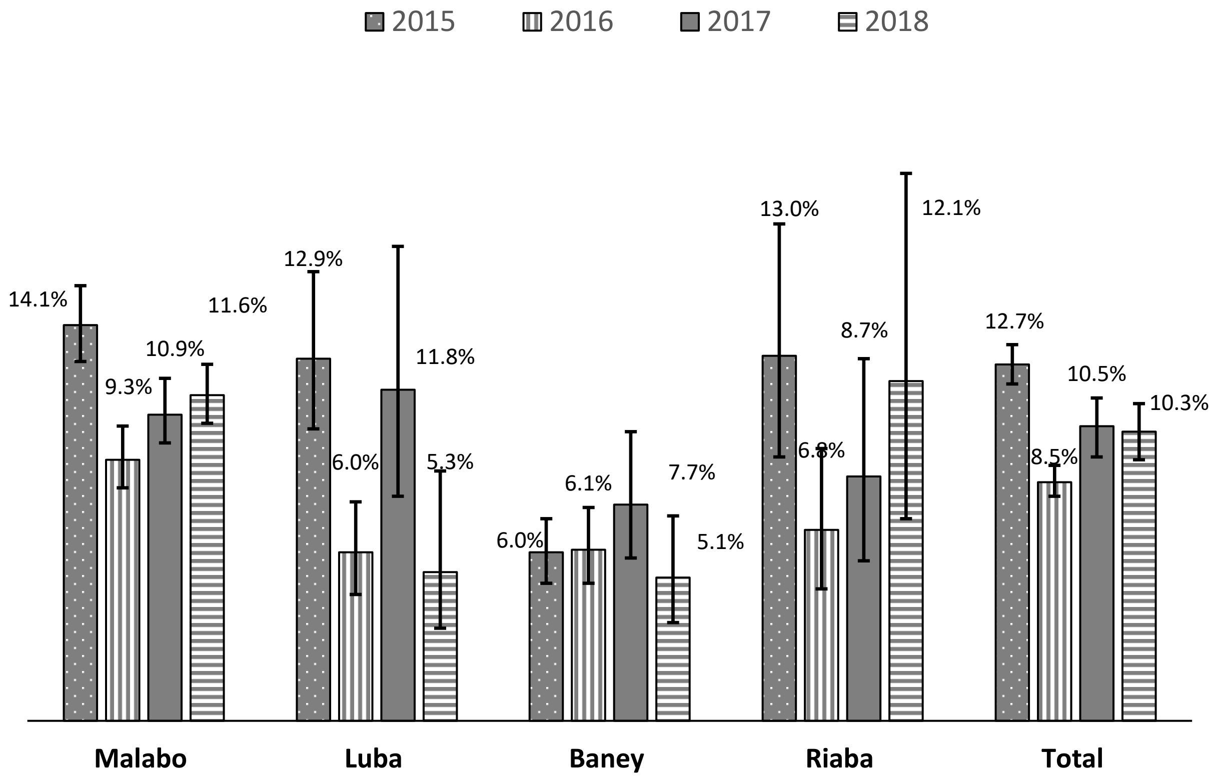


Figure 4.2 Trend of malaria positivity, by districts

Figure 4.3 shows that malaria positivity in both pregnant women and children age less than 5, did not change significantly over time.

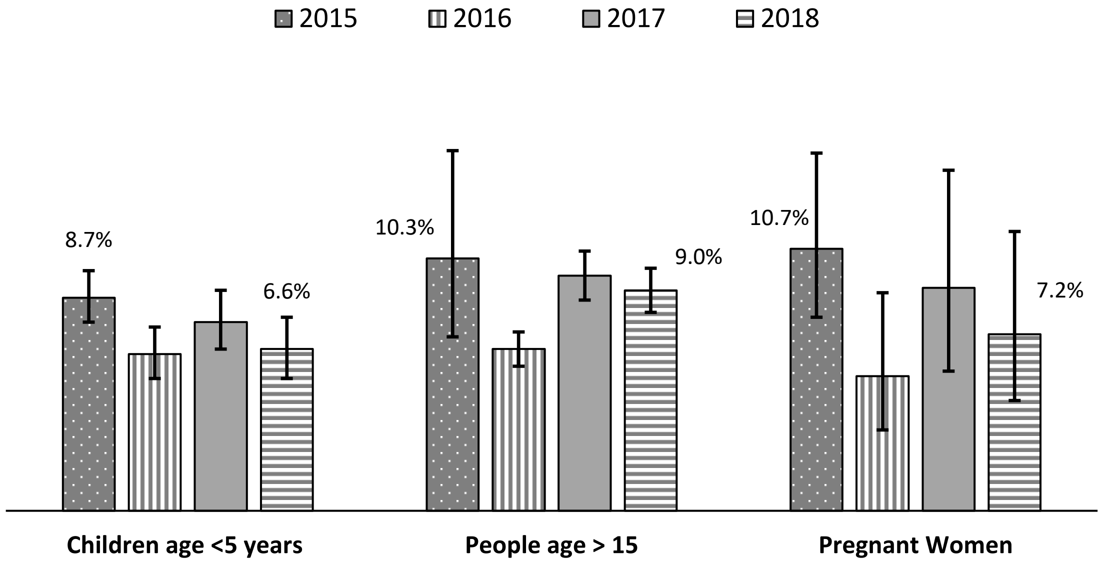


Figure 4.3 Trend of malaria positivity by pregnancy and age group

Plasmodium falciparum positivity trend amongst children age 2 to 14 years since the inception of the BIMCP is shown in Figure 4.4. Malaria positivity by *P. falciparum* decreased in historical sentinel sites to the lowest point in 2016, and since then has been plateauing, and the same observation was made in the whole island between 2015 and 2018.

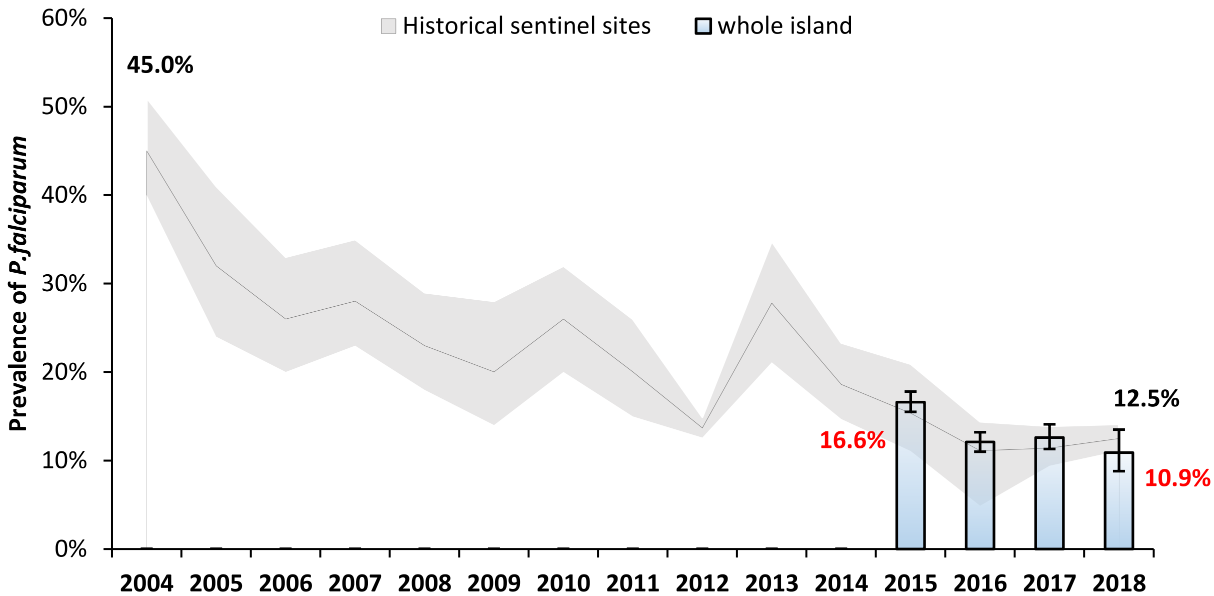


Figure 4.4 Trend of *P. falciparum* positivity, in children age 2 to 14 years

4.3. Fertility Rates and All-cause mortality in children

Fertility rates and child mortality are two important demographic indicators. Despite the controversy in the literature around the causal relationship between child mortality and fertility, there are some evidences of a secular relationship between the two **[25,26]**. It had been suggested that the continuing high rates of infant and child mortality are significant barriers to fertility decline in Sub-Saharan Africa (SSA), and inversely, reductions in fertility contribute to falls in infant mortality by enabling parents to devote more time and resources to their children **[27]**. The demographic transition (reduction in child mortality and fertility) in SSA has been relatively slow compared to the developed world since the mid-90s, and this region still has the highest fertility in the world with an average of 5.4 children/woman **[27]** and the highest child mortality **[28]**. In spite of EG's fast economic growth over the past decades, its Total Fertility Rate (TFR) has not changed significantly between 1983 (6 children/woman) and 2010 (5.1 children/woman) **[29]**.

Under 5 Mortality remains a public health issue in SSA, as together with Asia it accounts for about 80% of the global child and young adult deaths. Despite a global decrease in child mortality, SSA still continues to witness the highest Under-5 Mortality Rates (U5MR) in the

World, with about 76 deaths/1000 live births in 2017 **[28]**. This region also has the highest burden of preventable infectious diseases, including pneumonia, diarrhea, and malaria amongst others, to which have been attributed most of the childhood deaths **[30]**. Despite the Sustainable Development Goal (SDG) 3 objective to reduce neonatal mortality to at least as low as 12 deaths per 1,000 live births and U5MR to at least as low as 25 deaths per 1,000 live births, it has been shown that SSA countries are unlikely to achieve the objective by 2030 **[31]**. However there are increasing evidence on the impact of increasing malaria interventions scale-up in reducing all-cause U5MR **[32–35]**; and in 2009, Kleinschmidt and collaborators reported a marked increase in child survival on the island of Bioko after four years of intensive malaria control **[36]**. Thus, the success of a proper malaria intervention program in an endemic country like EG could contribute to further reducing all-cause infant and under 5 mortalities.

4.3.1. Age-specific and total fertility rates in women at childbearing age

Age Specific Fertility rate (ASFR) measures the annual number of births to women of a specified age or age group per 1,000 women in that age group; while Total Fertility Rate (TFR) is the mean number of children a woman would have by age 50 if she survived to age 50 and was subject, throughout her life, to the age-specific fertility rates observed in a given year **[37]**. Both ASFR and TFR in women at childbearing age (15 – 49 years) were estimated from live births historic data, using the *tfr2* Stata software module; originally designed to be used primarily with the Demographic Health Survey (DHS) data. Technically, the *tfr2* command transforms birth historic data into a table of births and exposure; and uses Poisson regression to compute fertility rates, fertility trends, and fertility differentials from the table of births and exposure **[38]**.

The 2018 MIS data reported a total of 2,558 women of childbearing age who have had a live birth and took part in the interview. However, there were also 1,433 women who did not give birth to a live child or could not carry the pregnancy to term. The ASFR (Figure 4.5) and the TFR were estimated for 3,991 cases (women at childbearing age), during the 1-year period preceding the survey (August 2017 – July 2018). The central date was January 2018, the number of events (live births) was 531, and the number of person-years was 3,933.

The ASFR was highest amongst the 25 to 29 years old group (213 births/1000 women at that age) and was minimal in the 44 to 49 years old group. The TFR was estimated to 3.8 children per woman; it was calculated as the sum of all the ASFR, divided by 7 (seven age groups of 5 from 15 to 49 years). This figure corroborates the value of 3.9 that was reported in 2017 in EG **[1]**. The Mean Age at Childbearing (MAC), defined as: *the mean age of mothers at the birth of their children if women were subject throughout their lives to the age-specific fertility rates observed in a given year*, was estimated to be 32 years.

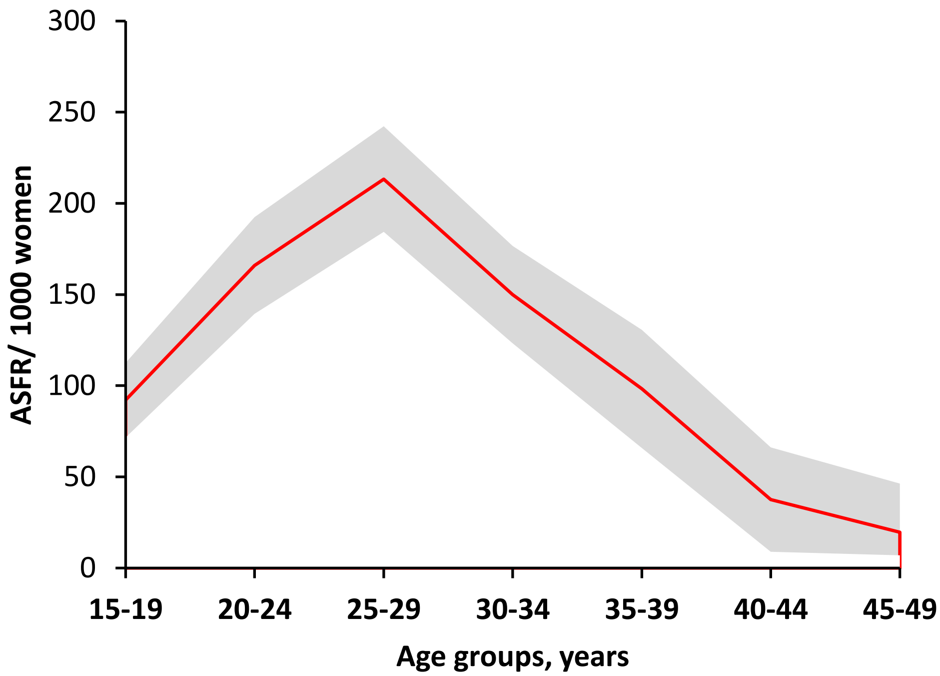


Figure 4.5 1-year (2017 to 2018) Age-Specific Fertility Rates

4.3.2. Infant and Under 5 Mortality rates

All-cause U5MR and Infant Mortality Rate (IMR) were estimated from the live birth history of all women age 15 to 49 years, using life tables, and results are shown in Table 4.6. Overall IMR was 35.1 per 1000 live birth and U5MR was 57.4 per 1000 live births. The probability of a child dying before his/her 5th Birthday was higher for the males than for female. Even though non-significant, lower socio-economic status was associated to a higher U5MR. Semi-rural and rural areas such as Luba and Riaba had higher U5MR when compared to semi urban and urban areas like Baney and Malabo.

Table 4.6 Infant and Under-5 mortality rates, MIS Bioko 2018

Probability of dying before the age of 1 year, and the probability of dying before the age of 5, per 1000 live births in the past 5 years (2014-2018) preceding the survey, according to background characteristics

Background characteristics	Total at risk at the beginning of the period	Died	IMR/1000 live births	U5MR/1000 live births
Child's gender				
Male	1,239	51	37.6 (28.0 - 50.4)	73.1 (40.1 - 131.4)
Female	1,200	44	32.4 (23.5 - 44.7)	44.0 (32.5 - 59.4)
District				
Malabo	1,880	72	34.6 (26.9 - 44.3)	57.0 (35.6 - 90.7)
Luba	149	6	29.1 (11.0 - 78.5)	77.1 (27.7 - 204.9)
Baney	310	11	38.4 (21.4 - 68.4)	38.4 (21.4 - 68.4)
Riaba	100	6	43.6 (16.6 - 112.3)	90.3 (37.9 - 206.9)
Wealth Quintiles				
Lowest	313	21	65.0 (41.9 - 100)	93.4 (54.3 - 158.3)
Second	474	20	31.9 (19.0 - 53.4)	53.6 (34.1 - 83.9)
Middle	568	25	42.7 (28.3 - 64.2)	86.4 (37.8 - 198.7)
Fourth	541	11	14.3 (6.8 - 29.7)	26.3 (14.5 - 47.7)
Highest	543	18	33.3 (20.9 - 53.1)	35.9 (22.7 - 56.4)
Total	2,439	95	35.1 (28.2 - 43.6)	57.4 (39.8 - 82.4)

Results are presented as percentage (95% CI)

CONCLUSION

The 2018 MIS was completed in 2-months (1st August - 30th September) by a team of 36 surveyors; who collected valid data for a total of 4,774 households, 20,012 individuals, 10,597 bed nets, and tested 13,852 people for malaria.

Exposure to malaria-related messages amongst respondents six months before the interview was 51%, with TV as the biggest source of media exposure. There is a need to exploit other methods to inform the population on malaria; and giving the wide access to cell phones, phone coverage, and the internet, text messages and social media should be considered. There is still a great amount of work to be done regarding malaria knowledge which is not optimal and deficient amongst males in general, populations living in Riaba, and people belonging to low socio-economic classes. Moreover, citing bed nets as a malaria preventive measure was highest in years during which mass bed nets distribution campaigns were conducted. The latter entails that knowledge decreases over time if not refreshed; hence, upgrading and customizing malaria messages to target specific groups and implementing constant community sensitization mechanisms should be explored.

Eighty-four percent of the households owned at least 1 ITN; 61% owned 1 ITN for every two persons, and 75% had either one ITN for every two persons or had received IRS in the past 12 months. Despite the high access to ITNs (74.6%), usage is still problematic as only 47% of the population was reported to have spent the night under an ITN. Similarly, to malaria knowledge, ITN use in both pregnant women, children younger than5 years old, and the general population was highest during years in which mass bed nets distribution campaigns were conducted, before dropping rapidly in subsequent years. There is a need to design qualitative studies with focus groups discussions at the community level to further investigate the reasons behind the low level of bed nets use; as this will inform and guide the development of strong sensitization methods to promote and encourage bed nets use.

Despite a very high level of ANC clinic attendance, amongst women who had live births in the past 2 years, optimal exposure (3 doses or more) to IPTp was found to be very low. It would be greatly advantageous, if the NMCP includes the maternal and child health program in the fight against malaria, to strengthen IPTp policy, and to improve use amongst pregnant women in Bioko. Another alternative to that would be to fully include the private sector in the efforts for malaria prevention in pregnancy, as a non-negligible proportion (23%) of women reported that they attended ANC in private health facilities.

Treatment seeking for children, younger than 5 years old presenting fever two weeks preceding the survey, over time has shifted from public health facilities to private facilities. Considering that free malaria diagnosis and treatment are available only in public health facilities in Bioko, people attending private health facilities might not benefit and might not be fully protected. Therefore, including the private sector in malaria case management activities might contribute to significantly reducing malaria on the island; especially with the anticipation of elimination.

Malaria prevalence in both the general population, pregnant women and in children younger than 5 years old was lower in Baney and Luba compared to the prevalence in Riaba and Malabo, but overall remained comparable each between 2015 and 2018. Similarly, the prevalence of *P. falciparum* amongst children ages 2-14 in historical sentinel sites remains stagnant since 2016. With the upcoming of the malaria pre-elimination phase, it is imperative to start considering the inclusion of alternative interventions on the present package. Options to be highly considered include the following suggestions: the implementation of malaria control activities on the mainland in EG to limit malaria reintroduction on the island, and the implementation of systematic malaria testing/treatment amongst travelers.

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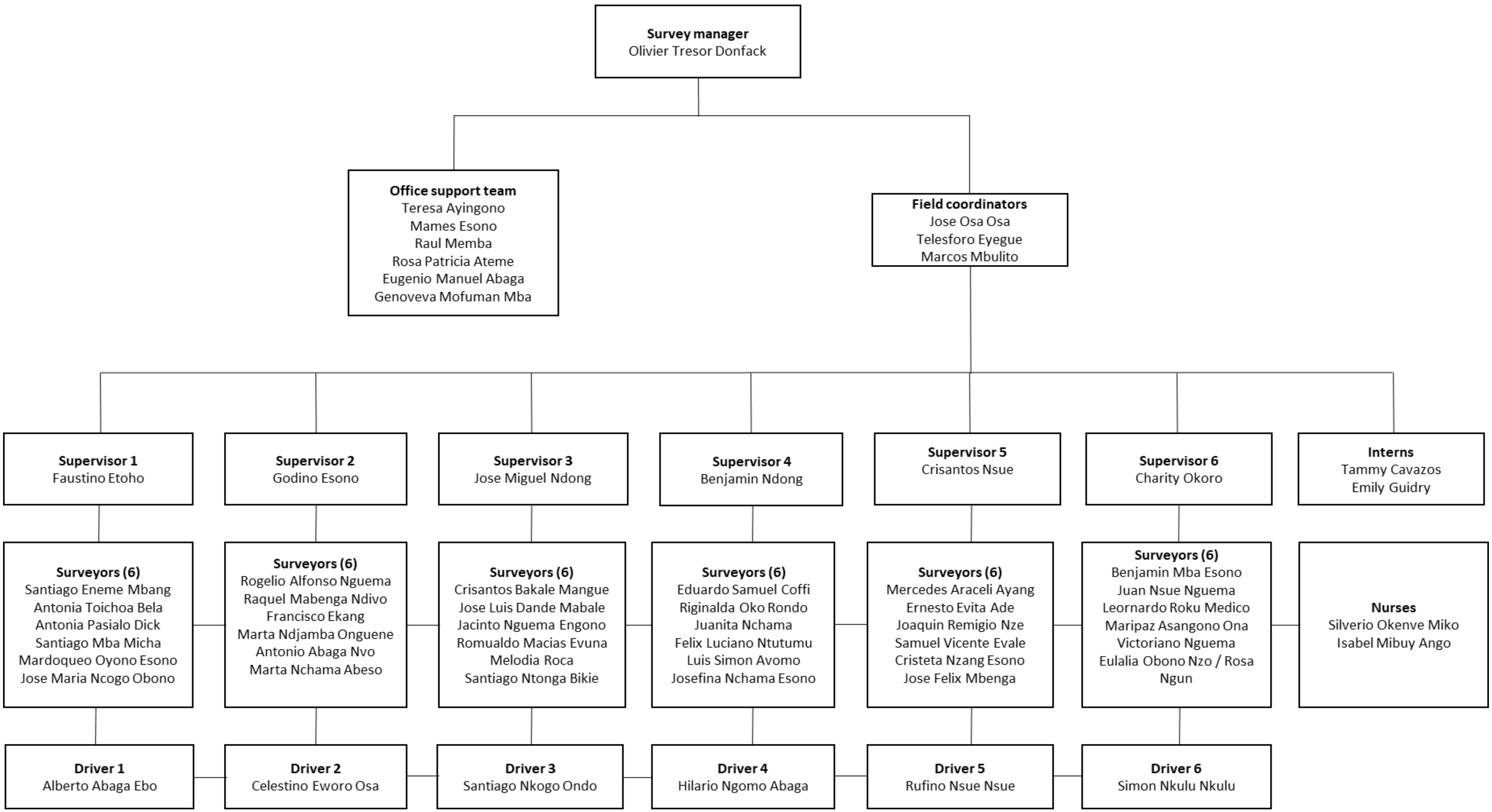
APPENDIX 1: SURVEY ORGANIGRAM AND STAFF



APPENDIX 2: INFORMATION SHEET AND CONSENT FORM

CONSENTIMIENTO INFORMADO DE PARTICIPACION EN LA ENCUESTA DE INDICADORES DE PALUDISMO EN GUINEA ECUATORIAL.

Introducción.
Buenos días. Mi nombre es ____________________. Trabajo para el Programa Nacional de Lucha Contra el Paludismo del Ministerio de Sanidad y estoy aquí para hacerle algunas preguntas y pruebas sencillas que permitan conocer los avances de la prevención y control del paludismo en Guinea Ecuatorial. Para recabar esta información, estamos visitando algunos hogares de su comunidad y de toda la Isla.

Propósito de la encuesta.
El propósito de la encuesta es saber si las actividades que se realizan en pro del control de paludismo en la Isla tienen los resultados que se esperan. Se necesita saber cuántas personas, tanto adultos como niños tienen paludismo, al igual que conocer los resultados de rociamiento y del uso de telas mosquiteras.

También, este año, realizamos algunas preguntas para determinar el estado socio-económico de la población en la Isla. El propósito de esta parte de la encuesta es saber si la distribución de actividades y tratamiento de paludismo es justa, y así ver si hay algunos grupos socio-económicos que posiblemente necesiten tener más servicios de salud.

Para esto necesitamos realizarle algunas preguntas sobre los miembros de su hogar, la vivienda, la enfermedad de los niños y de su familia, su conocimiento sobre paludismo y su de métodos de prevención como rociamiento y uso de telas mosquiteras. También es necesario realizar una prueba de sangre para saber si alguien en la vivienda tiene el parásito que causa la enfermedad, así como para detectar anemia. Asimismo, a las mujeres en edad reproductiva les haremos preguntas sobre salud reproductiva. Además, a algunas familias se le haran preguntas sobre costos asociados con el hogar.

Procedimientos
Si está de acuerdo en participar, además de realizar las preguntas sobre la familia, la vivienda etc., tomaremos una muestra de sangre a todos los niños que Ud. autorice y a todos los adultos que den su consentimiento. Para tomar la prueba de sangre usaremos una pequeña aguja con la que pincharemos el dedo, y tomarémos dos o tres gotas de sangre, las cuales son para determinar si las personas tienen paludismo mediante el uso de una prueba rápida de diagnóstico de paludismo (PDR). Esto también nos ayudara para la determinación el nivel de hemoglobina (que indica si la persona tiene anemia). También verificaremos si algunas de las personas que viven en este hogar tienen fiebre.

Los resultados de las pruebas le serán entregados al finalizar la entrevista. En caso de que el/la menor o algún adulto tenga paludismo, se le referirá al puesto de atención temporal con personal del Ministerio de Sanidad y Bienestar Social para que reciba tratamiento absolutamente gratuito.

El tratamiento a recibir es el mismo que se distribuye en los establecimientos de salud. Si alguna persona en su familia tiene anemia, le entregaremos una receta de referencia para que lleve a esta persona a un establecimiento de salud para que reciba más seguimiento y posibles tratamientos. Sin embargo, en caso de que tenga que ir al Centro de Salud para la anemia, le queremos informar de antemano que los tratamientos en ese establecimiento no son gratuitos.

Como un estudio adicional, las pruebas rápidas de diagnóstico de paludismo (PDR) serán guardadas y enviadas al laboratorio Clínico de Baney para ser examinadas con una tecnología que se llama Reacción en Cadena de la Polimerasa (PCR en siglas en Inglés). Esta es una prueba mucho más sensible y puede detectar parásitos en la sangre que posiblemente no sean detectables por las PDR. Estas pruebas serán realizadas en un futuro y el resultado del PCR no afectara los resultados de la prueba rápida. Por eso, los resultados individuales de esta prueba no serán compartidos con su familia. Puede dar su consentimiento para que realizamos esta prueba extra. Alternativamente, usted puede escoger participar en la encuesta sin dar el consentimiento para este estudio extra.

Beneficios

Su participación es muy importante no solo para su comunidad, sino que también para toda la isla, ya que los resultados de esta encuesta y pruebas resultarán en un mejor entendimiento del estado de paludismo en Bioko. Además, si participa en la encuesta, los miembros de su familia recibirán una prueba de paludismo y hemoglobina para verificar su estado de salud. Si los resultados indican que una persona tiene paludismo, usted va a recibir tratamiento gratuito de una enfermera del Ministerio de Sanidad y Bienestar Social.

Riesgos Potenciales

Las personas y/o niños a quienes se les hagan las prueba sentirán un pinchazo que dolerá un momento. Si la prueba indica que tiene paludismo, recibirá el tratamiento que recomienda el Ministerio de Sanidad y Bienestar Social. Se ha demostrado que estos medicamentos son seguros y eficaces, pero como cualquier medicamento puede causar efectos secundarios en un pequeño grupo de pacientes, la enfermera le explicará esto, en caso de que necesite tratamiento.

Voluntarios

Su participación en la encuesta es **completamente voluntaria**. **No está obligado a participar.** Si usted decide no participar en la encuesta, esto no afectará su atención o la de su familia en los centros de salud de su comunidad ni hoy ni en un futuro. Puede revocar su concentimiento en cualquier momento sin que afecte su atención o la de su familia.

Si decide participar, **sus respuestas a todas las preguntas y los resultados a todas las pruebas serán confidenciales** y no serán del conocimiento de nadie.

En caso de que tenga preguntas o requiera una aclaración respeto a la encuesta, por favor siéntase libre de preguntar al encuestador, la enfermera del puesto de atención provisional o los coordinadores del estudio **Teresa Ayingono Ondo** Tel: **222 079 697,** o **Marcos Mbulito Iyanga** Tel: **222 299 944.**

Sección de consentimiento
Este estudio me ha sido explicado, entiendo que mi participación es voluntaria. Estoy de acuerdo en tomar parte y que el (los) niños (s) a mi cuidado tome(n) parte.

☐ Estoy de acuerdo con el envío de las muestras de mi familia al laboratorio Clínico de Baney para realizar la PCR.

☐ No estoy acuerdo con el envío de las muestras de mi familia al laboratorio Clínico de Baney para realizar la PCR.

Nombre del participante: Teléfono: ___________________

____

Firma/Huella digital:

____

Relación con el/los niño(s) (si aplica): ________________________

Nombre de la persona que administro el consentimiento informado

____

Firma: ___________________________________ Fecha: ___________________
Para personas que no puedan firmar:
El consentimiento de arriba fue leído y la persona acepto participar.

Firma del testigo: ____________________________ Fecha: ________________

Nombre del testigo: ___________________ ______ Fecha: _________________

Otros adultos en casa:
Nombre y firma de cada adulto en la casa que da su conocimiento a realizar una prueba de paludismo:
Nombre: ____
☐ Estoy de acuerdo con el envío de mi muestra al laboratorio Clínico de Baney para realizar la PCR.

Firma/Huella digital: ___________________________________
Otros adultos en casa (en seguido):

Nombre: ____
☐ Estoy de acuerdo con el envío de mi muestra al laboratorio Clínico de Baney para realizar la PCR.

Firma/Huella digital: ___________________________________

Nombre: ____

☐ Estoy de acuerdo con el envío de mi muestra al laboratorio Clínico de Baney para realizar la PCR.

Firma/Huella digital: ___________________________________

Nombre: ____

☐ Estoy de acuerdo con el envío de mi muestra al laboratorio Clínico de Baney para realizar la PCR.

Firma/Huella digital: ___________________________________

Nombre: ____

☐ Estoy de acuerdo con el envío de mi muestra al laboratorio Clínico de Baney para realizar la PCR.

Firma/Huella digital: ___________________________________

Nombre: ____

☐ Estoy de acuerdo con el envío de mi muestra al laboratorio Clínico de Baney para realizar la PCR.

Firma/Huella digital: ___________________________________

Nombre: ____

☐ Estoy de acuerdo con el envío de mi muestra al laboratorio Clínico de Baney para realizar la PCR.

Firma/Huella digital: ___________________________________

Nombre: ____

☐ Estoy de acuerdo con el envío de mi muestra al laboratorio Clínico de Baney para realizar la PCR.

Firma/Huella digital: ___________________________________

The Bioko Island Malaria Control Project and the Equatorial Guinea Malaria Vaccine Initiative are being implemented under the auspices National Malaria Control Program of Equatorial Guinea within the Ministry of Health and Social Welfare and funded by a public-private partnership through the Government of Equatorial Guinea, Marathon Oil, Noble Energy, and Atlantic Methanol Production Company. Technical assistance for the management of the project is being provided by Medical Care Development International (MCDI). Technical support is also being provided by the London School of Hygiene and Tropical Medicine, Texas AgriLife at Texas A&M University, the Liverpool School of Tropical Medicine, Sanaria, Inc., and the Ifakara Health Institute, the Swiss Tropical and Public Health Institute, and the University of Southern Maine.

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