The prevalence and distribution of *Plasmodium species* among children at Malabo Regional Hospital on Bioko Island, Equatorial Guinea

Leonor Ada Okenve[1], Consuelo Ndong Avomo[2], Gninnousa Akadiri[1], Matilde Riloha Rivas[3], Ramona Mba[3], Mariluz Mangue[2] Godwin Fuseini[1], Wonder Philip Phiri[1], Carlos Cortes[1], Guillermo Garcia[1],

1. Medical Care Development International
2. Malabo Regional Hospital, Equatorial Guinea
3. National Malaria Control program

According to the World Health Organization (WHO), *Plasmodium falciparum* (Pf) infections account for about 99% of the total malaria cases in Africa. Thus antimalarial drugs and vaccines are mostly developed to target Pf infections. However, most malaria-endemic countries are increasingly recording mixed *Plasmodium* infections involving two or more of the species. Artemisinin-based combination therapies (ACTs), which are effective against blood stage infections, are recommended by WHO for the treatment of uncomplicated malaria caused by Pf. Relapses of Plasmodium vivax (Pv) and Plasmodium ovale (Po) blood stage can occur months after treatment of primary blood stage infections. Interactions of mixed *Plasmodium* species infections can influence the severity of the disease. Understanding the extent of mixed Plasmodium infections and species distribution on Bioko Island is important for the ongoing malaria vaccine trials in Equatorial Guinea. A total of 237 confirmed malaria cases were examined by microscopy to determine species-specific parasitemia and the prevalence of mixed infection at the Malabo Regional Hospital among children between one to 14 years old. Three species of *Plasmodium* were identified, *P. falciparum, P. malariae, and P. ovale*. Infections with P. *falciparum* alone accounted for 84.8% of the total cases, and that of *P. malariae* alone was 1.7%. Mixed infection of *P. falciparum* with *P. malariae* was 13.1%, while mixed infection of *P. malariae* with *P. ovale* accounted for 0.4%. Malaria vaccines and control strategies targeting only the dominant species could end up replacing the less dominant species. It is therefore important to establish the prevalence and the distribution of the different species of human Plasmodium parasites in control programs.

1726

The distribution of *Plasmodium* species among children in Malabo Regional Hospital, Equatorial Guinea

Leonor Ada Okenve Andeme[1], Godwin Fuseini[1], Consuelo Ndong Avomo[2], Gninoussa Akadiri[1], Matilde Riloha Rivas[2], Ramona Mba Andeme[2], Wonder Philip Phiri[1], Carlos Cortez Falla[1], Guillermo Garcia[1], Christopher Schwabe[1].

1. Medical Care Development International: 2. National Malaria Control Program, Equatorial Guinea

Leonor Ada Okenve Andeme email: laokenve@mcd.org

ABSTRACT

Background

Of the five known species of human malaria parasites, *Plasmodium falciparum (Pf)* infections accounts for about 99% of the total malaria cases in sub-Saharan Africa (WHO, 2017). Antimalarial drugs and vaccines are mostly developed to target *Pf* infections. However, most malaria-endemic countries are also recording mixed *Plasmodium* infections involving two or more of *Pf* species. Artemisinin-based combination therapies (ACTs) are an effective treatment against blood stage, uncomplicated *Pf* malaria (WHO, 2015). Unique to *Plasmodium vivax (Pv)* and *Plasmodium ovale (Po)* are infection relapses which can occur months after treatment of primary blood stage infections, hence effective treatment should target both blood-stage and liver-stage infections. Interactions of mixed *Plasmodium* species infections can influence the severity of the disease. The Equato-Guinean Malaria Vaccine Initiative (EGMVI) is conducting clinical vaccine trial on Bioko Island with the aim of evaluating the safety, tolerability, immunogenicity and the protective efficacy of the candidate anti-malarial vaccine. Understanding the distribution of *Plasmodium* infections on Bioko Island is not only important for the malaria vaccine initiative trial but for the elimination of malaria on the Island.

METHODS

Bioko Island

Bioko the largest island and home of the capital of Equatorial Guinea . The Bioko is located 32 km off the coast of Cameroon with a population of approximately 335,000 people. Malaria transmission occurs throughout the year.

Malaria Diagnosis

WHO recommends confirmation of all suspected malaria using microscopy or Rapid Diagnostic Test-RDT. The investigation was conducted at the Malabo regional hospital amongst children aged 1 to 14 years old. All positive cases detected by RDT were further examined by microscopy for species determination, as microscopy still considered as the “gold standard” for malaria diagnosis in endemic countries.

RESULTS

- A total of 237 confirmed malaria cases were examined by microscopy to determine species-specific parasitemia.
- Three species of *Plasmodium* were identified, *P. falciparum (Fig.1.), P. malariae (Fig.2.) and P. ovale (Fig.3.)*.
- Infections with *P. falciparum* only accounted for 84.8% of the total cases with *P. malariae* only 1.7% and *P. Ovale* only 0.4% (Fig. 4)
- Mixed infection of *P. falciparum* with *P. malariae* was 13.1%.
- *P. Vivax* and *P. knowlesis* were not detected

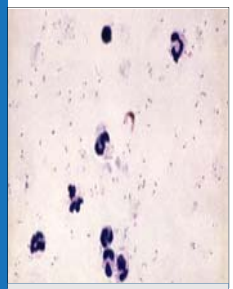

Fig. 1. P. falciparum

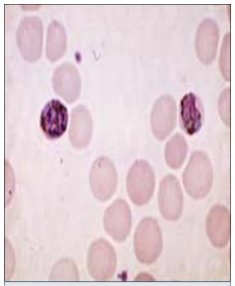

Fig.2. P. malariae

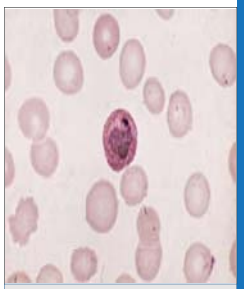

Fig.3. P. ovale

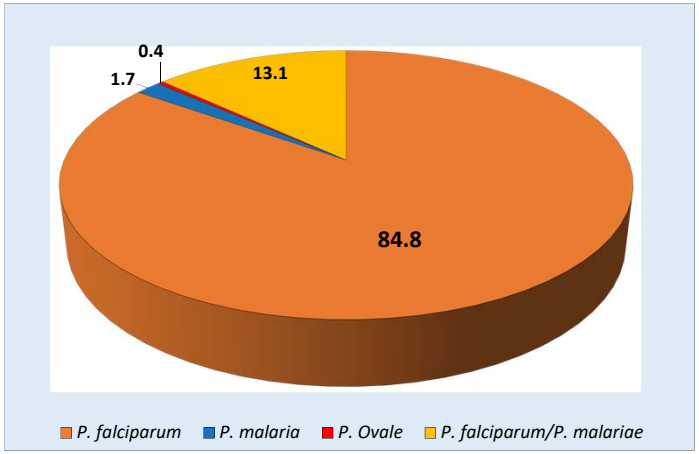

Fig 4. Distribution of *Plasmodium* species in children between 1-14 years on Bioko Island

DISCUSSION

- The EG National Malaria Treatment Guidelines recommends Artesunate + Amodiaquine as the first line treatment and Artemeter + Lumefantrine as second line treatment for uncomplicated malaria.
- The treatment options are not only recommended for treating of uncomplicated falciparum malaria but also for uncomplicated malaria caused by the other four species.
- However to prevent relapse in *P. vivax* and *P. ovale*, WHO recommends treatment with Primaquine for children and adults.
- Based on the results of this investigation, *P. ovale* (0.4%) was detected in this investigation and malaria diagnosis in the country should emphasize species differentiation for proper treatment.
- Roughly 13% of the infections involve coinfection of *P. falciparum* and *P. malariae*.

Further exploration is required on the following;

- What is the severity of malaria illness in children with mixed infections?
- What is treatment response of drugs and vaccines to mixed infections?
- How accurate are current routine laboratory techniques (RDTs and microscopy) in species-specific quantitative assessments?

REFERENCES

- WHO (World Health Organization) 2017. World Malaria Report. World Health Organization, Geneva, Switzerland.
- WHO (World Health Organization) 2015. Guidelines for the treatment of malaria. Third edition. World Health Organization, Geneva, Switzerland.

ACKNOWLEDGEMENTS

- Ministry of Health and Social Welfare , Equatorial Guinea,
- Bioko Island Malaria Control Project Team and MCDI
- The Funders: Marathon Oil Noble Energy, Atlantic Methanol, GEPetrol, Sonagas and the Government of Equatorial Guinea.