A RETROSPECTIVE SURVEY OF MALARIOMETRIC VARIABLES AND DRUG USAGE PATTERN:AN ASSESSMENT OF MALARIA EPIDEMIC IN ABRAKA, DELTA STATE, NIGERIA, 2013-2019

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ABSTRACT

Introduction: Despite concerted efforts to eliminate malaria, the disease, still pose the most severe public health problems worldwide, particularly in sub-Saharan Africa where Nigeria has the highest number of cases. Increasing incidence of malaria has been reported in the Northern, Southwestern, Southeastern and North Central parts of Nigeria in recent times, but information from the South-South region is scarcely available. Therefore, this study investigates the trends of malariometric variables; morbidity, mortality and drug use pattern in Abraka, South-South Nigeria, between 2013 and 2019.

Methods: Medical records of sixteen (16) (90%) health institutions in Abraka were reviewed after obtaining permission and a total of 188,945 clinical malaria cases documented from 2013 to 2019 were examined between January and March 2020. Data were then, analyzed using Microsoft Excel to generate graphs, while the Epi Info version 7 was used to evaluate Chi-square trends for significance.

Results: Data obtained indicated that malaria morbidity increased by 67% from 2013 to 2019 at rates of 180/1,000 population at risk in 2013 to 301 in 2019. The increase among males was 77% (95-168), while among the females was 58% (85-134). The average rates 142 vs 121 were, however, not significantly different ($p>0.05$). Morbidity among children (0-12 years), teenagers (13-19 years), young adults (20-49 years) and older adults (≥50 years), respectively, increased by 91% (110-210, average 182), 5% (40-42, average 43), 106% (18-37, average 27) and 0% (13-13, average 13). Children had the highest average rate, calculated to be significantly different ($p<0.05$). The average mortality rate/1,000 clinical cases was also highest ($p<0.05$) among children at 0.57 and then, 0.26, 0.03 and 0.00 for the rest age classes, accordingly. Drug use complied substantially with WHO's ACT recommendation for first line treatment of uncomplicated malaria in endemic areas. About 89% of regimen were ACT-based.

Conclusion: Malaria cases stably increased in Abraka from 2013 to 2019, in spite of the strong compliance to WHO treatment guidelines; indicating that the well-articulated National Malarial Strategic Plan 2014-2020, aimed at reducing malaria burden to pre-elimination levels and bringing malaria-related mortality to zero by 2020 was not successful in Abraka. Therefore, there is need for assessment of antimalarial drug quality and overhauling of the strategy for malaria elimination, so as to enable the National Malaria Elimination Programme (NMEP) achieve its goals and objectives.

Key words: Abraka, Malaria, Morbidity, Mortality, Elimination, Drug

INTRODUCTION

Malaria is a life threatening infection and it remains a major public health disease with alarming annual cases and worrisome mortality trends in particularly tropical and subtropical regions where the causative parasite can thrive and perpetuate the infection. In humans, malaria is caused by five (5) *Plasmodium* species *(P. falciparum, P. malariae, P. ovale, P. vivax* and *P. knowlesi)*[1]. Among these however, *P. falciparum* is the most common species known to be responsible for majority of malaria-related deaths in Africa[1]. The *Anopheles* mosquitoes; *An. gambiae, An. funestus, An. moucheti* and *An. arabiensis* are the major vectors that cause all year transmission[2]. In 2018 and 2019, WHO documented 231 million[3] and 228 million[1] cases of clinical malaria globally and Nigeria accounted for the highest proportion of cases in 2019 (25% or 57 million)[1]. Also, in Nigeria, malaria has been consistently ranked among the five causes of death in children[1]. The 2019 malaria prevalence for the world (57) and the WHO African Region (229) per 1,000 population at risk has been estimated[1], but similar information in Nigeria is herewith calculated to be 294 based on an estimated population of 200 million with 97% risk[1].

In Nigeria, malaria is responsible for 60% of outpatient hospital visits, about 11% maternal mortality and 30% death among children less than 5 years[4,5]. The debilitating infection hampered the nation's (Nigeria) economic productivity, leading to an estimated loss of 132 billion Naira (367 million USD), due to treatment costs, prevention/control measures and indirect costs[6,7]. Therefore, beginning from 2008, Nigeria started implementing the strategy of the National Malaria Elimination Programme, NMEP[8,9,10] aimed at reducing malaria burden to 50% by 2013 and then, to pre-elimination level by 2020.

However, current documentations in Kano, Northern Nigeria[3] and Imo State, Eastern Nigeria[11] indicate high prevalence of malaria, but no documented information from the Southern Nigeria, hence, this study was conducted in Abraka, a town in Delta State; located in Southern Nigeria. This investigation retrospectively assessed malariometric variables and drug use pattern in Abraka from 2013 to 2019, in order to determine the preponderance of malaria infection and response to drug regimes. This will aid in the robust assessment of the national programmes aimed at reducing malaria infection and

associated burden in Nigeria—the worst-hit country.

MATERIALS AND METHODS

Study Duration and Period

The study was conducted for about three (3) months from January to March, 2020 in Abraka.

Study Area

Abraka (Fig.1), the study area is one of the major Urhobo clan among the twenty-five (25) urhobo kingdoms in Delta State, Nigeria. Abraka has fourteen (14) community settlements (Abraka PO, Ekrejeta, Urhuoka, Umeghe, Obeje, Ajalomi, Urhuovie, Erho, Oria, Urhogbesa, Ughere, Oteri, Ugono-Abraka and Abraka inland [Otorho] — the traditional headquarters).

Abraka lies between latitudes 5° 45′ and 5° 50′ North of the Equator and longitudes 6° 06′ and 6° 15′ East of the Greenwich Meridian. The total land area of Abraka is about 168.4 square km [13] with an estimated population of 89,940 in 2012 [14] to a current projection of 116,850 based on annual growth rate of 3.8% [14] and density of 6,977/square km.

Temperature in Abraka varies minimally throughout the year. The warmest month is January (35.8°C) and coldest is August (23°C) with an annual average of 32°C[15]. However, it rains almost throughout the year (308.3 days) in Abraka with highest precipitation (wettest) in July (457.2mm) and lowest (driest) in January (25.4mm) with annual average of 1635mm[15]. The annual average relative humidity, wind speed and dew point are: 81.2%, 7.7 km/h and 23.4°C, respectively [16]. These weather conditions provide favourable environmental condition for breeding of *Anopheles* mosquito (*An. gambiae*)—the malarial parasite vector— in Abraka locality, putting inhabitants at high risk of

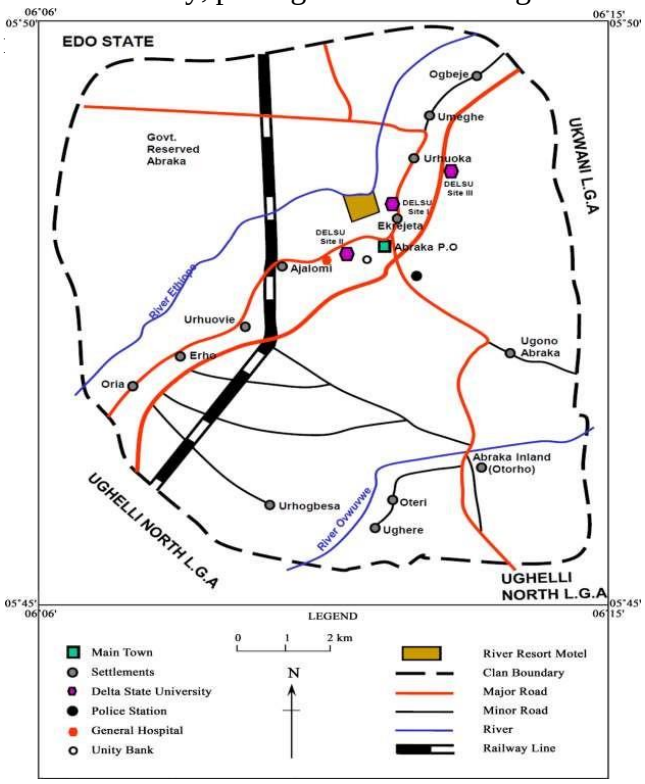

Figure 1: Map of Abraka[12] showing communities in study area

Malaria has been rated[1] as the 6th (101, 531 or 5.24% per annum) among the top 50 causes of death in Nigeria[1] and average life expectancy for Nigerians is 55.2 years with a global ranking of 178[1].

Abraka has only one general hospital, one primary healthcare centre and some private clinics. The location quotient (0.49) of these health facilities indicates disadvantage[17]. The accessibility indices of population to: hospital (43,170), doctor (15,237), nurses (3,012), bed space (1,062) and ambulance (129,511) were rated poor[17].

Data Collection and Analysis

The medical records of several health institutions in Abraka settlements were reviewed and 188,945 light microscopic diagnosed, clinical malaria cases, between 2013 and 2019 were counted and documented in terms of gender, age, deaths and drug treatment regimen. Sixteen (16) health institutions, representing about 90% of such institutions, gave verbal approval for the study, and so, malarial patients' medical records were accessed. The collected de-identified data were used to determine disease morbidity and mortality rates among age and gender strata for each year.

Data were analyzed using Microsoft Office Excel 2007 to generate graphs which were used to demonstrate the various trends in malaria morbidity and mortality over the study period (2013-2019). The Chi-square test for trends and *p*-values for test of significance at 5% probability (95% confidence) level were obtained by the Epi Info statistical package (version 7). The null (H_0) vs alternate (H_a) hypothesis were stated as: malaria epidemic trend, morbidity and mortality increased over time with age vs malaria epidemic trend, morbidity and mortality did not increase over time with age. The mean morbidity, mean mortality and their statistical significance for male and female patients were determined.

RESULTS

A total of 188,945 microscopically diagnosed clinical cases of malaria recorded from 2013 to 2019 in Abraka were reviewed between January and March, 2020. Overall, malaria morbidity per 1,000 population at risk, increased from 180 in 2013 to 301 in 2019 with an average of 263 (Fig. 2). The increase was significant (*p*-trend <0.05) over time, indicating upward trend in malaria cases in Abraka between 2013 and 2019, with peak in 2019, but little steep in 2018. Morbidity rate (malaria positive cases/total screens for malaria x 100) increased by 67% during the period (2013 to 2019) investigated and the test for trends was significant (*p*-trend <0.05).

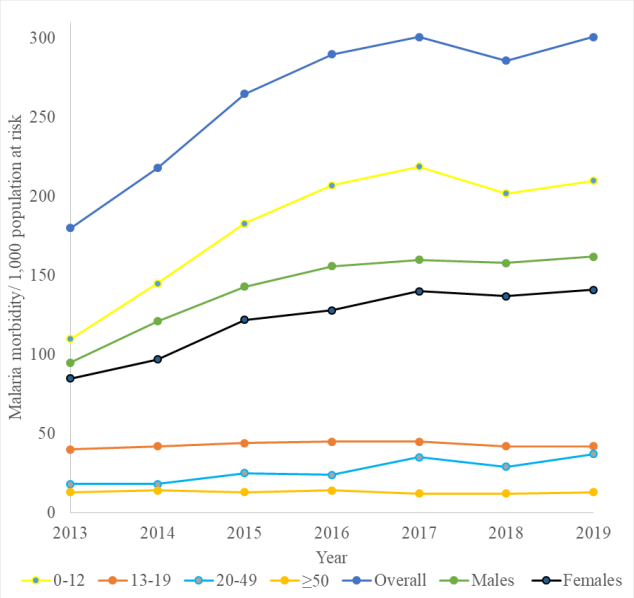

Figure 2: Malaria morbidity rates for gender and different age categories in Abraka between 2013 and 2019.

Increasing trends in malaria cases were also observed between gender (Fig. 2), infection rate was higher among males (9.5% in 2013 and 16.2% in 2019) than females (8.5% in 2013 and 14.1% in 2019). Average (2013-2019) morbidity rates per 1,000 population at risk were 142 (14.2%) for males and 121 (12.1%) for females. The increase in trends for both gender from 2013 to 2019 (males: 71%, females: 66%) were significant (p-trend <0.05), but the gender morbidity rates difference (142±26: males vs 121±23 females) over the 7-year period was not significant (p>0.05) when compared using Student's t-Test.

Among children (0-12 years), malaria morbidity increased sharply from 110/1,000 population at risk in 2013 to 210 in 2019, but the increases for the rest ages (teenagers: 13-19 years, young adults: 20-49 years and older adults: ≥50 years) were minimal and insignificant in trend (p-trend >0.05). However, the trend of the increase for the children were significant (p-trend <0.05) Fig. 2.

The overall morbidity rate decreased with advancing age with children (0-12 years) having the highest rate (182±40) which is significantly different from the other values (Fig.3). Among the children, females were more infected, although, not to a significant level (p-trend>0.05), but in other age groups, males had higher cases (Fig. 3).

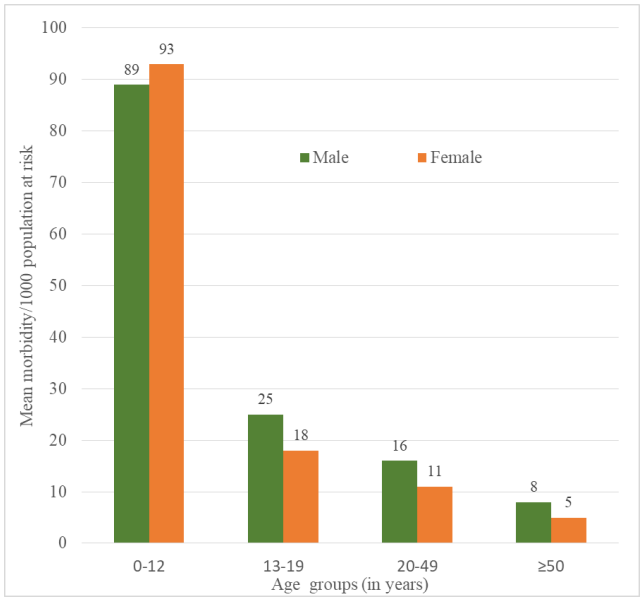

Figure 3: Seven-year mean malaria morbidity for gender and different age groups in Abraka, 2013-2019.

Mortality (death) rate per 1,000 clinical cases, significantly (p<0.05) decreased with age (0-12 years: 0.56±0.06, 13-19 years: 0.26±0.15, 20-49 years: 0.03±0.09 and ≥50 years: 0.00±0.00) with more deaths among females than males (Fig. 4). Children died most from the disease, but no such deaths among the adults.

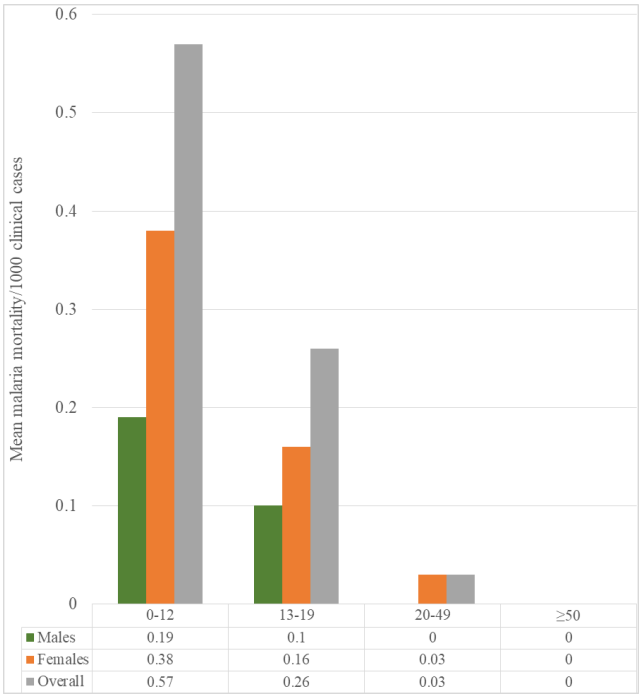

Figure 4: Age and gender differences in mean malarial mortality in Abraka over a seven-year period (2013-2019)

With regard to drug treatment regimens recommended for use, ACTs come highly recommended and so, most significantly used as first line drug (artemisinin-lumefantrine: 56.2%, arthemeter-lumefantrine: 32.4%) to treat patients with uncomplicated malaria (Fig. 5).

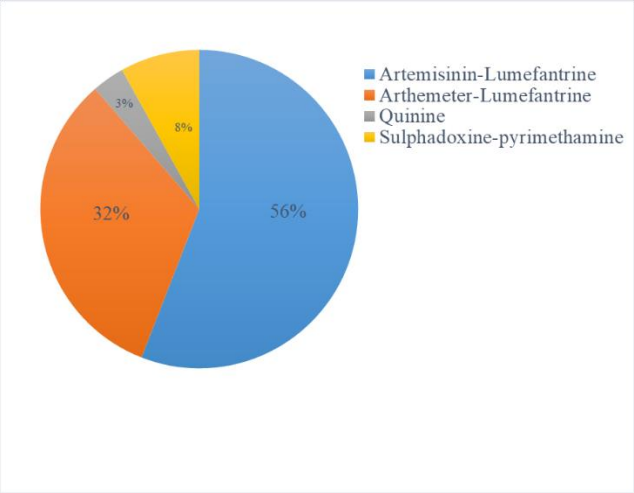

Figure 5: Antimalaria usage pattern in Abraka over a seven year combined period (2013-2019).

DISCUSSION

In Nigeria, the *Plasmodium* species implicated for malaria infection are *P. falciparum* (over 80%), *P. malariae* (up to 15%) and *P. ovale* (<5%)[21]. This agrees with the observation of this study. Although, not shown in the results, over 90% of the malarial cases were caused by *P. falciparum*.

In Nigeria, malaria significantly contributes to high morbidity and mortality. So, the disease accounts for 25% and 30% of infant and childhood mortality, respectively [18,19]. In recent times, increasing malaria cases have been reported in Kano[2], Imo[11] and Ondo[20] States of Nigeria

In Abraka, Delta State, this present study also shows that malaria cases steadily increased over the 7-year (2103-2019) reviewed period with morbidity and mortality (5.7%) rates highest among children (0-12 years). Although, these rates are lower than the average values (morbidity: 16%, mortality 12%) currently estimated for Nigeria[1], the increasing trend of cases, is however, worrisome. This study, thus, revealed that malaria cases and associated deaths were highest among children, and this observation agreed with the findings in Abuja[21] and Awka[22], Nigeria with prevalence rates of 64% and 59.6%, respectively.

In sub-Saharan Africa, malaria is the leading cause of under-five mortality, and also responsible for 10% of the region's overall disease burden; accounting for 40% of public health expenditure, 30-50% of in-patient admissions and close to 50% of outpatient visits[18]. In Nigeria, malaria accounts for 60% of out-patient visits to health facilities, 30% of childhood mortality, 25% of deaths among infants (<1 year), major cause of school absenteeism and low productivity[4]. The recognition of malaria morbidity and mortality with associated burden led to formation of Roll Back Malaria Initiative in 1998, which was consolidated during the Abuja Declaration in April, 2000, where African leaders decided to halve the burden of malaria and associated deaths

by 2010 via evidence-based and cost-effective interventions[23]. In line with the planned interventions, the National Malaria Strategic Plan, NMSP (2014-2020) proposal by the National Malarial Eradication Programme, NMEP, aimed to reduce malaria burden to pre-elimination levels and bring malaria-related mortality to zero by 2020, through four strategies. The first is universal coverage (one net per person in a household) in long-lasting insecticide treated nets, LLITNs distribution, while ensuring that 80% of vulnerable groups (under-five children and pregnant women) have access to and sleep under insecticide treated nets (ITNs)[23,24]. With the attainment of required coverage and proper use, ITN has been demonstrated to be the most cost-effective[25], and capable of reducing malaria transmission by at least 60% and child mortality by 20%[26,27]. However, the once-ever distributed ITN in Abraka, Delta State in 2018 was haphazard with lots of households not being covered. Also, elsewhere in Delta State (Abavo community), study revealed that, despite the high level of awareness about ITN, its ownership and utilization were very low[28]. Another study, still observed that in Nigeria, ownership of ITN was 10.1% and under-five utilization was 1.7%[27]. The high morbidity and mortality rates in this study suggest that many people especially pregnant women and children did not have access to the ITNs due to factors like low publicity; lack of educating people about the inherent dangers of not using mosquito nets, financial constraints on the part of parents; attributed to low or no income jobs, in order to access medical services, also, proximity (location index) to heath care facilities.

The second strategy involves indoor residual spraying, IRS. The NMSP 2014-2020 proposed a scale-up of IRS to cover about 40% of areas with high malaria endemicity. Notwithstanding, IRS is at the moment, only carried out in few LGAs in certain states with local funds, and in any case, Ezeigwe[29] reported for Lagos State (Ikorodu, Kosofe and Badagry). However, in March 2014 and November/December 2016, the Government of Nigeria in conjunction with Public Private Partnership implemented IRS using alphacypermethrin in selected LGAs in six States: Nasarawa, Bauchi, Jigawa, Lagos, Rivers, and Anambra, but most states could not continue IRS exercises due to limited domestic resources and lack of continuity in government policies. Sequel to the cost and limited investment by government, partners unanimously decided not to encourage the government to prioritize IRS. The U.S President's Malaria Initiative, PMI, only supported a two-year (2011-2013) IRS demonstration programme in Nasarawa State, and

since then, PMI had no plans to further support IRS activities in Nigeria with fiscal funding[30]. Consequently, there are no visible records that the Government of Delta State, where Abraka is located, ever funded IRS activity.

Then, the third and fourth strategies involve effective case management and preventive therapy via increasing access to malaria rapid diagnostic tests, RDTs/microscopic diagnosis, ACTs treatment and intermittent preventive therapy for pregnant women (IPT*p*) and infants, (IPT*i*). The objectives of these strategies are to ensure timely availability of appropriate antimalarial medicines and commodities needed to prevent (IPT*p*/IPT*i*) and treat (ACTs) malaria in Nigeria by 2018. Nonetheless, in Abraka, purchase of these chemopreventive and therapeutic agents rests on individuals with no or very little government interventions.

Results from this study indicate that drug management of cases complied significantly with WHO ACTs (Artemisinin-Lumefantrin and Artemether-Lumefantrin) recommendation for the treatment of uncomplicated malaria, but the treatment agents seem to be failing; possibly due to improper use of the drugs[21] as many do not complete their dosage resulting into antimalarial resistance and evidence of substandard artemisinin products in the Nigerian market has also been reported[31]. It has been estimated that poor quality antimalarials are responsible for 12,300 deaths and $892M in cost annually in Nigeria [32].

Available evidence from this study shows that NMSP 2014-2020 was not comprehensively implemented in Abraka, and so, judged to be unsuccessful.

Therefore, the rising cases of malaria morbidity and associated mortality may be due to myriad of factors that need to be identified for proper management of the infection.

CONCLUSION

Malaria cases will continue to increase and be a leading cause of deaths in Abraka, if the NMSP is not re-enforced. Therefore, National Malaria Eradication Programme (NMEP) should re-examine her strategies in line with the Global Technical Strategy (GTS 2016-2030) whose ultimate goal is to eliminate malaria in all countries of the world via universal access to malarial prevention, diagnosis and treatment. There is urgent need for the establishment of ACT centres for rural inhabitants to easily access treatment, and receive ITNs for preventive

purpose. Proper monitoring of ITNs distribution and education on the importance of usage should be ensured. Government policies on malaria eradication should be continuous with change in power to ensure the success of the programme.

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Authors' Contributions

AOO, JOA, UEU & PA were involved in data collection from field work, COE analyzed the data for statistical deductions, while IO—the corresponding author—designed the study, supervised the field work and prepared the draft manuscript which was approved by all authors.