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Evaluation of Malaria Parasitaemia among COVID-19 Patients in Rivers State, Nigeria

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

This study was an exploratory prospective observational study in a cohort of patients on admission with COVID-19 in some health institutions in Nigeria. Patients within the age group of less than 25 years to greater than 50 years of age with PCR-confirmed diagnosis of SARS-CoV-2 infection, involved only those who gave consent. Ethical concern was highly upheld. Taro Yamman formula was used to determine the sample size of 400 and probability sampling technique used. Primary and secondary data sources were used. Clinical assessments and blood sample collected at one point in time following standard protocol according to WHO. Malaria diagnosis was done using microscopy through thin and thick film using Gemisha staining. All data were analyzed for descriptive statistics- frequency and percentage distributions and prevalence rates. Total malaria prevalence rate in the study was high 327 (81.8%) and in terms of severity the older age group (>50years) had high (84.8%) malaria parasitaemia. However, low parasiteamia 154 (38.5%) was common regardless of the age groups and formed the majority of malaria parasites detected while the high malaria parasitaemia was least with 59 (14.8%). The prevalence of COVID-19 co-infection with malaria was high as recorded in this study. The age group >50years had the highest number of COVID-19 patients with high malaria parasitemia. The study findings highlight the significance of understanding the possible medical and therapeutic implications of such overlapping co-infections

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in malaria endemic area with high morbidity burden. Routine Malaria screening and treatment should be an integral aspect of COVID-19 treatment regimen in malaria endemic region with much emphasis among the geriatrics. All malaria elimination programme and roll back malaria core values should be strengthened from vector control, to use of insecticide treated nets and others should be regularly practiced.

Keywords: Prevalence; malaria; COVID-19 patients; healthcare.

1. INTRODUCTION

The novel coronavirus disease -COVID-19 was first found in Wuhan city in China precisely in December 2019 and in 2020 according to the report of Shija et al. [1] COVID-19 affected 146 countries worldwide. Age wise comparison shows that COVID-19 is less severe in children but highly pathogenic in older people making age a risk factor with severe clinical manifestation and increased mortality rates amongst the geriatrics population between age 65 years and above. D'Ascanio et al. [2] confirmed that age is a risk factor but asserted that age is not the only risk factors and expressed concerns towards other factors such as co-morbidities and long staying in residential home care.

Notably, co-morbidity is a similar concern investigated in this study; the co-infection of COVID-19 and malaria in relation to age. Similarly, Ho et al. [3] in a general population cohort study established that age is a strong factor although not the sole factor for complications and increased mortality. The issue of COVID-19 and malaria coinfection is a problem known to span across the extremes of age in essence; affecting the paediatrics and geriatrics. COVID-19 is less complicated and common among children but older adults are severely affected. Furthermore, under five age children are highly susceptible to malaria infection [4].

Based on this, the age of individuals with malaria and COVID-19 co-infection has been reported to be between 4−67 years as established by various studies [5]. Adetola et al. [6] confirmed same in Kambia, northern Sierra Leone. Also, Correia et al. [4] did not show contradicting view in their study on "a patient with severe malaria and covid-19: how do you tell the difference between these infections?" Junaedi et al. [7] in a case report of Covid-19 and severe malaria co-infection proved no variation about the age range and existence of COVID-19 co-infection with malaria. Furthermore, Mahajan et al. [8] in a population of pregnant women established similar report even in triple co-infections of malaria parasitemia, dengue fever and SARS-CoV-2. Likewise, the account of Sardar et al. [9] in an independent study; no disparity was displayed in terms of co-infection and age as much as the study of Papaccio et al. [5].

At the height of the COVID-19 pandemic countries devised means to contain the virus and combat community transmission through the enforcement of strict measures such as social distancing, good hand hygiene and movement restriction including lockdown. These restrictions especially the lockdown in countries during COVID-19 pandemic affected access to health facilities, resulting to reduced malaria chemoprevention, and a drop even suspension in the distribution of long-lasting insecticide-treated bed nets (LLINs). This in turn resulted to the increased rate of malaria infection and deaths observed during the pandemic in malaria-endemic areas, such as Africa; therefore, continuing attention to malaria during COVID-19 pandemic by including both COVID-19 and malaria diagnoses in cases of fever. This depicts the reality in the area of this present study. The study thus investigated the rate of malaria infection among COVID-19 patients and malaria parasitaemia classified in various degrees relative to the age of the subjects. Information obtained will be useful for clinician in the management of COVID-19 cases in malaria endemic region and provide facts on age specific intervention especially for the at risk group. Paucity of data in relation to age specific and malaria severity in COVID-19 malaria coinfection made the researchers to look in this direction.

2. METHODOLOGY

Study Design: This study was an exploratory prospective observational study in a cohort of patients on admission with COVID-19 in some health institutions in Nigeria.

Study Area: The study was conducted in Rivers State Covid-19 Treatment Centre siyuated in Eleme Local Government Area. The centre is an accredited centre for COVID-19.

Selection Criteria: Patients within the age group of less than 25 years to greater than 50 years old with a PCR-confirmed diagnosis of SARS-CoV-2 infection were recruited into the study following the provision of an informed consent or assent. These participants were consecutively registered for inclusion from COVID-19 treatment centres in some health institutions across the country-Nigeria.

Sample Size/Sampling Technique: Yamane Taro sample size formula was used to obtain the sample size of 400 used in this study [10]. The study utilized probability sampling technique which provided participants with equal chances of being selected to participate in the study without bias as described by some authors [11,12].

Data Sources: Both primary and secondary data sources were used in this study through measuring vital signs checks and results from laboratory analysis in addition to information obtained from health records.

Clinical assessments/Laboratory Protocol: Clinical assessments and blood sample was collected following WHO standard protocol for malaria test [13]. Malaria diagnosis in all patients was conducted using microscopy through thin and thick film smear, and stained using Giemsa staining methodology according to Chessbrough [14]. *Plasmodium falciparum* was identified and quantified by manual counting.

Outcome Measure: The main outcome was prevalence rate of malaria parasitaemia based on parasite load classified as low, moderate and/or high malaria parasitaemia. Overall and age group specific prevalence rates of malaria parasitaemia prevalence by age groups such as less than 25 years, 25 – 50years and greater than 50years.

2.1 Statistical Analysis

All data were firstly collated in Microsoft excel spread sheet and exported into Statistical Package for Social Sciences (SPSS) version 21. Data were cleaned, coded and analysis performed for descriptive statistics such as frequency and percentage distributions. Prevalence rates were obtained and all results presented.

3. RESULTS

The study finding represents high parasitiaemia however, the severity of the malaria parasites varied across age groups. Generally, study findings revealed; 154 (38.5%), 114 (28.5%) and 59 (14.8%) for low parasites, moderate and high parasitaemia respectively (Table 1).

Individuals >50years had the highest total prevalence (84.8%) of malaria parasitaemia among COVID-19 infected patients followed by age group 25 -50years (81.6%) while less than 25 years age group had the least prevalence (77.4%) in this study, (Table 2).

In addition, total of 62 COVID-19 patients less than 25years of age participated in this study, and 14 subjects had undetected infection while malaria across proved different degree and severities such as 22 (35.5), 15 (24.2), and 11 (17.7) for low, moderate and high malaria parasitaemia. Furthermore, the second age group 25 -50 years reported 44 (18.4), 92 (38.5), 67 (28.0), and 36 (15.1) for undected infection, low, moderate and high parasite loads

Table 1. Malaria parasitaemia levels among COVID-19 study participants

Study Participants	Malaria Parasitaemia (%)				Total Prevalence (%)
	Number Examined	Low	Moderate	High	
COVID – 19 Patients	400	154 (38.5)	114 (28.5)	59 (14.8)	**327 (81.8)**

Table 2. Malaria prevalence among COVID-19 study participants in relation to age

Age Groups	Number Examined	Number Undetected	Malaria Parasitaemia (%)			Total Prevalence (%)
			Low	Moderate	High	
0- 25 Years	62	14 (22.6)	22 (35.5)	15 (24.2)	11 (17.7)	48 (77.4)
25 – 50 Years	239	44 (18.4)	92 (38.5)	67 (28.0)	36 (15.1)	195 (81.6)
>50 Years	99	15 (15.2)	40 (40.4)	32 (32.3)	12 (12.1)	84 (84.8)
Total	400	73 (18.2)	154 (38.5)	114 (28.5)	59 (14.8)	327 (81.8)

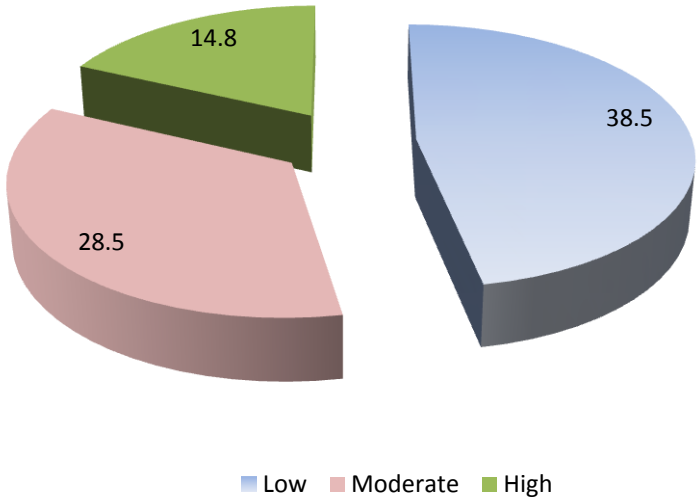

Fig. 1. Pie Chart showing Prevalence of Malaria Parasitaemia

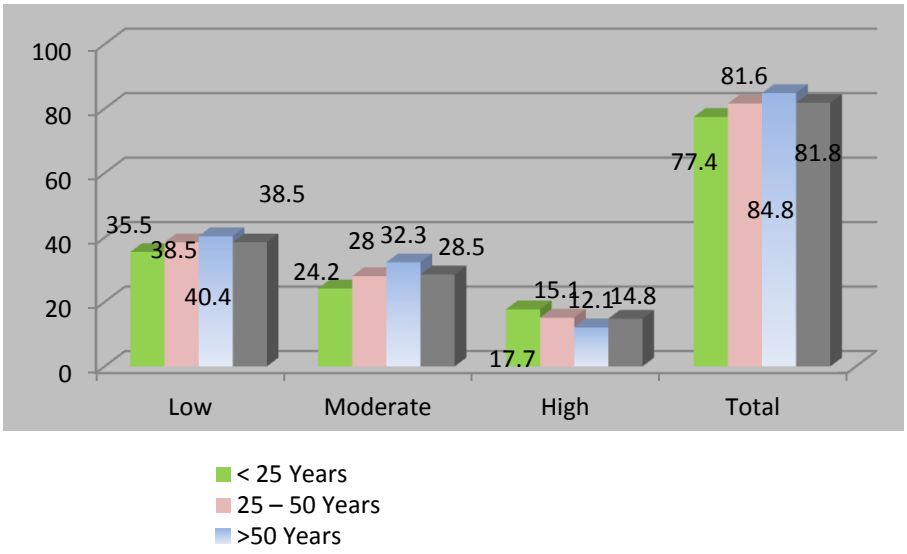

Fig. 2. Prevalence (%) of malaria parasitaemia by age group

respectively. Also, the last age group comprisedof>50years COVID-19 subjects of *99 patients.*15 (15.2) were undetected for malaria infection while 40 (40.4) had low parasitaemia, 32 (32.3%) reported moderate level of malaria parasites while 12 (12.1%) had high malaria parasitemiae.

3. DISCUSSION

This study presented a high prevalence (81.8%) of malaria parasitaemia among COVID-19 patients within the study population. This showed contradiction with the report of Wilairatana et al. [15] which showed 11% of prevalence of *Plasmodium* spp. infection and characteristics of COVID-19 in patients co-infected with malaria and COVID-19 however, this was a pooled prevalence with the constraint of heterogeneity. The finding of this study is also not the same with Matangila et al. [16] which reported a lower prevalence rate and Mahajan et al. [8] as well observed low rate of co-infection. The high prevalence of co-infection of COVID-19 and malaria may be as a result of the area of the study –Nigeria is an endemic area for malaria

and the COVID-19 pandemic period of lock down, reduced mobility and access to routine health checks and treatment hence, the build-up of malaria during that period. Also, malaria treatment suffered a bit of neglect during the early pandemic period including its programmes for prevention and control as such the consequence is the high rate observed in this study [15]. However, low prevalence of co-infection can be altered by reducing the prevalence of malaria in the area in an endemic area by the use of antimalarial drugs prior to hospitalization and in the absence of access to healthcare facility in the pandemic period [16].

Although, studies such as Mahajan et al. [8] suggested that COVID-19 and malaria coinfection may enhance recovery from COVID-19, with virus clearance through glycosylphosphatidylinositol immunoglobulin G antibodies against plasmodium-specific antigens cross-reacting with SARS-CoV-2 antibodies [8,16]. Also, the mechanism of ACE2 down regulation reduces the entrance of the novel coronavirus into the respiratory epithelial cells. By implication, the prevalence rate observed in this state might possibly confer a protected advantage on the COVID-19 patients.

Comparable to the high prevalence of coinfection of COVID-19 and malaria obtained in this study are two Nigeria based studies with prevalence rates of 63% [17] and 100% [18]. Additionally, the studies suggested that, high levels of 8-iso-PGF2α in COVID-19 coinfected malaria patients are linked with deteriorated condition due to raised oxidative stress-induced pro-inflammatory response against COVID-19 [17]. Variation in the COVID-19 and malaria Co-infection prevalence rates may be as a result of different factors such as methodological concerns, study designs, geographical location and cases under reported as most persons in low and middle income countries seek health care help only with visible signs and symptoms whereas in some cases there could be asymptomatic especially in COVID-19 infected young patients [15]. The role of age cannot be over emphasized.

Besides, the low testing and reduced confirmatory testing due to cost, multiple stages, shortages and lack of expertise are contributory. Although COVID-19 co-infection with malaria have overlapping clinical manifestations, this has resulted to misdiagnosis particularly with symptoms such as fever, complicated COVID-19 symptoms like organ failures, shock and others are common with severe malaria and the geriatrics are mainly affected [19]. There is need to consider this population and malaria endemic areas remain paramount.

Study finding suggests that COVID-19 coinfection is accompanied by low to moderate malaria parasitaemia, only few patients that recorded high malaria parasitaemia. This low to moderate parasitaemia observed is similar to the observations made in previous studies [4,16]. Furthermore, Sardar et al. [9] supports this evidence. A similar study conducted in same region in Nigeria showed no variation to this [18].

On the other hand, few cases of high malaria parasitemia were recorded in this study with older age (>50years) mostly affected. This exception of severe malaria parasitemia shared similarity with the study of Junaedi et al. [7] and it was revealed that the cause of high malaria parasitemia in COVID-19 patients is linked with an initial misdiagnosis of malaria with other clinical conditions such as pancreatic disease, pneumonia and dengue fever [7]. Age has been identified as a predictor of unfavourable outcomes among COVID-19 irrespective of the malaria status. The prevalence of malaria parasitaemia among COVID-19 in terms of severity of the malaria and high parasite density was high among older patients in the study.

4. CONCLUSION/ RECOMMENDATION/ STUDY LIMITATION

Less than 25 years had the greatest rate (17.7%) of high malaria parasitemia hence, had the highest severity amongst all age groups. While age 25 -50 years had the second highest overall prevalence of malaria parasitemia (81.6%) although more of low and moderate while the older population (>50 years) had highest overall/total prevalence rate (84.8%) with least malaria severity (12.1%) but marked with more of low and moderate malaria compared to less than 25 years.

The study suggests increased capacity in the detection and identification of COVID-19 and malaria coinfections at an early stage should be strengthened particularly in malaria-endemic regions. Symptomatic patients irrespective of the age should be tested and treated promptly.

Small sample size and coverage limited this study therefore, under representation of the entire population of the area hence,

generalization of the findings should be made with caution. There were no comparative group especially group comprising of mono infection and fewer laboratory and clinical data to make other conclusions. Further studies are suggested to fill this research gap and to understand the impact or presumed mechanism of protection in the case of COVID-19 malaria co-infection.

CONSENT AND ETHICAL APPROVAL

Ethical concern was high upheld with approval from Rivers State Ministry of Health. Confidentiality and privacy remain key. Consents were obtained from study subjects as patients freely participated without coercion. Approval were obtained from relevant authorities such as the health institutions and facility heads, head of departments, approval from laboratory heads and bench permissions obtained.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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