The Impact of Age on Malaria Prevalence among COVID-19 Patients and Healthy Volunteers with some Associated Symptoms in Rivers State, Nigeria

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Authors' contributions

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ABSTRACT

Background: The co-morbidity of malaria and COVID-19 is a growing public health concern since the outbreak of covid-19 especially in low and middle income countries due to poor healthcare facilities, system, personnel manpower and financial resources. It is generally known that age has a significant impact on malaria vulnerability, but with emerging concern on malaria and covid-19 co-infection, age based prevalence are among many studied characteristics of malaria prevalence in covid-19 patients especially in malaria endemic areas.
Aim: The study was aimed at evaluating the impact of age in the prevalence of malaria and COVID-19 co-infection as well as some associated symptoms in Rivers State, Nigeria.
Methodology: The study was a cross-sectional study conducted among 600 covid-19 patients admitted in Rivers State Covid-19 Treatment Centre, Eleme. Consenting subjects were randomly selected and were classified into three groups based on age; 0-25yrs, 26-50yrs and >50yrs. Blood samples were collected using venipuncture technique and blood was collected in EDTA bottles. Thick film was prepared was stained using Giemsa for malaria microscopy. All data generated were analyzed statistically using analysis of variance (ANOVA) and chi-square test with a $P<0.05$ considered significant.

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Result: Results showed that total malaria prevalence was 70.2 while on age group classifications, the prevalence was 100% in all age groups but healthy control group had less prevalence. This study has shown that prevalence of malaria among covid-19 subjects was significantly higher in all age groups (p<0.05). All symptoms were significantly associated with age at P<0.05; individuals >50years and 26 – 50years experienced more symptoms among COVID-19 patients and healthy volunteers respectively (P<0.05).

Conclusion: This study has shown that malarial prevalence is absolutely higher among covid-19 subjects and the level of prevalence does not discriminate among age groups. However, more research work is needed to fully understand the relationship between malaria and COVID-19 co-infection due to the novel nature of the disease globally and their shared clinical symptoms.

1. INTRODUCTION

The pandemic which ravaged the whole in early 2020 started in China and is caused by the virus SAR-CoV-2 [1]. Since the outbreak of the viral infection, lots of measures have been put in place to mitigate the spread and the negative impact of the infection and disease locally, nationally and internationally. According to World Health Organisation [2], 2020, COVID-19 as it is otherwise called is a public health concern and this concern is on a significant rise following events of co-infection or co-morbidities. WHO, 2020 has reported a higher rate of morbidity and mortality in covid-19 patients with other background illness than a case of mono-covid-19 infection. Although Africa has so far recorded low infection rate and mortality but the poor health infrastructure, system, personnel capacity and financial resources are cheap routes through which infection can easily spread and the outcome of co-infection may be more devastating [3].

Malaria is a disease caused by protozoan parasites of the genus *Plasmodium*. It is transmitted to human through the bite of an infected female anopheles mosquito [4]. Malaria is a serious health burden of low income and middle income countries, including Nigeria. Recent world malaria report indicates that Nigeria accounts for quarter of all malaria cases in the 45 malaria endemic countries in Africa thus showing the challenge malaria poses in Nigeria. This may also be due to the large population of the country as approximately 150 million people live in the areas of high malaria transmission. The shared similarity of malaria and COVID-19 infection has made it difficult to differentiate between malaria infection and COVID-19 except via laboratory intervention

The emergence of malaria and COVID-19 co-infection is a growing concerning since the outbreak of COVID-19 especially in malaria endemic area like Nigeria [5]. There are widespread concerns about the impact of age on COVID-19 spread and susceptibility especially among young (children less than 5years) and elderly individuals; most of these concerns have been unresolved because COVID-19 is novel with little scientific database. Also, children (0 – 5 years) are more susceptible to malaria due to their developing immune systems and little/absent acquired immunity compared to older individuals who have more developed immune systems and stronger acquired immunities from previous bouts of malaria [6]. The present study was conducted to evaluate the impact of age in the prevalence of malaria and COVID-19 co-infection as well as the associated symptoms and risk factors in Rivers State, Nigeria.

2. MATERIALS AND METHODS

2.1 Study Design

The study was a cross-sectional study with 600 participants; 300 covid-19 patients and 300 healthy participants who made up the control group. Study participants were grouped based on age; 0-25yrs, 26-50yrs and >50yrs. These subjects who provided consent for inclusion in the study were selected using simple random method.

2.2 Study Location

The study was conducted at Rivers State Covid19 Treatment Centre, Eleme Local Government Area, Rivers State, Nigeria. Rivers State is situated in the South-South region of Nigeria with a population of 5,198,716 according to 2006 Census report and is located at coordinates, 4° 55' N, 6^o50'E. Rivers State is

bound at the south by Atlantic ocean, the North by Imo, Abia, and Anambra States, to the East by Akwa-Ibom State and to the West by Bayelsa and Delta States.

2.3 Eligibility Criteria

2.3.1 Inclusion criteria

Inclusion in the study was based on subject's consent provision, admission in the treatment centre and presentations of intermittent fever, abdominal pains, reduced/loss of appetite and general body weakness. Control subjects included was based on the fact that they were neither covid-19 positive or malaria infected.

2.3.2 Exclusion criteria

Exclusion of participants from the study was based on the following; presence of other febrile conditions, other infections, malaria treatment, and inability to provide informed consent.

2.4 Subject Selection

A total of 600 convenient sample size subjects were selected in a simple random technique from the study location (Rivers State Covid19 Treatment Center, Eleme Local Government Area, Rivers State, Nigeria), having ensured that they met the criteria on the questionnaire that made them suitable for inclusion and exclusion. Participants were required to pick from a number system of 0-1. All participants who picked "1" were recruited while those who picked zero were rejected.

2.5 Sample Collection

Samples of blood for malaria parasite test were collected in EDTA bottles using venepuncture technique as described by World Health Organization [7].

2.6 Malaria (Plasmodium Specie) Examination

A thick and thin blood film was made on a slide and allowed to air dry. The thin film was fixed using absolute methanol. After which both the thin and thick blood film was stained using giensa stain and allowed to air dry. When the both films were completely dried, a drop of immersion oil was placed on an area of the film that appears mauve coloured (around the edges). The film was then examined for malaria parasite under a microscope using the X100 objective lens.

2.7 Statistical Analysis

The data obtained from the study were analysed using the GraphPad Prism Version 8.0.2.263. using chi-square test with a $P<0.05$ considered significant.

3. RESULTS

Table 1 above shows the Prevalence of malaria in relation to age groups among study population An overall malaria prevalence of 70.2% was recorded in this study; all COVID-19 participants had malaria parasites (100% prevalence) while healthy volunteers had a prevalence of 40.3% ($P<0.05$) (Table 1). Overall malaria prevalence values of 77.9%, 72.4% and 60.5% were recorded for age groups 0 – 25, 26 – 50 and >50 respectively ($P>0.05$).

Table 2 above shows the relationship between symptoms and age groups among study population. All symptoms were significantly associated with age ($P<0.05$); individuals >50years and 26 – 50years experienced more symptoms among COVID-19 and healthy volunteers respectively ($P<0.05$).

Table 1. Prevalence of malaria in relation to age groups among study population

Study Population	Age Groups (Years)						Grand Total	
	0-25		26-50		>50			
	NE	NI (%)	NE	NI (%)	NE	NI (%)	NE	NI (%)
COVID-19 Patients	46	46 (100)	175	175(100)	79	79 (100)	300	300(100)
Healthy Volunteers	85	56 (48.2)	122	40 (41.0)	93	25 (32.3)	300	121(40.3)
Total	131	102(77.9)	297	215 (72.4)	173	104 (60.5)	600	421(70.2)

P-value<0.05
NE = Number Examined; NI = Number Infected

Table 2. The relationship between symptoms and age groups among study population

Symptoms		COVID-19 Patients			Healthy Volunteers			
Age Groups (%)				Age Groups (%)				
NE		0 – 25	26 – 50	>50	NE	0 – 25	26 – 50	>50
Fever								
Yes	61	5 (8.2)	26 (42.6)	30 (49.2)	76	17 (22.4)	24 (31.6)	18 (23.7)
No	239	41 (17.2)	149 (62.3)	49 (20.5)	224	49 (18.3)	70 (31.3)	54 (24.1)
Dyspnea								
Yes	21	1 (4.8)	6 (28.6)	14 (66.7)	05	1 (20.0)	2 (40.0)	1 (20.0)
No	279	45 (16.1)	169 (60.6)	65 (23.3)	295	65 (22.0)	92 (31.2)	71 (24.1)
Cough/Sneezing								
Yes	53	3 (5.7)	23 (43.4)	27 (50.9)	12	3 (25.0)	4 (33.3)	3 (25.0)
No	247	43 (17.4)	152 (61.5)	52 (21.1)	288	63 (21.9)	90 (31.3)	69 (24.0)
Headache								
Yes (33.3)	57	5 (8.8)	19	33 (57.9)	141	31 (22.0)	44 (31.2)	34 (24.1)
No	243	41 (16.9)	156 (64.2)	46 (18.9)	159	35 (22.0)	50 (31.4)	38 (23.9)
Loss of Smell/Taste								
Yes	131	24 (18.3)	64 (48.9)	43 (32.8)	38	8 (21.1)	12 (31.6)	9 (23.7)
No	169	22 (13.0)	111 (65.7)	36 (21.3)	262	58 (22.1)	82 (31.3)	63 (24.0)
Running Nose								
Yes	33	1 (3.0)	12 (36.4)	20 (60.6)	134	29 (21.6)	42 (31.3)	32 (23.9)
No	267	45 (16.9)	163 (61.0)	59 (22.1)	166	37 (22.3)	52 (31.3)	40 (24.1)
Sore Throat								
Yes	14	3 (21.4)	8 (57.1)	3 (21.4)	112	25 (22.3)	35 (31.3)	27 (24.1)
No	286	43 (15.0)	167 (58.4)	76 (26.6)	188	41 (21.8)	59 (31.4)	45 (23.9)

NE = Number Examined

4. DISCUSSION

Age plays an important role in the susceptibility, co-morbidity and spread of diseases such as COVID-19 and malaria. Malaria is endemic in most parts of sub-Saharan Africa and in Nigeria in particular and shares several similar symptoms with COVID-19. This study evaluated the impact of age on malaria prevalence among COVID-19 patients and healthy volunteers with some associated symptoms in Rivers State, Nigeria. Subjects were selected randomly from Medical Laboratory of the Covid19 Treatment Center, Eleme Local Government Area, Rivers State, Nigeria.

An overall malaria prevalence of 100% (300 out of 300) was recorded for COVID-19 patients while healthy volunteers had overall malaria prevalence of 40.3% (121 out of 300). Within the age groups 0-25 years had 100% infected with malaria and COVID-19 co-infection while the healthy individuals for this age group had 48.2% infected with malaria. The result also showed that age group 26-50 years also had 100% malaria and COVID-19 co-infection while the healthy individuals had 41.0% infected with malaria. The age group >50 years also had 100% malaria and COVID-19 co-infection and the healthy individuals had 32.3% infected with malaria. This shows that malaria is endemic in the study area. Also, the 100% malaria prevalence recorded among COVID-19 patients suggests that individuals with malaria (irrespective of age) are highly susceptible to COVID-19 especially in malaria-endemic regions. The malaria prevalence of 40.3% among healthy volunteers is comparable to reports from similar studies on malaria in Nigeria; 38.7% in Kano [8], 39.5% in Benue [9], 40.8% in Rivers [10] and 40.8% in Sokoto [11].

The malaria prevalence (100% and 40.3%) in this study is of public health significance and can be attributed to several factors such as suitable environmental conditions for the thriving of *Anopheles* and over-crowded settlements (which aid easy spread of diseases) in the study area. Individuals in age group 0 – 25 years had the highest overall malaria prevalence of 77.9% (102 out of 131). This suggests that individuals in this age group are highly susceptible to malaria and COVID-19 due to their developing immune systems but more molecular and immunological researches are required for in-depth knowledge.

Individuals in age groups >50 years and 26 – 50 years experienced more symptoms among COVID-19 and healthy volunteers respectively; this can be attributed to other underlying health conditions and more exposure to causative agents of COVID-19 and malaria.

Comparing the relationship between symptoms and age groups among study population result showed that 8.2% of patients with COVID-19 and within the age group of 0-25 years had fever, 42.6% within the age group of 26-50 also had fever and 49.2% within the age group > 50 years also had fever. This shows that those within the age group > 50 years had the highest percentage of fever for the COVID-19 patients, this implies that the older the age the higher the rate of fever in COVID-19 patients. The age group with the highest fever symptom among the healthy individuals was seen within the age group 26-50 years with 31.6% implying that the middle aged individual without COVID-19 are more prone to fever when infected with malaria. Those of the COVID-19 group with the highest rate of headache, Dyspnea, Cough/Sneezing Running Nose This suggests that the elderly with COVID-19 are more prone to malaria symptoms than other age groups while in the healthy individuals the age group prone to more malaria symptoms are those within the age range of 26-50 years. This is in agreement with a study carried out by Manmohan et al., [12]

5. CONCLUSION

This study has shown that there is no age discrimination or varying age-based vulnerability of malaria in covid-19 patients, thus, individuals should take necessary health and environmental measures to protect themselves against malaria and COVID-19 irrespective of their age. Further research works on molecular and clinical studies are required to fully understand malaria and COVID-19 co-morbidity in relation to age [13].

6. LIMITATION

Participation of subjects to meet the required sample was a major challenge because their consent letters were not forthcoiming.

ETHICAL CONSIDERATION AND INFORMED CONSENT

The Ethics Committee of the Rivers State Ministry of Health, Port Harcourt, Nigeria approved the protocol for this study. After due counselling, exposition of research aim, procedure, its benefits, and subject data privacy, a written informed consent filled

alongside the questionnaire was obtained from adult participants while consent for children were provided by parents or guardians.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Africa Centre for Disease Control. Coronavirus disease 2019 (COVID-19). Latest updates on the COVID-19 crises from Africa CDC;2020.
2. World Health Organisation. Coronavirus disease 2019 (COVID-19) Situation Report-37. World Health Organization, Geneva;2020.
3. Kapta N, Ihekweazu C, Ntoumi F. Is Africa prepared for tackling the COVID-19 (SARS-CoV-2) epidemic, lessons from past outbreaks, ongoing Pan_African public health efforts and implications for the future. International Journal of Infectious Diseases. 2020;9:233-236.
4. DiGennaro F, Marotta C, Locantore P, Pizzol D, Putoto G. Malaria and COVID-19: common and different findings. Tropical Medical Infectious Diseases. 2020;5: 141.
5. Wilson RJ, Pasvol G, Weatherall DJ. Invasion and growth of Plasmodium falciparum in different types of human erythrocyte.Bulletin of the World Health Organization. 2018;55:179–186.
6. Young MD, Moore DV. Chloroquine resistance in Plasmodium falciparum. American Journal of Tropical Medicine and Hygiene. 2017;10:317–320.
7. Cheesbrough M (2nd Ed). District laboratory practice in tropical countries. Cambridge: Cambridge University Press part 1. 2010;454.
8. Mohammed Y, Dabo N, Kawo A, Yakubu A. Comparison of Microscopic examination and Rapid Diagnostic Tests used to diagnose malaria among pregnant women in Kano, North-Western Nigeria. International Journal of Science and Technology. 2015;5(2):1–6.
9. Houmsou R, Amuta E, Sar T, Adagba A. Malarial infection among patients attending a Nigerian semi – urban based hospital and performance of HRP – 2 Pf rapid diagnostic test (RDT) in screening clinical cases of Plasmodium falciparum malaria. Translational and Biomedicals. 2011;2(1): 1 – 5.
10. Amala SE, Nwibani CP. Malaria in pregnancy and its association with ABO blood group and haemoglobin genotype. International Journal of Developmental Research. 2015;5(8),5317 – 20.
11. Sani U, Jiya N, Ahmed H. Evaluation of a malaria rapid diagnostic test among febrile children in Sokoto, Nigeria. International Journal of Medical Science. 2013;3(5):434 – 440.
12. Manmohan S, Sweeta M, Praveen KB. Clinical and molecular monitoring of Plasmodium falciparum resistance to antimalarial drug (artesunate+sulphadoxine-pyrimethamine) in two highly malarious district of Madhya Pradesh, Central India from 2012-2014. Indian council of Medical Research Report. 2017;3 (23):45-59.
13. World Health Organisation. Malaria Fact Sheet. World Health Organization, Geneva;2020.