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NEONATAL SEPSIS AT UNIOSUN TEACHING HOSPITAL, OSOGBO, SOUTH WEST, NIGERIA

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ABSTRACT

Background: **Neonatal sepsis is an important cause of morbidity and mortality of newborns, especially in developing countries. Even though neonatal sepsis is one of the major clinical conditions for neonatal admissions in developing countries; however, this is the first study of neonatal sepsis in our Teaching Hospital. This study aimed to determine the prevalence of confirmed sepsis and the bacteria isolates of neonatal sepsis among term neonates with maternal and neonatal risk factors for sepsis admitted to UNIOSUN Teaching Hospital (UTH), Osogbo, Southwest Nigeria.**

Methodology: **This was a consecutive, cross-sectional descriptive study of one hundred and six term newborns over 6 months with maternal and neonatal risk factors for sepsis at admission into the newborn unit. Exclusion criteria included preterm babies and babies with asphyxia. Clinical features and laboratory results, including blood cultures, were obtained. Data obtained were entered into SPSS version 25 and analyzed using the chi-squared test.**

Results: **Of the 291 neonates admitted during the period, 106 neonates who had risk factors for sepsis were studied. Sixty-six (62.3%) were males and 40 (37.7%) were females, with female-to-male ratio of 1:1.7. Thirty-five (33.0%) had positive blood culture-proven sepsis. *Staphylococcus aureus* was the most commonly isolated organism. Of maternal risk factors, peripartal fever and dysuria were found in 27 (25.5) and 20 (18.9%) mothers, respectively. However, higher proportions of neonates with abnormal temperature (Odds ratio = 6.545, 95% Confidence intervals {CI} = 1.825-23.465 and p-value = 0.002), respiratory distress (Odds ratio = 2.971,95%CI = 1.221-7.232, p-value = 0.014) and convulsions (Odd ratio = 3.278, 95%CI = 1.309-8.208, p-value = 0.009) had positive blood culture**

Conclusion: Neonatal sepsis remains a growing concern, especially in babies with respiratory distress and those born to mothers with peripartal fever.
Recommendation: Strengthen policies, enhance newborn care facilities, raise awareness of early signs, and ensure neonatologists follow screening protocols and provide timely, coordinated care.
***Keywords*: Maternal, neonatal risk factors, Neonatal sepsis, Osogbo, Nigeria.**

INTRODUCTION

Despite major advances in neonatology in the past few decades, bacterial sepsis is still one of the most important causes of morbidity and mortality in this age group worldwide, especially in developing countries.[1] Neonatal sepsis is the third leading cause of neonatal mortality and a major public health problem, especially in developing countries.[2] It is however, a global health challenge, with its incidence ranging between 3.5 and 38 per 1000 live births globally.[3] Every year, 2.6 million neonates die; three-fourths of these deaths occur in the first week of life, and almost all (99%) of these deaths occur in low- and middle-income countries.[4,5] Neonatal sepsis can present in several ways, with a substantial number of cases with nonspecific signs and symptoms. Sometimes, it may be clinically indistinguishable from various noninfectious conditions such as respiratory distress syndrome (RDS), congenital heart diseases, and even maladaptation.[6–8] The incidence of sepsis ranges from 1 to 5 cases/1000 live-births in high income countries (HICs) unlike in low- and middle-income countries (LMICs) with a 3 to 20-fold increase in the incidence.[9]

Neonates are more susceptible to infections than children at any other age period.[10] Timely recognition and treatment are crucial to the outcome in neonatal sepsis given the associated high mortality and prolonged morbidities like neurodevelopmental outcomes at follow-up, including cerebral palsy, low mental psychomotor development index scores, visual impairment, and impaired growth.[11] Positive blood culture is the gold standard for the diagnosis of neonatal sepsis.[12]

Olorukooba et al in Zaria reviewed the case notes of 465 neonates admitted into the neonatal unit over one year, 175 (37.6%.) neonates had positive blood culture.[13] Mokuolu et al in 2002 at Ilorin reported the prevalence of neonatal sepsis as 7.04/1000 hospital live births.[14] Also, Adejuyigbe *et al* in a study more than 2 decades ago reported an incidence of 22.9/1000 live births, while Adebami et al in a retrospective study in 2010 at Osogbo reported an incidence of neonatal sepsis to be 25.4%.[15,16]

Although several studies in Nigeria have reported varying rates of neonatal sepsis—ranging from about 7% to 38%—many of these reports are either old, cover only specific regions, or do not clearly separate findings based on maternal and neonatal risk

factors. There is also a lack of recent, broad-based data that link maternal conditions such as peripartal fever with newborn clinical signs like respiratory distress. Furthermore, information on the current bacterial causes of neonatal infections remains limited. These gaps highlight the urgent need for updated and comprehensive research to support evidence-based treatment, improve hospital care practices, and guide national health policies aimed at reducing neonatal illness and death.

Subjects and Methodology

Study Design

This study is a hospital-based comparative descriptive study

Study location

Subjects were from the maternity unit of the hospital for inborn babies and the children emergency unit (CEU) for outborn babies.

Study Setting

This study was conducted at the inborn and outborn sections of the Special Care Baby Unit (SCBU) of LAUTECH Teaching Hospital (LTH), Osogbo, Osun State. Osogbo town with an estimated population of 750,000 is the capital of Osun State, and it lies at coordinates 70461 North 40341 East, covering an area of 47 kilometer square.[17] Osogbo shares a boundary with Ikirun, Ilesha, Ede, Egbedore and Iragbiji towns.

Ladoke Akintola University of Technology (LAUTECH) Teaching Hospital is a tertiary hospital with 314 beds. It provides health care services to the residents of Osogbo and its neighbouring states, including Ogun, Oyo, Ondo and Kwara states. It is a training centre for undergraduate and postgraduate students and other health professionals. The SCBU has 24 beds and averages 500 admissions yearly. The medical complement running the unit include 2 supervising consultant neonatologists, 4 residents and 4 interns.

Study Population

The study population comprised 106 consecutive-term neonates aged 0-28 days with risk factors and/or clinical features of sepsis. These include abnormal temperature (axillary temperature of <35.5℃ or >37.5^{0}C), respiratory distress, poor suck, jaundice, hypoglycaemia, convulsion, irritability, lethargy and maternal risk factors for sepsis included prolonged rupture of membranes, peripartum fever, fetal tachycardia and chorioamnionitis. Chorioamnionitis was diagnosed when the mothers had fever, abdominal tenderness, and/foul-smelling liquor. especially with prolonged/premature rupture of membrane (PROM), while maternal urinary tract infection was made when the mothers had dysuria or abnormal vaginal discharge); antepartum haemorrhage were mothers with placenta previa or abruptio placentae.

Exclusion criteria

1. Babies that have commenced antibiotics
2. Babies with perinatal asphyxia
3. Preterm neonates

4. Babies whose parent/guardian refuses to give consent

Study location

Babies are admitted mainly into the Special Care Baby Unit (SCBU) unit for sepsis, asphyxia, neonatal jaundice, also for being low birth weight/preterm and other conditions. The inborn unit has a capacity for 12 babies. Babies without clinical features or risk factors for sepsis after delivery are nursed by the mother's side at the maternity unit. These sets of babies are reviewed at least daily by the neonatal unit team and discharged after 72 hours if they do not develop other complications.

Outborn unit cares for babies referred from private hospitals, state hospitals, both in the state and outside the state, maternity centres and traditional birth homes. They are admitted into the neonatal ward via the children's emergency unit of the hospital.

Sample size determination

The formula for comparison of 2 proportions according to Varkevisser *et al*. was used:

$$N = \frac{(u+v)^2\{P_1(100-P_1)+P_2(100-P_2)\}}{(P_1-P_2)^2}$$

Where:

N= sample size

u= one-sided percentage point of the normal distribution, corresponding to 100%-the power=0.84

v= percentage point of normal distribution, corresponding to the 2-sided 5% significance level=1.96.[18]

P_1= proportion of proven septic neonates according to a previous study=50%.[18]

P_2= proportion of non-septic neonates =30.5%.[19]

$$N = \frac{(0.84+1.96)^2\{50(100-50)+30.5(100-30.5)\}}{(50-30.5)^2}$$

10% of the sample is to be added for possible attrition from early neonatal death, discharge against medical advice, withdrawal from the study, and to increase precision. A total of 106 term neonates were studied from March to August 2023.

Ethical approval for the study was obtained from the Ethics and Research Committee of UNIOSUN Teaching Hospital, Osogbo, Osun State, with ethical certificate no UTH/EC/2022/07/596. Informed consent was also taken.

Data Collection

Two mls of blood for blood culture is taken into the BACTEC® Peds Plus bottle. Blood culture broth media used were labelled with the patient's identification number. In the subjects, a peripheral vein was located, and the area was prepared with methylated spirit. To reduce the risk of contamination, a closed blood sample collection system (butterfly needle attachment to the BACTEC® bottle) was used to collect the sample. After the blood samples were collected, they were taken to the microbiology laboratory and incubated in the BACTEC 9040 machine for a maximum period of 5 days. The BACTEC 9040 machine is a controlled environment where the vials

are maintained at 37℃. It can incubate 50 vials at the same time, and each vial is identified by its unique barcode BACTEC Peds Plus® . It continuously shakes the vials, leading to an earlier detection of positive vials. Each culture vial has a sensor which detects an increase in carbon dioxide produced by the growth of microorganisms as they metabolize the substrates present in the vial. The BD BACTEC automatically monitored an increase in its fluorescence for the presence of carbon dioxide. A positive reading indicates the presumptive presence of microorganisms in the vial. Bottles were checked for microbial activity, evidenced by flagging of the machine. (This identifies the bottle growing an organism). This usually occurs within 48-72 hours.

Bottles with growth were sub-cultured on blood agar, chocolate agar and MacConkey agar. MacConkey agar is a differential medium and is useful for enteric pathogens for example *Klebsiella spp*, and *E.coli* Blood agar is useful for Streptococcus species while chocolate agar is useful for fastidious organisms for example *Haemophilus influenzae* and *Neisseria spp.*

A direct gram stain was done alongside the subcultures in the plate. This helps to rapidly identify any organisms and rule out contamination.

Data analysis

The information obtained included the demographic data, the risk factors, clinical findings of the selected subjects and the result of the blood culture. The data obtained from these patients was entered into the computer and analyzed using IBM SPSS version 25. Continuous variables were expressed as mean and standard deviation, median and mode. Comparison of categorical variables and tests of association was by chi-square(x^2) test. Results were presented in tables and charts as appropriate. Statistical significance was taken at p-value <0.05.

Results

General demography of babies and Socioeconomic status of mothers.

Of the 291 neonates admitted during the period, 106 neonates who had risk factors for sepsis were studied. Sixty-six (62.3%) were males and 40 (37.7%) were females. This resulted in a male-to-female ratio of 1.7 to 1. The mean age ± standard deviation was 5.69 ± 7(4.7.65 days (136.49 ±183.671hours). Also, 84 (79.6%) had normal weight, 12 (11.3%) were macrocosmic, and 10 (9.4%) were low birth weight as shown in **Table I**.

Table I: Neonatal characteristics of the study population (n=106)	
Characteristics	**Frequency (%)**
Age	
<72hours	57(53.8)
>72hours	49(46.2)
Gender	
Male	66(62.3)
Female	40(37.7)
Birth weight	
<2.5kg	10(9.4)
2.5-4kg	84(79.2)
>4kg	12(11.3)
Place of birth	
Govt hospital	88(83.0)
Private hospital	15(14.2)
Traditional home	2(1.9)
Home delivery	1(0.9)
Category of place of delivery	
Inborn	59(55.7)
	47(44.3)

Outborn	

Characteristics of mothers of the neonates studied

Sixty-four percent (60.4%) of mothers of neonates had tertiary education. Spontaneous vaginal delivery was the most common delivery method, accounting for 60 (56.6%) of deliveries. Twenty-six (24.5%) of participants were in the upper socioeconomic class (I & II), 28(26.4%) were in the middle class (III) and 52 (49.1%) were in the low socioeconomic class (IV & V). **(Table II).**

Table II: Characteristics of mothers of the neonates studied (n=106)

Characteristics	Frequency	Percentage
The age group of mothers		
≤ 25yrs	14	13.2
26-34yrs	75	71.7
≥ 35yrs	17	15.1
Mother's education		
Primary	7	6.6
Secondary	35	33.0
Tertiary	64	60.4
Mother's occupation		
Unemployed	15	14.2
Trading	60	56.6
Artisan	7	6.6
Civil Servant	14	13.2
Professional	10	9.4
Mode of delivery		
SVD(Spontaneous Vertex Delivery)	60	56.6
C/S (Caesarian Section)	46	43.4
Socio-Economic Status (Occupation and Educational attainment of parent)		

Upper	26	24.5
Middle	28	26.4
Lower	52	49.1

Maternal risk factors and clinical features in babies with risk factors for sepsis.

The study also identified various maternal risk factors for neonatal sepsis. Peripartal fever was the most prevalent risk factor observed in mothers of 27 babies (25.5%). Dysuria was the second most common risk factor, with 20 babies (18.9%) affected. On the other hand, the least common risk factors were: chorioamnionitis and fetal tachycardia, each observed in just one baby (Table III). Seventy-six babies (71.7%) showed abnormal temperature as the most common clinical feature. Other prevalent symptoms included respiratory distress (60% of babies), poor activity (29.2% of babies) and poor suck (24.5% of babies).

Table III: Neonates Clinical features and maternal risk factors of sepsis

Neonates' Clinical Features	**Frequency (%)**	**Maternal Risk factors**	**Frequency (%)**
Abnormal temperature		**Peripartal fever**	
No	31(28.3)	No	79(74.5)
Yes	75(71.7)	Yes	27(25.5)
Respiratory distress		**Urinary Symptoms**	
No	46(42.5)	No	86(81.1)
Yes	60(57.5)	Yes	20(18.9)
Poor activity		**History of PROM(Premature Rupture of Membrane)**	
No	76(71.7)	No	96(90.6)
Yes	30(28.3)	Yes	10(9.4)
Poor suck		**Gestation**	
No	80(74.5)	Single	98(92.4)
Yes	26(25.5)	Multiple	8(7.6)
Convulsion		**Chorioamnionitis**	

No	81(76.4)	No	105(99.1)
Yes	25(23.6)	Yes	1(0.9)
Hypoglycaemia		**Foetal tachycardia**	
No	88(82.1)	No	105(99.1)
Yes	18(17.9)	Yes	1(0.9)

Blood culture, bacterial isolates, and mortality

Out of the 106 participants, 35 (33%) had positive blood cultures. *Staphylococcus aureus* was the most commonly isolated organism 17(48.6%), followed by *Klebsiella pneumoniae* **(Figure 1).**

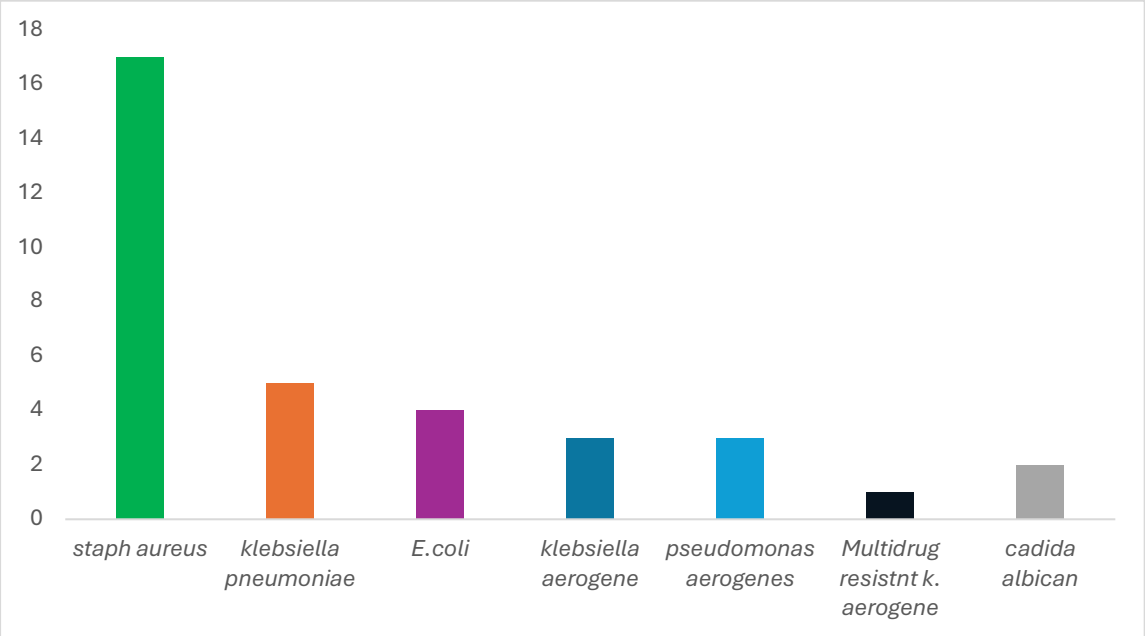

Figure 1: Organisms isolated from the blood culture

Association between the clinical features with blood culture

Of seventy-six participants with abnormal temperature, 32(42.1%) had positive blood culture while 44 had negative blood culture.

There is a statistically significant relationship between abnormal temperature and blood culture (p=0.002). This is demonstrated in Table IV. Five (4.7%) died out of the 106 participants

Table IV: Association between the clinical features with blood

Variable	Blood culture		p-value	95% CI	Odd ratio
	Negative(n=71)	Positive (n=35)			
Poor suck					
No(n=79)	54(68.4%)	25(31.6%)	0.607	0.510 - 3.168	1.271
Yes(n=27)	17(63.0%)	10(37.0%)			
Abnormal temperature					
No(n=30)	27(90.0%)	3(10.0%)	0.002	1.825 - 23.465	6.545
Yes(n=76)	44(57.9%)	32(42.1%)			
Respiratory distress					
No(n=45)	36(80.0%)	9(20.0%)	0.014	1.221 - 7.232	2.971
Yes(n=61)	35(57.4%)	26(42.6%)			
Hypoglycaemia					
No (n=25)	60(69.0%)	27(31.0%)	0.353	0.584 - 4.472	1.616
Yes (n=81)	11(57.9%)	8(42.1%)			
Convulsion					
No (n=80)	59(73.8%)	21(26.3%)	0.009	1.309 to 8.208	3.278
Yes (n=26)	12(46.2%)	14(53.8%)			

Association between the maternal risk factors with blood culture

Table V below shows the relationship between the maternal risk factors and blood culture results. However, there is no statistically significant association between these maternal factors and blood culture result of neonates. Although presence of PROM shows borderline association.

Table V: Association between the maternal risk factors with blood culture

Variable	Blood culture		p-value	95% C.I.	Odd ratio
	Negative (n=71)	**Positive (n=35)**			
Chorioamnonitis No (n=105) Yes (n=1)	71(67.6%) 0(0.0%)	34(32.4%) 1(100.0%)	p =0.285*	0.246 -0.427	0.342
Peripartal fever No (n=79) Yes (n=27)	55 (69.6%) 16 (59.3%)	24 (30.4%) 11(40.7%)	p = 0.323	0.637 - 3.895	1.576
Urinary symptom No (n=86) Yes (n=20)	60 (69.8%) 11 (55.0%)	26(30.2%) 9(45.0%)	p =0.317*	0.699 - 5.101	1.888
Fetal tachycardia No (n=105) Yes (n=1)	70 (66.7%) 1 (100.0%)	35 (33.3%) 0 (0.0%)	p =1.000*	0.582 - 0.763	0.667
History of PROM No (n=96) Yes (n=10)	67 (69.8%) 4 (40.0%)	29 (30.2%) 6 (60.0%)	p =0.120*	0.909 - 13.209	3.466

PROM: Prolonged rupture of membrane. *Yates's corrections made

Discussion

Incidence of neonatal sepsis varies across regions, across centers within the same region and from time to time within the same facility. In the present study, the rate of positive blood culture was found to be 33% highlighting a significant burden of neonatal sepsis in this population. This finding is consistent with previous studies that have reported varying prevalence rates of neonatal sepsis; Mokuolu *et al* reported a positive blood culture rate of 30.8% in Ilorin during a 2-year review with a sample size nearly double that of the sample size of the

present study.[14] Similarly, Olokooba *et al* reported a positive blood culture rate of 37.6% in Zaria from a one-year study, compared to the six-month duration of this study.[13] Boma West *et al.* reported an incidence of 41.6%, in Port-Harcourt, Nigeria, in 2012, although the number of neonates studied over 6 months was four times higher than the neonates in this study.[20] Collectively, these findings underscore the persistent prevalence of sepsis across various regions, confirming that it remains one of the leading causes of morbidity and mortality in newborns. This trend persists despite improvements in hygiene practices and the availability of newer antimicrobial agents, emphasizing the need for early detection and more effective preventive strategies.

The most frequently isolated organism in this study was *Staphylococcus aureus*, corroborating findings from Mokuolu *et al*. and Pius *et al*. both of whom identified *Staphylococcus aureus* as the leading cause of neonatal sepsis.[14,21] This indicates that *Staphylococcus aureus* remains a major pathogen in this setting, likely due to its ability to colonize human skin and mucous membranes, facilitating transmission to neonates during delivery or via contact with healthcare workers. Other organisms isolated in this study include *Klebsiella pneumoniae, Escherichia coli, Klebsiella aerogenes,* and *Pseudomonas aerogenes*. Similar findings were identified in various studies across Nigeria and sub-Saharan Africa.[14,22,23] These findings are critical for empirical antibiotic selection in neonatal sepsis management, especially before culture results become available. Early initiation of appropriate antimicrobial therapy can help reduce complications and mortality associated with delayed treatment.

Among neonatal risk factors, abnormal temperature, respiratory distress, and convulsions were significantly associated with positive blood cultures. This is similar to the findings by Jatsho *et al*. who found convulsions and respiratory distress to be related to positive blood culture in neonates.[24,25] Also, Pius *et al*. found fever to be related to positive blood culture in neonates with neonatal sepsis.[26]

Maternal risk factors such as chorioamnionitis, peripartal fever, urinary symptoms, and fetal tachycardia, while clinically important, did not show statistically significant associations in this cohort. This could be due to small sample size for some variables (e.g., only one case of chorioamnionitis and fetal tachycardia), limiting statistical power. However, the borderline significance observed with prolonged rupture of membranes (PROM, $p = 0.066$) supports previous literature identifying PROM as a notable risk factor for neonatal sepsis. These findings reinforce the need for heightened clinical vigilance and possible prophylactic measures in mothers with such risk profiles.

Although some maternal variables did not reach statistical significance, they remain clinically relevant for risk-based screening and early intervention, particularly in resource-limited settings where laboratory support is often delayed or unavailable.

The findings of this study emphasize the critical need for prevention and early

detection of neonatal sepsis to mitigate the associated morbidity and mortality.

Study Limitations

The limitations in this study are that it was a single-centred study, the sample size was relatively small, and the study duration of six months may limit the generalizability of findings to other settings. Additionally, reliance on blood culture alone could have led to underestimation of the true burden of sepsis; low-volume sampling can yield false-negative results. Despite these limitations, the study provides valuable local data that contribute to the understanding of neonatal sepsis patterns in this region.

Policy and Practice Implications

The findings of this study highlight the need for strengthened infection prevention and control (IPC) measures within neonatal units, including strict hand hygiene practices and routine screening of healthcare workers for potential pathogen carriage. The persistence of *Staphylococcus aureus* as a dominant pathogen suggests that infection control lapses remain a critical challenge in healthcare delivery.

At the policy level, there is a need to align local hospital practices with national neonatal sepsis management guidelines, incorporating updated data on prevalent pathogens and resistance trends. Regular surveillance of bacterial isolates and antibiotic susceptibility patterns should be institutionalized to guide empirical therapy and reduce antimicrobial resistance. Furthermore, maternal health interventions, such as timely management of PROM and febrile illnesses during labor, should be prioritized as part of a comprehensive neonatal sepsis prevention strategy.

Conclusion

The persistence of high neonatal sepsis rates despite medical advances highlights the need for continuous monitoring, targeted prevention, and early diagnosis. Strengthening both maternal and neonatal care protocols, supported by updated evidence such as this study, will be key to reducing neonatal morbidity and mortality in Nigeria. Future research should explore the impact of facility-level factors—including infection control practices and staffing—to inform more effective prevention and management strategies for vulnerable newborns.

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Author Contributions:

A.O. Omoboyeje: Conceptualization, Writing – Original draft, Investigation, Methodology and Visualisation
O.J. Adebami: Supervision, Writing – review & editing, Validation
O.E. Adeoye: Data curation, Formal analysis, Visualization
R.G. Afolabi: Investigation
All authors read and approved the final manuscript.

The authors declare no conflict of interest

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