Revisiting Dengue in Nigeria: Epidemiological Analysis, Current Trends and Recommendations

Abstract

Dengue is the world's most significant arboviral disease and it is endemic in contemporary Nigeria. It is usually underreported and misdiagnosed because of its overlapping clinical manifestation with other common causes of fevers such as malaria and typhoid fever. By deploying rich secondary sources, this piece discovered that southwestern Nigeria carried the highest burden of dengue from 1964 to 2023, and dengue had an average prevalence rate of 21 percent between 2001 and 2023. Thus, one out of every five Nigerians is susceptible to dengue infection in contemporary Nigeria. Therefore, our review article maintains that dengue is a largely unrecognized but significant cause of fevers, which requires the utmost public health attention in modern Nigeria. This article highlights the burden of dengue to stem the tide of this arboviral disease through a high index of clinical suspicion, increased surveillance and case testing.

Keywords: Dengue, DENV, virus, Nigeria, prevalence, fever, epidemiology

Introduction

As of December 7, 2024, Nigeria is inhabited by over 230 million, making it the 6th most populous nation in the world, and the most populous black nation (Worldometer, 2024) It has a predominantly tropical climate characterized by high relative humidity and rainfalls between May and September that favors the breeding of mosquitoes (Baba and Talle, 2011). Mosquito-borne diseases create significant public health challenges in tropical and sub- tropical countries. Dengue is the world's most important mosquito-borne disease. Dengue virus (DENV), the causation agent of dengue fever, is of the genus Flavivirus and family *Flaviviridae*, which encompasses four antigenically different serotypes DENV 1, DENV 2, DENV 3, and DENV 4 (Narayan, et al., 2016; Emeribe et al., 2021). An infection from one serotype of the virus usually confers immunity for life against the virus. However, the immunity is partial if such an individual is infected by a new serotype.

Dengue virus (DENV) is carried by infected mosquitoes, especially *Aedes aegypti* and *Aedes albopictus*, which are common vectors of DENV in the West African region including Nigeria (Powell, 2018: Sinha et al., 2024). In Nigeria, the public health burden of dengue is grossly underestimated (Nasir et al., 2017: Akinsulie et al., 2023: Onoja et al., 2023). Aedes Species are vital species of mosquitoes, which thrive in hot and humid conditions, and cause dengue fever in almost all parts of the country. However, there is a greater seroprevalence of the virus in the southeastern and southwestern parts of the country which might be due to proximity to rainforests that provide enabling breeding sites for dengue vectors (Emeribe et al., 2021)

Dengue is the world's most important arbovirus and it is endemic in Nigeria. It is the most common mosquito-transmitted viral infection with 50 percent of the world's population living in prone areas (Messina et al., 2019). It diffuses swiftly in humid regions, affecting roughly 128 countries globally including Nigeria (Bhatt, et al., 2013). In 2023, the world recorded over 5 million cases and 5000 dengue-related deaths (Rabiu et al., 2024). From January 1 to April 28, 2024, 13 countries including Nigeria had ongoing spread of the virus, and they reported that 14,095 souls suffered from dengue fever with 1095 severe cases, and 57 deaths (WHO-Dengue Global Situation, 2024). The recent resurgence of dengue in some tropical and tropical climes could be the consequences of El Niño phenomena in 2023 and climate change leading to increasing temperatures and high rainfall and humidity (WHO Key Dengue Facts, 2024). As of December 2023, 18 African Union countries including Nigeria have witnessed an increase in dengue infections since 2019, with a recorded 270, 000 cases and 753 deaths (Mercy et al. 2024). Nigeria was a hyperendemic dengue region from 2009 to 2020, and all four serotypes of the virus are known to coexist in laboratory analysis (Emeribe et al., 2021: Nasir et al. 2017: Sule et al., 2019). Some factors enhance easy spread and endemicity of dengue in Nigeria. Factors such as urbanization, climate change, and inadequate healthcare systems have contributed immensely to the persistence and dispersal of the disease in the country. The advent of new dengue virus serotypes (Normille, 2013) and the possibilities of co-infection with other arboviruses additionally complicate control efforts (Adesola et al., 2024: Ayukekbong, 2015). Moreover, cases are underreported and misdiagnosed because of their similarity with malaria in clinical presentation. For example, Kolawole et al. (2017) showed concurrence between malaria infection and dengue virus in patients who presented with fever in Ilorin, Nigeria. Hence it might be difficult to estimate the actual burden of dengue in Nigeria.

Even though most dengue infections are subclinical and self- limiting, approximately 1-2 percent might develop clinically severe Dengue Hemorrhagic Fever, Dengue Shock Syndrome, and multisystemic failure leading to mortalities (Brady et al., 2012). Recently, Ademola and Onoja (2017) showed an increasing prevalence of Dengue Hemorrhagic fever in Nigeria. They highlighted that there is gross underreporting of the infectious disease in Nigeria due to poor surveillance and misdiagnosis, hence the late clinical diagnosis and treatment of dengue hemorrhagic fever leading to unwarranted dengue mortalities. The increasing prevalence of dengue, underreporting, misdiagnosis, and inadequate dengue testing infrastructure have triggered a renewed interest in thorough epidemiological analysis of this important arboviral disease in contemporary Nigeria.

There is no dearth of scholarship about dengue fever in the Nigerian context. Most scholars have however focused on the clinical manifestation and its management (Ayukekbong, 2015; Tizhe et al., 2023; Otu et al.,2019; Hamisu et al., 2017; Nyenke et al. 2023). They highlighted the main serotypes of Dengue as DENV 1, DENV 2, DENV 3, and DENV 4, and they posited that the commonest strains in Nigeria are DENV 1 and DENV 2, though recent studies have confirmed the existence of the four strains in some parts of the country. However, Normile (2013) discovered a new strain with a different viral property and categorized it as the fifth strain. Regarding the vectors of the disease, Nyenke et al. (2023) highlighted that Aedes mosquitoes, specifically, Aedes aegypti, are the main transporters of the virus. Aedes albopictus, Aedes

polynesiensis, and Aedes scutellaris are other Aedes species capable of dispersing the disease. Concerning its clinical features in the Nigerian context, the disease is characterized by symptoms such as high fever, headache, body aches, nausea, vomiting, swollen glands, and rash. According to Ademola and Onoja (2017) secondary infections usually lead to complicated cases of dengue resulting in complications such as bleeding, organ impairment, dengue shock syndrome, and dengue hemorrhagic syndrome. According to Chen and Wilson (2010), Kuno (2009) and Gould and Solomon (2008) dengue hemorrhagic fever arise when a person contracts another strain of dengue virus after an earlier infection with a different strain. Most infections are self-limiting and patients usually recover within 1 to 2 weeks. Dengue has no specific treatment, and patients are treated symptomatically. Only a few dengue patients get severe illness and require hospitalizations.

There are emerging issues of underreporting and misdiagnosis of dengue in Nigeria. Many scholars have reported coinfection of dengue with other infectious diseases such as yellow fever, zika, chikungunya, and even non- arboviral diseases like malaria and COVID -19 present with overlapping clinical symptoms, hence the burden of dengue is exceptionally underreported (Raut et al., (2015); Onoja et al., (2016); Kolawole et al. (2017); Oladipo et al. (2022); Asaga Mac et al., (2023). Similarly, even common tropical bacterial infections have shown coinfection with dengue virus. Against the backdrop of the paucity and inadequacy of dengue testing kits and other infrastructures in resource-poor climes including Nigeria, the implications of this could be grave regarding underdiagnosis of dengue in favor of commoner causes of fevers in Nigeria. For instance, Baba et al. (2013) showed substantial coexistence of dengue with other infections in 310 patients in Borno State who presented with suspected malaria and typhoid symptoms. There was approximately 48 percent case positivity for dengue virus irrespective of the presence or absence of malaria or typhoid. Similarly, Moses et al. (2016) outlined the similarities in clinical manifestation of dengue, malaria, and typhoid in patients who presented with fever in Uyo, Nigeria. In this light, it is shown that dengue has contributed substantially to the diagnosis of fevers in Nigeria. Therefore, it should be considered along with malaria and typhoid as vital causes of fevers in contemporary Nigeria.

Similarly, other scholars delve into the institutional and systemic issues of the disease in Nigeria. For instance, Adesola et al. (2024) highlighted challenges of insufficiencies of surveillance infrastructure, late diagnosis, inadequate vector control strategies, limited dengue testing dengue capacity, and poor healthcare funding in most healthcare facilities in Nigeria. Apart from these issues, public awareness and participation of majority of the populace is low. There is poor sensitization of substantial proportions of the citizenry about vector control and environmental sanitation to stem the tide of dengue virus. Olamiju et al. (2014) assessed the public awareness and knowledge of neglected tropical diseases (NTDs) in Abuja, Nigeria by interviewing governmental officials, business owners, policy makers, politicians, students, job seekers, and the general public. They demonstrated that despite the government's numerous efforts geared towards the management of NTDs in Nigeria including dengue, there is little sensitization of the general public. In contrast, Oche et al. (2021) discovered a high sensitization of 95.1 percent among 367 healthcare workers in Sokoto concerning dengue transmission and its vector control.

There is no paucity of scholarship regarding the prevalence of dengue in Nigeria. Several studies have attempted to evaluate dengue prevalence, albeit on a regional basis. These results show obvious disparities and variations based on geographical location, test samples, populations, and diagnostic criteria. Okoror et al. (2019) reported a dengue seroprevalence of 21.9 percent among some rural communities in South West Nigeria. Contrastingly, in Jos, Miri et al. (2019) detected 55.3 percent seroprevalence for dengue among tested individuals. In difference, Idris et al. (2013) reported 10.1 percent seroprevalence for DENV 3 in Maiduguri while Okonkwo et al. (2023) reported a prevalence of 2.1 percent among pregnant women in Port-Harcourt, Rivers State. However, there is a dearth of a thesis, which attempts to harmonize the varied dengue prevalence across diverse geographical settings in Nigeria. This scholastic adventure is imperative to authenticate this infectious disease as an infectious disease of national significance across all regional contexts. This exercise is expedient to validate dengue as a major cause of fever across the country so that it could receive adequate public health attention like malaria, typhoid, and other common causes of febrile illness in Nigeria. Thus, the focus of this study is on delineating past and present dengue epidemiological features to ascertain the average prevalence of dengue in contemporary Nigeria.

Moreover, most health facilities in Nigeria lack adequate laboratory capacity for dengue virus identification and classification thereby obscuring the real burden of the virus in Nigeria. For instance, in the recent dengue epidemic in Sokoto in 2023, 84 dengue cases were identified without adequate sample estimation, viral testing and identification (Adesola et al. 2023). In this regard, we seek to examine the current epidemiological situation of dengue to construct future perspectives and plan for a robust and effective management of dengue and other arboviruses in Nigeria. To achieve this lofty objective, this article intends to analyze and critique the prevalent dengue testing methods in Nigeria to proffer adequate recommendations for optimal dengue virus identification and diagnosis to enhance effective management.

This review article deployed and analyzed robust secondary sources regarding dengue research in Nigeria between 1964 and 2023. The articles were extracted from Google Scholar, PubMed, Web of Science and other relevant sources. In addition, a snowballing method was used to identify other related publications.

Historical Epidemiology of Dengue in Africa

Dengue fever has probably been present in Africa for centuries but its clinical significance remained subsumed under other common fevers such as malaria, typhoid fever, and yellow fever. There is paucity of a detailed record of dengue history in Africa, but dengue outbreaks were well documented from the late eighteenth century. Cairo, Egypt encountered the first recorded dengue-like epidemic in 1779 (Christie, 1881). Other epidemiological records reported dengue-like outbreaks in the late nineteenth century in Zanzibar, Senegal, and Gambia (Gubler and Clark, 1995; Vasilakis and Weaver, 2008). Christie (1881) detailed how dengue got its name in the epidemic of 1870 in Zanzibar. The locals initially referred to the disease as *denga*. Subsequently, it was changed to dengue. However, earlier epidemics could not be exclusively

attributed to dengue, because there was plausibility of coinfection with other arboviruses, and other similar arboviruses might have been responsible for the outbreaks (Braack et al. 2018). Even though dengue fever might have been dispersed by frequent sailings occasioned by the triangular slave trade dynamics, the serological studies of the virus were nonexistent in the nineteenth century, hence the presence of the epidemics could not be solely pinned on dengue with certainty. It was not until the early twentieth century that retrospective serological studies confirmed dengue virus caused the first outbreak in Africa. South Africa witnessed the first outbreak of dengue in Africa in 1927. (Kokernot et al. 1956). Likewise, some patients being managed for fever between 1964 and 1968 at University College Hospital (UCH), Ibadan in Nigeria tested positive to serotypes DENV 1 and DENV 2, and it was the first time the two common strains were isolated in Africa (Carey et al. 1971).

In twentieth-century Africa, some sporadic and scattered dengue epidemics were reported in South Africa, Upper Volta, Senegal and other parts of West Africa. In West African climes, and particularly on the ships and the harbors, many countries encountered dengue epidemics. For example, between 1925 and 1928, dengue outbreaks were recorded in Upper Volta (presently Burkina Faso) and Dakar in Senegal (Legendre, 1926; Perves,1928). Equally in Durban, South Africa, a dengue disease affecting more than 40, 000 people broke out between 1926-27 (Edington, 1927). During World War 2, East Africa and the adjoining islands witnessed several dengue epidemics against the backdrop and dynamics of the global conflict (McCarthy and Brent, 1943; McCarthy and Wilson, 1948; Menjaud, 1947). Between 1977 and 2009, five large epidemics with about 300, 000 cases were recorded in Seychelles, Reunion Island, Comoros Island, Djibouti, and Cape Verde (Dengue/DHF update, 2009; Cornet, 1993; Sang, 2006).

Epidemiological Analysis of Dengue in Nigeria, 1964-2023

Dengue infections have probably been present in Nigeria since the early modern era. They were significantly enhanced by the commercial exchanges of slaves and raw materials between the Europeans and Africans mainly through the sea route. However, the first infections in Nigeria were officially recorded at the University College Hospital, Ibadan between 1964 and 1968 (Carey et al. 1971b). The detected serotypes were mainly DENV-1 and DENV-2. In 1973, the first recorded outbreak occurred in the ancient city of Abeokuta in South West Nigeria (Fagbami et al., 1977). Many sporadic cases of dengue have occurred across different geographical regions in Nigeria since the 1960s when the first serological evidence of DENV was discovered at UCH. The common symptoms of dengue among Nigerians include fever, headache, myalgia, arthralgia, rash, and lymphadenopathy (Moore et al., 1975; Fagbami et al. 1976). Most cases are underreported because of overlapping symptoms with common causes of fevers such as malaria, typhoid fever, yellow fever, and even hepatitis. Thus, the burden of dengue remained higher than reported values (Okoror, et al., 2021). In this regard, our review article intends to examine and evaluate common epidemiological characteristic of past and present dengue epidemics to compute and compare their prevalence rates. For this analysis, the past dengue outbreaks connote recorded cases from its first recorded cases in 1964 to 1999. However, there were no available data of dengue cases from 1981 to 2000. Therefore, the analysis of past infections would span

between 1964 and 1980. The present era of dengue cases starts from 2001 to 2023. Six key criteria will be analyzed. They are the location of cases, number of cases, sample size, diagnostic criteria, prevalence, and dengue virus serotype. Table 1 displays the epidemiological data of dengue from 1964 to 1980 in Nigeria.

Table 1: Epidemiology of Dengue in Nigeria, 1964-1980

Survey Period	Location	Number of Cases	Sample Size	Diagnostic Approach	Prevalence (%)	Dengue Serotypes
1964-68	Ibadan	32	N/A	Virus Isolation and Neutralization Test	NA	DENV 1 -18 DENV 2-14
1968-69	Oyo State	136	216	Virus Isolation and Neutralization Test	NA	DENV 1 -18 DENV 2-14
1972	Oyo State	164	304	Serology	54	NA
1973	Abeokuta	1	N/A	N/A	N/A	DENV 1
1975	Oyo State (Igbo- Ora)	52	78	Hemagglutination Inhibition Test	67	DENV 1-67% DENV 2-45%
1977	Nigeria	811	1816	Neutralization Test	45	DENV 2
1980	Kaniji Lake Basin	124	267	Hemagglutination Inhibition Test	46	DENV 2
Total		**1320**	**2681**			

Adapted from Adesola et al., (2024) Addressing the Dengue Fever Challenges in Nigeria: A narrative review and recommendation for control. *Le Infezioni in Medicina* 2:157-167.

From Table (1), we can see that Nigeria recorded a total of 1,320 cases of dengue between 1964 and 1980. The further analysis of Table (1) shows that between 1964 when the virus was first isolated in 32 patients presenting with febrile conditions at University College Hospital (UCH) Ibadan and roughly a decade after in 1975, there were 385 cases altogether in Nigeria in 1975 with Oyo state including Ibadan accounting for virtually all the cases of dengue. The reason might not be farfetched. The UCH was established on 20 November 1957 (Okutoyi, 2023), and was the premier teaching hospital in Nigeria, thus it commenced the novel dengue surveillance, health education, awareness, and viral identification studies. From there it spread to other regions of the country. Moreover, because it was the first and revered tertiary health institution in Nigeria, most febrile cases would have been transported to Ibadan for treatment and hence

laboratory analysis. Since Oyo state houses Ibadan where the facility was situated, the overall dengue cases represented the total dengue cases in Nigeria during the era. Thus, the entire number of dengue cases skyrocketed from a total of 385 cases over the previous decade to a total of 811 cases in 1977. This substantial increment represented a growth of over 100 percent. It is noteworthy that this astronomical increase in dengue cases was not directly related to outbreaks but rather due to increased efforts at surveillance, case detection, and laboratory testing.

Considering the total values of samples evaluated for dengue virus from 1964 to 1980 and discountenancing 1964-68 and 1973 when the sample size unavailable, Table (1) displays that 1320 samples were positive for dengue out of the total sample of 2681. This represented a high prevalence rate of dengue of 50 percent during the review period. Regarding the prevalence of dengue during the era, if we discountenance 1964-68 and 1973, when there were no recorded prevalence data, the average prevalence rate from 1968 to 1980 was 55 percent, with the highest prevalence rate of 68 percent dengue cases reported in Oyo state between 1968 and 1969. The prevalence rate of 45 percent reported in Nigeria in 1977 was the lowest recorded between 1968 and 1980. This could be attributed to a reason. The prevalence of dengue is expected to wane with the increasing population at risk relative to the number of actual cases. It is also noteworthy that hemagglutination inhibition test and neutralization were the main diagnostic methods of dengue between 1968 and 1980. In all, both DENV 1 and DENV 2 were responsible for the causation of dengue fever between 1968 and 1980 but with a preponderance of DENV 2. Table (2) highlights the main epidemiological data on dengue in Nigeria between 2001and 2023.

Table 2 Epidemiological Data of Dengue in Nigeria, 2001-2023

Survey Period	Location	Number of Cases	Sample Size	Diagnostic Approach	Prevalence (%)	Dengue Serotypes
2001	Maiduguri	5	973	ELISA	0.5%	DENV-1-(1) DENV-2-(4)
2001-2002	Abuja Ibadan Gombe Calabar Kano Maiduguri	13	1948	ELISA	0.9%(Ibadan) 0.36%(Abuja) 0.1%(Calabar) 1.67(Maiduguri)	DENV-1 (Ibadan, Abuja, and Calabar); DENV-2(Maiduguri)
2004	Uyo	7	145	Serology	3.7% Male 5.5% Female	N/A
2008	Maiduguri	193	310	Neutralization Test	67.71%	DENV -1 DENV – 2 DENV- 3 DENV-4
2010	Plateau	4	182	ELISA	2.2%	N/A
2011	Maiduguri	26	256	Microneutralization Assay	18.5%(Female); 6.3% (Male)	DENV-3
2013	Ilorin	40	120	ELISA	44.1% (Male); 16.1% (Female)	DENV-1; DENV-2; DENV-3; DENV-4
2013	Kaduna	6	340	ELISA	1.80%	N/A
2013	Ibadan	138	188	ELISA	73%	N/A
2014	Ibadan	64	274	ELISA	23.4%	N/A

2014	Kaduna State	190	366	ELISA	72.95%(Kafanchan) 34.42%(Birnin Gwari) 57.21 (Female) 46.36% (Male)	N/A
2014	Ogbomoso	16	93	ELISA	17.2%	N/A
2014	Osun State	77	100	ELISA	77%	N/A
2014	Sagamu	1	60	Standard Diagnostic Dengue NS1 + Ab combo rapid test kit	1.7%	N/A
2014	Jos and Maiduguri	111	529	ELISA	21%	N/A
2014-2015	Osun State	67	89	ELISA	41.6% (IgM); 33.7% (IgG)	N/A
2015	Maiduguri	34	91	ELISA	22.2%(Male) 41.1%(Female)	N/A
2015-2016	Nasarawa State	17	354	ELISA	4.0%	N/A
2015-2016	Osogbo	3	170	ELISA	1.80%	N/A
2016	Ile- Ife	46	179	ELISA	26.5% (Male); 25% (Female)	N/A
2016	Maiduguri	67	90	ELISA	74.40% (IgM); 90% (IgG)	N/A
2016	Kwara State	76	176	ELISA	46%	N/A
2016	Abia and Cross River	3	17	Polymerase Chain Reaction	17.6%	DENV-1 DENV-2
2016	Abuja	74	171	ELISA	43.3%	N/A
2016	South East	44	338	ELISA	13.02%	N/A
2017	Cross River	25	420	Lateral flow immunoassay Cassettes	6%	N/A
2017	Jos	33	113	ELISA	19.0% (Male - IgM); 21.4% (Male - IgG); 2.4% (Female - IgM and IgG); 6.6% (IgM); 10.5% (IgG); 2.6% (IgG/IgM)	N/A
2017	Osogbo	2	91	ELISA	2.20 %	N/A
2017	Nasarawa State	12	400	Aria Dou dengue virus rapid diagnostic test kit	3%	N/A
2017	Abuja	79	178	ELISA	44.4%	N/A
2010-2018	Ibadan Abuja Lagos	379	709	ELISA	67.7% (Jos); 62.3% (Ibadan); 32.1% (Abuja); 58.6% (Female); 50% (Male)	N/A
2018	Lagos	11	130	Polymerase Chain Reaction	8.5%	DENV- 1 DENV - 3
2018	Anambra	74	96	ELISA	54.1% (Male); 45.9% (Female)	N/A
2018	Kano	13	137	ELISA	9.4%	N/A
2018	Borno	176	197	ELISA	89%	N/A
2018-2019	Lagos State	76	305	Micropoint lateral flow chromatographic immunoassay	24.9%	N/A
2019	Kogi state	42	200	Immunoassays	23.1% (Male); 20.5% (Female)	N/A

2019	Jos	52	94	ELISA	55.3%	N/A
2019	Rivers State	75	385	ELISA	19.5%	N/A
2020	Adamawa State	82	424	ELISA	19.4%	DENV - 1
2020	Jos	36	220	Mytest Dengue NS1 Ag+Ab Combo card	16.30%	N/A
2021	Awka	38	138	ELISA	20.2%	N/A
2021	Enugu	67	150	ELISA	44.7%	N/A
2021	South West	305	1074	ELISA and Reverse Transcriptase Polymerase Chain Reaction (RT-qPCR)	29.4%	N/A
2019-2022	North central	60	1006	ELISA	6%	N/A
2022	Anambra	17	96	ELISA	17.7%	N/A
2022	Rivers State	2	94	ELISA	2.1%	N/A
2023	Sokoto State	84	N/A	N/A	N/A	N/A
Total		3069	14, 215			

Adapted from Adesola et al., (2024) Addressing the Dengue Fever Challenges in Nigeria: A narrative review and recommendation for control. *Le Infezioni in Medicina* 2:157-167.

From Table (2) it could be deduced that there was heightened and more expansive testing for dengue across the various geopolitical zones of the country compared with the previous century restricted to southwestern Nigeria as initially highlighted in Table (1). In Table (2), if we minus Sokoto's dengue case (84) from the total number of 3069 cases, because it was devoid of a sample population, and divide it by a total of 14, 215 samples, we get 20.99 percent prevalence rate between 2001 and 2023. An average dengue prevalence rate of approximately 21 percent implies an enormous unrecognized dengue burden in contemporary Nigeria. This value correlates with the dengue prevalence rate of countries with similar geographical settings and climatic conditions. For instance, Amoako et al. (2018) discovered a dengue seroprevalence of 21.5 percent among children with suspected malaria in Ghana. Similarly, Nkenfou et al. (2021) highlighted dengue prevalence rate of 20.2 percent among febrile children in Cameroon. In Nigeria, the prevalence rate of the disease is plausibly higher considering that dengue is not routinely tested in patients presenting with fevers. Therefore, the burden is probably higher among the populations than those presenting at the health facilities. To corroborate this claim, Okoror et al. (2019) outlined a prevalence rate of 57.5 percent for the dengue virus in selected rural communities in South West Nigeria.

Comparing the dengue positivity rate of 21 percent in Table (2) with recent malaria prevalence gives interesting propositions. Interestingly, it correlates with the present malaria prevalence in southwestern and north-central Nigeria. In 2017, Olukosi et al. (2018) discovered an average malaria prevalence of 19.4 percent by malaria Rapid Diagnostic Test (mRDT) and 11.9 percent by microscopy in southwest and north-central Nigeria. Typhoid is another vital cause of febrile illness among Nigerians but its prevalence rate is much lower. Ohanu (2019) outlined an 11.4 percent prevalence rate for typhoid in Enugu State, Nigeria. Hence, dengue is one of the most significant causes of fever in Nigeria.

In a related vein, from table (2), the 3069 positive cases out of 14, 215 samples taken between 2001 and 2023 represented a substantial rise in dengue infections compared with 1320 positive

dengue cases out of 2681 total samples between 1964 and 1980 in Nigeria. The roughly 3-fold increase in the total dengue cases is probably due to more expansive surveillance, and heightened awareness about the disease among health workers leading to an increased index of suspicion, hence increased case testing and setting of some dengue testing centers in twentieth-first century Nigeria. The more developed transportation system, which encourages movement of people, mosquito vectors and the virus as well as heightened rural- urban drift, climatic change and expansive population growth encountered from the turn of the twenty-first century Nigeria are other plausible reasons for the monumental rise in dengue cases.

Deconstructing the broad values into different components, South West Nigeria carries the main burden of dengue in contemporary Nigeria. From Table (2) Osun state had a 77 percent prevalence rate of dengue in 2014, which remained the highest till date. It was closely followed by Maiduguri with 74 percent in 2016, and Ibadan with 73 percent in 2013 of dengue prevalence. Calabar had the lowest dengue prevalence with 0.1 percent between 2001 and 2002. Similarly, from Table (1) Oyo state had the peak case positivity rates for dengue between 1964 and 1980 with a prevalent rate of 67 percent in 1975 and 57 percent in 1973. Hence, we assert that South West Nigeria carries the heaviest dengue burden in Nigeria. However, other areas might have a higher prevalence than southwest Nigeria but are inapparent presently due to the challenges of serological and molecular surveillance for dengue in Nigeria. This is more apparent in rural and remote settings with significantly poor health systems.

Regarding the diagnostic criteria, the most common method of dengue diagnosis in Nigeria between 2001 and 2023 was Enzyme Linked Immunosorbent assay (ELISA). This is a common, less time-consuming and less technical serological test, which detects active immunoglobulin M (IgM) 4- 5 days after the appearance of symptoms of primary infections, and it can last up to 30 days in the serum. ELISA also detects IgG in the convalescent stage, usually starting from 7 days, and can last for up to 3 months or a lifetime (Kirkpatrick et al., 2015). ELISA is useful for analyzing large samples, and therefore effective for screening purposes, but it has an obvious limitation for epidemiological analysis. As seen in Table (2) the limitation of ELISA is its inability to delineate specific dengue virus responsible for infections. The majority of the tests done did not display the dengue serotypes, which caused the infections. It is imperative to delineate dengue viruses into distinct serotypes and to differentiate them from other coexisting arboviruses. Most dengue infection cocirculate with other flaviviruses, specifically with Zika virus; hence, precise detection of dengue virus plays a pivotal role in outbreak control and patient management (Herrada et al., 2018).

Much more importantly, it is pertinent to distinguish between primary and secondary dengue infections. The latter usually leads to dengue shock syndrome, dengue hemorrhagic fevers, and multiple organ failure, which results in high mortalities. In this regard, the World Health Organization (WHO) has endorsed the hemagglutination inhibition (HI) test to differentiate between primary and secondary dengue infections (Lukman et al., 2016). It is also imperative to plan disease intervention regarding environmental and vector control. Some mosquitoes are specific carriers of certain serotypes of virus depending on their geographical attributes. Hence, we suggest more sensitive and specific molecular-based tests such as Hemagglutination

inhibition tests and Reverse Transcriptase-Polymerase Chain Reaction. It would engender dengue virus identification and isolation to enhance diagnosis and to properly reveal the true burden of dengue fever in Africa including Nigeria.

From Table (2), even though the majority of ELISA tests carried out from 2013 to 2023 failed to identify specific dengue serotypes, a few more specific dengue tests such as PT- PCR and Neutralization tests essentially revealed DENV 1 and DENV 2 serotypes as the dominant cause of infections between 2001 and 2023. In 2008, the first four serotypes were first isolated and attributed to dengue infections for the first time in Maiduguri. From Table (2), DENV 3 gained prominence when it independently triggered an outbreak in Maiduguri in 2011. Subsequently in 2013, in Ilorin, the four dengue virus strains were codependently isolated in a sample of patients presenting with high fever among other symptoms. It is plausible that most of the sporadic outbreaks since 2013 had been caused by the four serotypes. However, there were no ways to authenticate this assertion without adequate molecular testing for suspected dengue cases. Although Nigeria has been described as a hyperendemic state, there is little evidence to substantiate this claim because the country lacks the widespread laboratory capacity to carry out the necessary dengue molecular viral identification. It is then pertinent to say that the overreliance on the cheap, and less sophisticated ELISA in diagnosing dengue has rubbed the country of adequate epidemiological analysis of sporadic cases and outbreaks of dengue in Nigeria. It is imperative to show the real prevalence of dengue fever, and to consider it as a reportable disease in the most populous black nation. This has led to a consistent inability to recognize dengue as an infectious disease of public health concern in Nigeria.

Conclusion

This article has shown dengue as an important cause of fever in Nigeria. However, its resultant burden has often been underplayed and unrecognized. We analyzed the past and present epidemiological data on dengue in Nigeria. By deploying relevant secondary sources from Google Scholar, PubMed, and other relevant sources, the thesis discovered that South West Nigeria had the highest burden of dengue between 1964 and 2023. The study also found out that the average prevalence rate of dengue was 21 percent between 2001 and 2023, hence one out of every five Nigerians is prone to dengue fever in the contemporary era. Thus, we claim that dengue is one of the commonest causes of febrile illness in Nigeria. Moreover, this thesis outlined that despite the heightened laboratory testing for dengue between 2001 and 2023, the overreliance on ELISA as the dominant diagnostic method of dengue made it somewhat impossible to carry out adequate and reliable epidemiological analysis of dengue in contemporary Nigeria. As shown in this study, the paucity of more sophisticated tests such as Hemagglutination and RT-PCR necessitates the widespread incorporation of Dengue Virus NS1 antigen test into the dengue serology test system, most especially at primary health care settings . The determination of this antigen is an important test to detect acute dengue infections, which could enhance surveillance, rapid dengue testing and case management. This would highlight the

true prevalence of dengue in Nigeria. In the foreseeable future, the first licensed vaccine against dengue named CYD-TDV, which have been approved for individuals aged 9 years or above from populations with high transmission rates, could prove valuable as shown by Torres et. al. (2019). Other emerging vaccines include Dengvaxia and Tak-003, which have been approved and licensed in some countries (Haider et al., 2024). However, there are issues regarding their safety and suitability for diverse age groups and different serotypes. Other vaccines are under consideration. In conclusion, this article argues that dengue is an unrecognized and a significant cause of fever in Nigeria, and a veritable public health burden. More significantly, dengue should be considered a reportable disease to enjoy more surveillance, widespread awareness, and enhanced molecular-based laboratory dengue testing to illuminate the true burden of the scourge in Nigeria.

Disclaimer (Artificial intelligence)

Option 1:

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

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