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Full Length Research Paper

Epidemiology of Dengue Virus Infection and Associated Risk Factors among Febrile Patients Attending Tertiary Hospitals in Southwestern Nigeria

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Abstract

Dengue is an under-recognised cause of acute febrile illness in West Africa, where malaria is frequently presumed and dengue is rarely tested. This hospital-based cross-sectional study determined the seroprevalence of dengue virus (DENV) infection, characterised circulating serotypes, and identified demographic, environmental, and behavioural risk factors among febrile patients in Southwestern Nigeria. A total of 384 febrile patients aged 2–68 years were consecutively recruited from outpatient and emergency departments of two tertiary hospitals in Ibadan and Abeokuta between April and October 2025. Blood samples were tested for DENV NS1 antigen, anti-DENV IgM and IgG by enzyme-linked immunosorbent assay (ELISA), and DENV RNA by real-time reverse-transcription polymerase chain reaction (RT-PCR) with serotyping. Malaria parasitaemia was assessed by microscopy and rapid diagnostic test. Structured questionnaires captured socio-demographic, environmental, and clinical data. Data were analysed with SPSS Version 27.0; associations were assessed with chi-square, Fisher's exact test, and multivariable logistic regression at $p \leq 0.05$. The overall DENV seroprevalence (NS1 and/or IgM and/or IgG) was 28.4% (109/384): acute infection (NS1 and/or IgM positive) 13.5% (52/384) and past exposure (IgG only) 14.8% (57/384). RT-PCR confirmed DENV RNA in 41 patients (10.7%), with DENV-2 predominating (53.7%), followed by DENV-1 (26.8%), DENV-3 (14.6%), and DENV-2/DENV-3 co-infection (4.9%). Dengue-malaria co-infection was found in 6.5% (25/384) of patients. In multivariable analysis, stagnant water within 50 m of residence (AOR = 2.84; 95% CI: 1.68–4.80), absence of window screens (AOR = 2.31; 95% CI: 1.36–3.92), open water-storage containers (AOR = 1.98; 95% CI: 1.18–3.33), and age 15–34 years (AOR = 1.87; 95% CI: 1.08–3.24) were independently associated with DENV infection. Headache (78.8%), myalgia (71.2%), retro-orbital pain (48.1%), and thrombocytopenia (platelets <150 × 10^9/L, 42.3%) were significantly more common in acute dengue than in malaria-only illness. Dengue is a substantial,

under-diagnosed cause of febrile illness in Southwestern Nigeria. Routine dengue testing in febrile patients, vector control, and clinician awareness are urgently needed.

Key words: Key words: Dengue virus, seroprevalence, NS1 antigen, febrile illness, risk factors, Aedes aegypti, Nigeria, co-infection.

INTRODUCTION

Dengue virus (DENV), a mosquito-borne flavivirus transmitted principally by Aedes aegypti and Aedes albopictus, is the most rapidly spreading arboviral disease globally, with an estimated 390 million infections annually, of which about 96 million are clinically apparent (Bhatt et al., 2013; WHO, 2024). Four antigenically distinct serotypes (DENV-1 to DENV-4) circulate, and secondary infection with a heterologous serotype increases the risk of severe dengue through antibody-dependent enhancement (Guzman and Harris, 2015). Clinical manifestations range from undifferentiated fever to dengue fever, dengue haemorrhagic fever, and dengue shock syndrome, and overlap substantially with malaria, typhoid, and other febrile illnesses endemic in tropical Africa (WHO, 2009).

Although dengue has long been considered a disease of Asia and Latin America, accumulating evidence shows extensive, largely unrecognised transmission in Africa (Amarasinghe et al., 2011; Were, 2012). Outbreaks have been documented in Senegal, Burkina Faso, Kenya, Angola, Tanzania, and Nigeria, often detected retrospectively or only after travellers return ill (WHO, 2024; Musa et al., 2020). In Nigeria, dengue was first reported in Ibadan in the 1960s, and recent serosurveys and outbreak investigations in Lagos, Ibadan, Maiduguri, and Port Harcourt suggest appreciable circulation (Oyero and Ayukekbong, 2014; Omatola et al., 2020; Bello et al., 2022). Nevertheless, dengue is not part of routine fever work-up in most Nigerian hospitals, and febrile patients are frequently treated empirically for malaria without laboratory confirmation of alternative aetiologies.

Several factors favour dengue transmission in Southwestern Nigeria: dense urban populations, tropical rainfall with two peaks, poor drainage, indiscriminate refuse disposal, open water storage, and widespread Aedes breeding in discarded tyres, flower pots, and uncovered containers (Oladipo et al., 2021; Adeleke et al., 2023). Rapid urbanisation and climate variability, including warmer temperatures and altered rainfall, may further expand vector range and lengthen transmission seasons (Ebi and Nealon, 2016; Messina et al., 2019). Despite this, hospital-based data combining NS1 antigen, IgM/IgG serology, and RT-PCR serotyping remain scarce, and risk-factor data that could guide targeted vector control are limited.

The present study was therefore designed to: (i) determine the seroprevalence of acute and past DENV infection among febrile patients attending tertiary hospitals in Southwestern Nigeria; (ii) identify circulating DENV serotypes by RT-PCR; (iii) estimate the prevalence of dengue-malaria co-infection; and (iv) identify demographic, environmental, and behavioural factors independently associated with DENV infection. It was hypothesised that dengue would account for a substantial proportion of acute febrile illness and that proximity to Aedes breeding sites and inadequate household vector-proofing would be key predictors.

MATERIALS AND METHODS

Study design, period, and setting

This was a hospital-based cross-sectional study conducted from April to October 2025 — spanning the early rainy season through the peak rainy season — at the University College Hospital, Ibadan, and the Federal Medical Centre, Abeokuta, both tertiary referral hospitals in Southwestern Nigeria.

Ibadan (7.38°N, 3.90°E) and Abeokuta (7.15°N, 3.35°E) are densely populated urban centres with tropical wet-and-dry climates, mean annual rainfall of 1,200–1,400 mm, and well-documented Aedes aegypti populations.

Study population, inclusion and exclusion criteria

Participants were patients presenting with acute febrile illness (axillary temperature ≥37.5°C or history of fever within the preceding 7 days) to outpatient, emergency, or paediatric departments. Inclusion criteria were age ≥2 years, residence in Oyo or Ogun State for at least 3 months, and written informed consent (or assent with parental consent for minors). Patients who had received a dengue vaccine, who had a confirmed diagnosis of a non-febrile condition explaining fever, or who declined blood sampling were excluded. Patients with a history of jaundice in the preceding 3 months were also excluded to avoid confounding with other flavivirus testing pathways in the hospital protocol.

Sample size and sampling technique

Sample size was calculated using Cochran's formula for a single proportion, assuming a dengue seroprevalence of 32% from a prior Nigerian febrile-patient study (Omatola et al., 2020), 95% confidence, 5% precision, and 10% non-response, yielding a minimum of 369 participants. A total of 384 patients were consecutively enrolled until the target was reached. The sample-size adequacy and post-hoc power were verified with G*Power version 3.1.9.7 for chi-square and logistic regression (effect size 0.30, power 0.88).

Data collection and laboratory analyses

A structured, pre-tested questionnaire was administered to capture socio-demographic characteristics (age, sex, occupation, education, residence), environmental exposures (stagnant water near home, open water storage, refuse disposal, presence of window screens, use of insecticide-treated nets, use of mosquito repellents), travel history, and clinical features (duration of fever, headache, myalgia, arthralgia, retro-orbital pain, rash, vomiting, bleeding). Clinical examination, temperature, and blood pressure were recorded. Venous blood (5 mL) was collected aseptically into EDTA and plain tubes.

DENV NS1 antigen, anti-DENV IgM, and anti-DENV IgG were detected by commercial ELISA kits (Panbio Dengue Early ELISA and Dengue IgM/IgG Capture ELISA) according to manufacturers' instructions, with positive and negative controls in each run. DENV RNA was extracted from plasma (QIAamp Viral RNA Mini Kit) and amplified by real-time RT-PCR targeting the 3' untranslated region, with serotype-specific primers/probes for DENV-1 to DENV-4. Malaria was diagnosed by Giemsa-stained thick and thin blood films and a histidine-rich protein-2/pLDH rapid diagnostic test. Full blood count, including platelet count and haematocrit, was performed with an automated haematology analyser. Laboratory staff were blinded to questionnaire data.

Definitions

Acute DENV infection was defined as NS1 antigen and/or IgM positive, with or without IgG. Past exposure was defined as IgG-only positivity. Dengue-malaria co-infection was defined as laboratory evidence of acute DENV infection plus malaria parasitaemia. Thrombocytopenia was defined as platelet count <150 × 10^9/L. Severe dengue features were assessed using WHO (2009) criteria.

Statistical analysis and ethical considerations

Data were entered in Microsoft Excel and analysed in SPSS Version 27.0. Categorical variables were summarised as frequencies and percentages; continuous variables as mean (SD) or median (IQR).

Bivariate associations were tested with chi-square or Fisher's exact test for categorical variables and Student's t-test or Mann-Whitney U test for continuous variables. Variables with $p < 0.20$ in bivariate analysis were entered into multivariable logistic regression, reporting adjusted odds ratios (AOR) with 95% confidence intervals. Statistical significance was set at $p \leq 0.05$. Ethical approval was obtained from the University of Ibadan / University College Hospital Ethics Committee (UI/EC/2025/011) and the Federal Medical Centre Abeokuta Ethics Committee (FMC/AB/2025/004). Written informed consent was obtained from all participants or guardians. Results were communicated to attending clinicians for patient management; no participant identifiers are reported.

RESULTS

Socio-demographic and clinical characteristics

Of 384 febrile patients, 198 (51.6%) were female and 186 (48.4%) male; mean age was 29.4 ± 14.8 years (range 2–68 years). The 15–34-year age group accounted for 46.1% of participants, followed by 35–54 years (24.5%), 2–14 years (18.2%), and ≥55 years (11.2%). Most participants resided in urban areas (72.4%); 58.3% reported stagnant water within 50 m of their residence, 47.1% stored water in open containers, and 52.6% lacked window screens. The commonest presenting symptoms were fever (100%), headache (71.6%), myalgia (62.5%), arthralgia (44.3%), and vomiting (28.6%). Median duration of fever at presentation was 4 days (IQR 3–6 days).

Prevalence of dengue virus infection and serotypes

Overall DENV seroprevalence (NS1 and/or IgM and/or IgG) was 28.4% (109/384). Acute infection was present in 13.5% (52/384): NS1 positive in 9.6% (37/384), IgM positive in 10.2% (39/384), and both NS1 and IgM positive in 6.3% (24/384). Past exposure (IgG only) was found in 14.8% (57/384). DENV RNA was detected in 41 patients (10.7% of all participants; 78.8% of acute cases). Among RT-PCR-positive patients, DENV-2 predominated (53.7%, 22/41), followed by DENV-1 (26.8%, 11/41), DENV-3 (14.6%, 6/41), and DENV-2/DENV-3 co-infection (4.9%, 2/41). No DENV-4 was detected. Serotype distribution did not differ significantly by hospital site ($p = 0.42$).

Table 1. Laboratory markers of dengue virus infection among febrile patients (n = 384).

DENV marker	Positive, n (%)	Interpretation
NS1 antigen	37 (9.6)	Early acute infection
Anti-DENV IgM	39 (10.2)	Recent / acute infection
Anti-DENV IgG only	57 (14.8)	Past exposure
Any DENV marker	109 (28.4)	Overall seroprevalence
DENV RNA (RT-PCR)	41 (10.7)	Confirmed viraemia
DENV-2 (of 41 RT-PCR+)	22 (53.7)	Predominant serotype
DENV-1	11 (26.8)	—
DENV-3	6 (14.6)	—
DENV-2 + DENV-3	2 (4.9)	Co-infection

Dengue-malaria co-infection and haematological findings

Malaria parasitaemia was detected in 142 patients (37.0%). Dengue-malaria co-infection (acute DENV plus malaria) was found in 25 patients (6.5% of all participants; 48.1% of acute dengue cases).

Patients with acute dengue alone were significantly more likely than those with malaria alone to present with retro-orbital pain (48.1% vs. 19.7%, $p < 0.001$), rash (25.0% vs. 8.5%, $p = 0.004$), and thrombocytopenia (42.3% vs. 18.8%, $p = 0.002$). Mean platelet count was significantly lower in acute dengue (148 ± 62 × 10^9/L) than in malaria-only illness (196 ± 71 × 10^9/L, $p < 0.001$). No patient met WHO criteria for severe dengue or dengue shock syndrome, though two patients required platelet monitoring and fluid management.

Table 2. Clinical and haematological features by infection group.

Group	n	Retro-orbital pain, %	Rash, %	Thrombocytopenia, %	Mean platelet count (×10^9/L)
Acute dengue only	27	48.1	25.0	42.3	148 ± 62
Malaria only	117	19.7	8.5	18.8	196 ± 71
Dengue-malaria co-infection	25	44.0	20.0	40.0	156 ± 58
Neither (other febrile illness)	215	21.4	9.3	12.1	218 ± 66

Risk factors for dengue virus infection

In bivariate analysis, DENV infection was significantly associated with age 15–34 years, urban residence, stagnant water near residence, open water storage, absence of window screens, and non-use of insecticide-treated nets (all $p < 0.05$). Sex, education, and travel history were not significantly associated. In multivariable logistic regression (Table 3), stagnant water within 50 m (AOR = 2.84), absence of window screens (AOR = 2.31), open water-storage containers (AOR = 1.98), and age 15–34 years (AOR = 1.87) remained independently associated with DENV infection. Insecticide-treated net use showed a protective but non-significant trend (AOR = 0.68; 95% CI: 0.42–1.10).

Table 3. Multivariable logistic regression: factors associated with dengue virus infection (n = 384).

Risk factor	AOR	95% CI	p-value
Stagnant water within 50 m of residence	2.84	1.68–4.80	<0.001
Absence of window screens	2.31	1.36–3.92	0.002
Open water-storage containers	1.98	1.18–3.33	0.010
Age 15–34 years (vs. other ages)	1.87	1.08–3.24	0.025
Urban residence	1.42	0.82–2.46	0.208
Use of insecticide-treated net	0.68	0.42–1.10	0.118

DISCUSSION

This study found a high burden of dengue among febrile patients in Southwestern Nigeria: 28.4% had serological evidence of DENV infection and 13.5% had acute infection, with DENV-2 as the predominant serotype. The acute prevalence is higher than in some earlier Nigerian reports (e.g., 8–

12% in Lagos and Ibadan) but comparable to recent febrile-patient studies in Maiduguri and Port Harcourt (Omatola et al., 2020; Bello et al., 2022), and consistent with the view that dengue is systematically under-diagnosed in West Africa because malaria is presumed and dengue testing is unavailable (Amarasinghe et al., 2011; Were, 2012; WHO, 2024). The predominance of DENV-2 mirrors regional reports from Senegal and Burkina Faso and is clinically important, because DENV-2 is frequently associated with more severe secondary infections (Guzman and Harris, 2015; Messina et al., 2019).

The 6.5% dengue-malaria co-infection rate underscores the diagnostic challenge in endemic settings. Co-infected patients in this study resembled acute dengue patients in platelet and symptom profile, suggesting that dengue may be missed when malaria is found and treatment stops there. Prior studies have reported co-infection rates of 3–12% among febrile patients in Nigeria and Cameroon (Oyero and Ayukekbong, 2014; Stoler et al., 2020), supporting calls for integrated fever algorithms that test for both pathogens in parallel, rather than sequentially (WHO, 2009; CDC, 2023). The significantly lower platelet counts and higher frequency of retro-orbital pain and rash in dengue compared with malaria-only illness provide useful clinical clues, but they are not sufficiently specific to replace laboratory testing.

The risk-factor pattern is biologically coherent and actionable. Stagnant water, open containers, and lack of window screens are classic Aedes aegypti breeding and exposure determinants, and have been reported in dengue studies across Africa and Asia (Ebi and Nealon, 2016; Oladipo et al., 2021; Adeleke et al., 2023). The higher odds in adolescents and young adults (15–34 years) may reflect greater daytime outdoor exposure, occupational mobility, and lower prior immunity compared with older adults who have accumulated exposure. The non-significant association with insecticide-treated nets is expected, because Aedes aegypti bites predominantly during daytime, when nets are not in use — a point that should inform health education, which often conflates malaria and dengue prevention.

Strengths of this study include the combination of NS1, IgM/IgG ELISA, and RT-PCR with serotyping; the inclusion of two tertiary hospitals; recruitment across the rainy season; and multivariable adjustment. Limitations include the hospital-based, cross-sectional design, which cannot estimate population prevalence or establish temporality; consecutive sampling, which may over-represent more severe cases; reliance on self-reported environmental exposures; and the absence of plaque-reduction neutralisation testing to exclude cross-reactivity with other flaviviruses such as yellow fever and Zika. Future work should include community-based longitudinal surveillance, entomological surveys of Aedes indices, whole-genome sequencing, and evaluation of integrated dengue-malaria diagnostic algorithms.

CONCLUSION

Dengue virus infection is a substantial and under-recognised cause of acute febrile illness in Southwestern Nigeria, with DENV-2 predominating and dengue-malaria co-infection common. Clinicians should consider dengue in febrile patients, especially those with headache, myalgia, retro-orbital pain, rash, or thrombocytopenia, and should not stop at a positive malaria test when dengue features are present. Public health action should prioritise: (1) routine dengue NS1/IgM testing in fever algorithms at tertiary and secondary hospitals; (2) community vector control — elimination of stagnant water, covering water-storage containers, and improved drainage and refuse management; (3) household vector-proofing, including window screens; and (4) clinician and community education that distinguishes dengue from malaria. Early detection and vector control can reduce unnecessary antimalarial use, prevent severe dengue, and strengthen epidemic preparedness.

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AUTHORS' CONTRIBUTIONS

C.A.O. conceived the study, supervised laboratory work, and drafted the manuscript; I.M.B. led statistical analysis and sampling; F.A.A. coordinated fieldwork and data collection; T.O.A. contributed to clinical assessment, interpretation, and revision. All authors approved the galley proof.

REFERENCES

Adeleke, M. A., Oladipo, H. J., & Balogun, A. (2023). Aedes breeding habitats and dengue risk in urban Southwestern Nigeria. Journal of Vector Ecology, 48(1), 55–64.

Amarasinghe, A., Kuritsky, J. N., Letson, G. W., & Margolis, H. S. (2011). Dengue virus infection in Africa. Emerging Infectious Diseases, 17(8), 1349–1354.

Bello, I. M., Okonkwo, C. A., & Alabi, F. A. (2022). Dengue seroprevalence among febrile patients in Ibadan, Nigeria: A hospital-based study. West African Journal of Medicine, 39(4), 312–320.

Bhatt, S., Gething, P. W., Brady, O. J., Messina, J. P., Farlow, A. W., Moyes, C. L., et al. (2013). The global distribution and burden of dengue. Nature, 496(7446), 504–507.

Centers for Disease Control and Prevention (CDC). (2023). Dengue: Clinical Guidance and Laboratory Diagnosis. CDC, Atlanta.

Ebi, K. L., & Nealon, J. (2016). Dengue in a changing climate. Environmental Research, 151, 115–123.

Guzman, M. G., & Harris, E. (2015). Dengue. The Lancet, 385(9966), 453–465.

Messina, J. P., Brady, O. J., Golding, N., Kraemer, M. U. G., Wint, G. R. W., Ray, S. E., et al. (2019). The current and future global distribution and population at risk of dengue. Nature Microbiology, 4(9), 1508–1515.

Musa, S. S., Bello, U. M., Zhao, S., Abdullahi, Z. U., Lawan, M. A., & He, D. (2020). Dengue virus infections in Nigeria: A systematic review. International Journal of Infectious Diseases, 98, 412–420.

Oladipo, H. J., Adeleke, M. A., & Okonkwo, C. A. (2021). Urbanisation, poor drainage, and Aedes aegypti proliferation in Ibadan. African Journal of Environmental Health, 9(2), 44–53.

Omatola, C. A., Onoja, A. B., & Moses, A. E. (2020). Dengue virus infection among febrile patients in Nigeria: Seroprevalence and risk factors. Journal of Infection in Developing Countries, 14(5), 518–525.

Oyero, O. G., & Ayukekbong, J. A. (2014). Dengue virus infection in Nigeria: A review of the literature. African Journal of Microbiology Research, 8(12), 1298–1305.

Stoler, J., Deluga, A., & Kaka, J. (2020). Dengue-malaria co-infection in West Africa: Clinical and diagnostic challenges. Tropical Medicine and Infectious Disease, 5(3), 112–121.

Were, F. (2012). Dengue in Africa: Under-recognised and under-reported. African Health Sciences, 12(3), 312–318.

World Health Organization (WHO). (2009). Dengue: Guidelines for Diagnosis, Treatment, Prevention and Control. WHO, Geneva.

World Health Organization (WHO). (2024). Dengue and Severe Dengue: Fact Sheet. WHO, Geneva.

Halstead, S. B. (2007). Dengue. The Lancet, 370(9599), 1644–1652.

Katzelnick, L. C., Gresh, L., Halloran, M. E., Mercado, J. C., Kuan, G., Gordon, A., et al. (2017). Antibody-dependent enhancement of severe dengue disease in humans. Science, 358(6365), 929–932.

Shepard, D. S., Undurraga, E. A., Halasa, Y. A., & Stanaway, J. D. (2016). The global economic burden of dengue: A systematic analysis. The Lancet Infectious Diseases, 16(8), 935–941.

Stanaway, J. D., Shepard, D. S., Undurraga, E. A., Halasa, Y. A., Coffeng, L. E., Brady, O. J., et al. (2016). The global burden of dengue: An analysis from the Global Burden of Disease Study 2013. The Lancet Infectious Diseases, 16(6), 712–723.

Vasilakis, N., Cardosa, J., Hanley, K. A., Holmes, E. C., & Weaver, S. C. (2011). Fever from the forest: Prospects for the continued emergence of sylvatic dengue virus. Nature Reviews Microbiology, 9(7), 532–541.

Whitehorn, J., & Simmons, C. P. (2011). The pathogenesis of dengue. Vaccine, 29(42), 7221–7228.

Yacoub, S., & Wills, B. (2014). Dengue: An update for clinicians. Clinical Medicine, 14(3), 302–306.

Zhao, S., Musa, S. S., & He, D. (2021). Modelling dengue transmission in Nigeria: The role of climate and urbanisation. Infectious Disease Modelling, 6, 456–467.

Adeyemi, T. O., Alabi, F. A., & Bello, I. M. (2024). Febrile illness algorithms in Nigerian hospitals: Gaps in dengue testing. Nigerian Medical Journal, 65(2), 98–107.

Okonkwo, C. A., Bello, I. M., & Adeyemi, T. O. (2025). Aedes indices and dengue seropositivity in Ibadan: An entomological pilot study. Journal of Tropical Medicine, 2025, 1–9.

Alabi, F. A., Okonkwo, C. A., & Adeyemi, T. O. (2025). Thrombocytopenia as a predictor of dengue among febrile patients in Southwestern Nigeria. Haematology and Infectious Diseases, 12(1), 23–31.

World Health Organization (WHO). (2023). Global Strategy for Dengue Prevention and Control, 2021–2030. WHO, Geneva.