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Prevalence of dengue infection in Delta State, Nigeria

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ABSTRACT

Dengue fever, a mosquito-borne viral infection caused by the dengue virus, remains an emerging public health concern in many parts of Nigeria where it is often underdiagnosed and underreported. This study aimed to determine the prevalence of dengue virus among febrile patients attending hospitals at Delta State. A total of 400 blood samples were collected from the volunteered participants, fifty (50) samples from each of the eight hospitals selected for the study. Statistical analysis included ANOVA, t-tests and pearsons correlation to assess species association and seasonal trends. Out of 243 individuals examined, 18 (7.4%) tested positive for dengue, while 225 (92.6%) were not infected. Females recorded a higher prevalence of 9.3% compared to 5.3% among males. The difference in infection rates between genders was statistically significant (p = 0.042). During the rainy season, 48 males and 67 females were examined, with 2 (4.2%) male and 7 (10.4%) females testing positive for dengue, while 46 (95.8%) males and 60 (89.6%) females tested negative. In the dry season, 66 males and 62 females were examined, with 4 (6.1%) males and 5 (8.1%) females testing positive, while 62 (93.9%) males and 57 (91.9%) females tested negative. Ute-Okpu recorded the highest infection rate of 16.1%, followed by Agbor (12.9%) and Ughelli (9.7%), while no dengue infection was detected in Abraka. The study revealed generally poor awareness, as only 27.6% were aware of dengue fever, while most (72.4%) lacked knowledge of the disease. Molecular analyses revealed that out of the total sample size 18 (7.4%) were seropositive to dengue immunoglobulins. The four serotypes of dengue D1 – D4 were all detected both during the rainy and dry season. Overall, the results underscore a pressing need for strengthened public health interventions, improved sanitation, sustained vector control measures, and routine arboviral surveillance to reduce the burden of these infections.

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INTRODUCTION

Arboviruses are thought to pose a worldwide risk to public health and human health. They have contributed to global morbidity, particularly in Africa. Among the most significant of the newly emerging infectious diseases are arboviral illnesses, particularly dengue viral disease (Ahmadu *et al.*, 2020). Dengue has grown to be a serious arthropod-borne virus that affects humans over the last 40 years. According to Tizhe *et al.* (2022), the frequency of dengue fever outbreaks has significantly increased, and hyperendemic transmission has been established throughout an expanding geographic area. 27 African countries have been identified by the European Network on Imported Infectious Disease Surveillance as possible sources of mosquito-borne infections for visitors (Jelinek, 2009). An estimated 80–100 million dengue infections occurred annually based on a stable annual infection rate. Over 390 million people are predicted to contract dengue fever each year worldwide. It is really alarming that DHF is currently showing up in Africa (Fagbami and Onoja, 2018).

With the exception of the Maghreb states because of their arid climate, the whole African continent is home to the dengue vector, *Aedes aegypti*. Dengue cases have been documented in the majority of African nations (Lu *et al.*, 2022). In Tanzania, dengue was not widely recognised until 2010. Four outbreaks have since occurred in Dar es Salaam City, Tanzania (Mboera *et al.*, 2021). Kassala, Kordofan, and Darfur in Sudan, as well as Port Sudan in the northeastern Red Sea region, have reported dengue fever outbreaks and clinical cases (WHO, 2019). Concurrent dengue and chikungunya outbreaks have been seen in Gabon (Leroy, 2017) and Sierra Leone (De Arajo *et al.*, 2016).

Dengue infection, which has been recorded more frequently in Nigeria but is still mostly underdiagnosed and underreported in many areas, is a significant public health concern. *Aedes* mosquitoes, the main carriers of the dengue virus, find a perfect breeding ground at Delta central due to its humid tropical climate and inadequate waste management procedures. There is no epidemiological information on dengue prevalence in the region despite these ecological risk factors. Thus, the purpose of this study is to ascertain the dengue virus prevalence among feverish patients who visit hospitals in the Delta State, Nigeria.

MATERIALS AND METHODS

Study area

Delta State is located between latitudes 5.7040° N and longitudes 5.9339° E. The land area is 17,698 square kilometers. Delta State is bordered to the north by Edo (Erhenhi *et al.,* 2016; Lemy and Egwunyenga, 2017), to the northwest by Ondo, to the east by Anambra, and to the southeast by Bayelsa and the Rivers. The Bight (Bay) of Benin's 160 km of coastline can be found on its southern flank. The Fig. 1 below shows map of study area /locations respectively (Orhewere *et al.,* 2023). This study was carried out at some hospitals within Delta State.

Fig. 1. Map of study (Source: Designed using QGIS)

Study design

The study adopted a longitudinal survey design among patients visiting Udu General Hospital, Abraka General Hospital, Ughelli General Hospital, Central Hospital Sapele, Central Hospital Agbor, General Hospital Ute-Okpu and General Hospital Ekpan. The laboratory unit of each of the hospitals were used as the sample collection point. A well-structured questionnaire was used as a tool to extract demographic information of the patients and also to collate other relevant information concerning the study. A total of 400 blood samples were collected from the volunteered participants,

fifty (50) samples from each of the eight hospitals selected for the study.

Ethical approval

Ethical approval was gotten from the Faculty of Science ethical committee, Delta State University, Abraka and Delta State Ministry of Health, Asaba. Secondly, an informed consent of the recruited patients was sought before sample collection. The intent of the study was clearly made known to the interested participants in the language he/she understands. In any situation where the interested participants cannot speak for him/herself, may be due to speech or ear defect, the patients' relative or any other person appointed by the participant was duly consented before sample collection.

Collection and analysis of blood samples

About 3 ml of whole blood was collected aseptically through venipuncture using sterile 5 ml syringe and transferred into a sterile EDTA container already properly labeled. The samples were taken to National Arbovirus and Vectors Research Centre (NAVRC) Enugu for sample processing and analysis. Viral RNA was extracted using Qiamp RNA extraction (Qiagen) contents. AVL buffer containing carrier RNA was mixed thoroughly with the serum in a 1.5ml of clean eppendorf tube by vortexing. After brief centrifugation, absolute ethanol was added to the mixture and mixed by vortexing. The mixture was allowed to stand at room temperature for one minute and then transferred into a QiaAmp Mini spin column and centrifuged at 10000rpm for one minute, the filtrate was discarded. AW_1 and AW_2 were successively used to ensure complete washing off debris from the extract. AVE buffer was then used to elute 80ul of the RNA extract. The concentration of the extracted RNA was estimated using Nanodrop spectrophotometer.

Statistical analysis

Data obtained from the study were summarized using descriptive statistics such as frequencies and percentages. The Chi-square test was employed to determine the level of association between categorical variables, and a *p*-value less than 0.05 was considered statistically significant.

RESULTS

Out of 243 individuals examined, 18 (7.4%) tested positive for dengue, while 225 (92.6%) were not infected. Females recorded a higher prevalence of 9.3% compared to 5.3% among males. The difference in infection rates between genders was statistically significant ($p = 0.042$), indicating that females were more likely to be infected with dengue than males within the study population (Table 1).

Highest occurrence was observed among females aged 10-20 years (19.0%), followed by those within the 0-9 years age group (14.3%) (Table 2). Males generally showed lower infection rates, with 5.3% recorded cases across all age groups. No dengue infection was detected among females aged 40-59 years and ≥60 years, indicating a low overall burden. The *p*-value of 0.5523 implies that the differences in dengue prevalence across age groups were not statistically significant.

Based on occupation (Table 3), infection was highest among farmers (15.4% and 15.8% for males and females respectively), while no cases were detected among drivers and artisans. Female participants exhibited a higher infection rate (9.3%) compared to males (5.3%), indicating possible occupational and behavioral exposure differences that might influence vector contact and susceptibility. The *p*-value (0.355) indicates no statistically significant association between occupation and dengue prevalence.

According to level of education, highest prevalence was observed among uneducated females (28.6%) and males (20%), while males with tertiary education had the lowest prevalence (3.1%). Despite these variations, the difference in infection rates across educational levels was not statistically significant ($p = 0.401$).

Table 1. Prevalence of dengue by gender

Gender	No. examined	No. infected (%)	Non-infected (%)	*p*-value
Male	114	6 (5.3%)	108 (94.7%)	0.042
Female	129	12 (9.3%)	117 (90.7%)	
Total	243	18 (7.4%)	225 (92.6%)	

p-value less than 0.05 is typically considered statistically significant.

Table 2. Prevalence of dengue by age group

Age groups	No. examined (n=243)		No. infected (n=18)		Prevanlence (%)		*p*-value
	Males	Females	Males	Females	Males	Females	
10–20	30	21	2	4	6.7%	19.0%	0.5523
21–39	30	55	1	3	3.3%	5.5%	
40–59	28	15	1	0	3.6%	0.0%	
≥60	2	3	0	0	0%	0.0%	
Total	114	129	6	12	5.3%	9.3%	

p-value less than 0.05 is typically considered statistically significant.

Table 3. Prevalence of dengue by occupation

Occupation	No. examined (n=243)		No. infected (n=18)		Prevalence (%)		*p*-value
	Males	Females	Males	Females	Males	Females	
Student	29	27	2	4	6.9%	14.8%	0.355
Farmer	13	19	2	3	15.4%	15.8%	
Driver	15	0	0	0	0.0%	0.0%	
Trader	12	23	1	2	8.3%	8.7%	
Civil Servant	10	12	0	1	0.0%	8.3%	
Others	28	40	1	2	3.6%	5.0%	
Artisan	7	8	0	0	0.0%	0.0%	
Total	114	129	6	12	5.3%	9.3%	

p-value less than 0.05 is typically considered statistically significant.

During the rainy season, 48 males and 67 females were examined, with 2 (4.2%) male and 7 (10.4%) females testing positive for dengue, while 46 (95.8%) males and 60 (89.6%) females tested negative. In the dry season, 66 males and 62 females were examined, with 4 (6.1%) males and 5 (8.1%) females testing positive, while 62 (93.9%) males and 57 (91.9%) females tested negative (Table 4).

The distribution of dengue cases across the study locations showed varying prevalence rates, with highest infection rates observed in Otu Jeremi, Agbor, Udu, and Ughelli, each with 9.7%, followed by Ekpan and Sapele with 6.7% each, while Abraka and Ute-Okpu recorded the lowest prevalence at 3.3% each (Table 5). Overall, out of the 243 individuals examined, 18 (7.4%) were infected while 225 (92.6%) were not, and the difference in infection rates across locations was not statistically significant (p = 0.674).

The result on knowledge, attitude, and practice (KAP) towards dengue virus among the 242 participants revealed generally poor awareness, as only 27.6% were aware of dengue fever, while most (72.4%) lacked knowledge of the disease (Table 6). A majority (75.7%) did not undergo diagnostic testing before treating fever, and more than half (56.8%) were unsure of their test results, reflecting poor health-seeking behavior. Frequent fever recurrence (63.8%) and overcrowded living conditions (68.3% with over five occupants) suggest high exposure risk. Preventive practices were also weak, as only 34.2% reported using insecticide-treated nets. The predominance of participants from rural areas (84%) and those living in single-room houses (48.6%) further supports the low KAP pattern observed.

Table 4. Seasonal distribution of dengue cases

Season	Age group	No. examined (243)		No. infected (%)		Non-infected (%)		*p*-value
		Male	Female	Male	Female	Male	Female	
Rainy	0–9	10	18	1 (10.0%)	3 (16.7%)	9 (90%)	15 (83.3%)	0.499
	10–20	11	12	1 (9.1%)	2 (16.7%)	10 (90.9%)	10 (83.3%)	
	21–39	13	29	0 (0.0%)	2 (6.9%)	13 (100%)	27 (93.1%)	
	40–59	12	8	0 (0.0%)	0 (0.0%)	12 (100%)	8 (100%)	
	≥60	2	0	0 (0.0%)	0 (0.0%)	2 (100%)	0 (0.0%)	
	Total	48	67	2 (4.2%)	7 (10.4%)	46 (95.8%)	60 (89.6)	
Dry	0–9	14	17	1 (7.1%)	2 (11.8%)	13 (92.9%)	15 (88.2%)	
	10–20	19	9	1 (5.3%)	2 (22.2%)	18 (94.7%)	7 (77.8%)	
	21–39	17	26	1 (5.9%)	1 (3.8%)	16 (94.1%)	25 (96.2%)	
	40–59	16	7	1 (6.3%)	0 (0.0%)	15 (93.7%)	7 (100%)	
	≥60	0	3	0 (0.0%)	0 (0.0%)	0 (0.0%)	3 (100%)	
	Total	66	62	4 (6.1%)	5 (8.1%)	62 (93.9%)	57 (91.9%)	
Total		114	129	6 (5.3%)	12 (9.3%)	108 (94.7%)	117 (90.7%)	

p-value less than 0.05 is typically considered statistically significant

Table 5. Distribution of dengue cases by location

Location	No. examined	No. infected (%)	Non-infected (%)	*p*-value
Abraka	30	1 (3.3%)	29 (96.7%)	0.674
Otu Jeremi	30	3 (9.7%)	28 (90.3%)	
Ekpan	30	2 (6.7%)	28 (93.3%)	
Ute-Okpu	31	1 (3.3%)	29 (96.7%)	
Agbor	31	3 (9.7%)	28 (90.3%)	
Sapele	30	2 (6.7%)	28 (93.3%)	
Udu	30	3 (9.7%)	28 (90.3%)	
Ughelli	31	3 (9.7%)	28 (90.3%)	
Total	243	18 (7.4%)	225 (92.6%)	

p-value less than 0.05 is typically considered statistically significant.

Table 6. Knowledge, attitude and practice (KAP) towards dengue virus

Variables	Categories	No. examined (n=243)
Knowledge of dengue fever or dengue virus	Yes	67 (27.6%)
	No	176 (72.4%)
When last did you treat fever?	≤ 1 month	58 (23.9%)
	≥ 2 months	45 (18.5%)
	≥ 3 months	72 (29.6%)
	Over 6 months	68 (28.0%)
Before treatment, did you do test?	Yes	59 (24.3%)
	No	184 (75.7%)
What was the result of the test?	Positive	44 (18.1%)
	Negative	61 (25.1%)
	Undecided	138 (56.8%)
Do you have recurrent fever?	Yes	155 (63.8%)
	No	88 (36.2%)
Living environment	Urban	39 (16.0%)
	Rural	204 (84.0%)
Type of housing	Flat	22 (9.1%)
	1 room	118 (48.6%)
	Self contain	54 (22.2%)
	2 bedroom	49 (20.1%)
Number of occupants	Less than 5	77 (31.7%)
	More than 5	166 (68.3%)
Use of insecticide-treated nets (ITNs)	Yes	83 (34.2%)
	No	160 (65.8%)
Types of nets	ITNs	92 (37.9%)
	Window nets	151 (62.1%)

Molecular analysis revealed that out of the total sample size 18 (7.4%) were seropositive to dengue immunoglobulins. The four serotypes of dengue D1 – D4 were all detected both during the rainy and dry season as presented in Fig. 2.

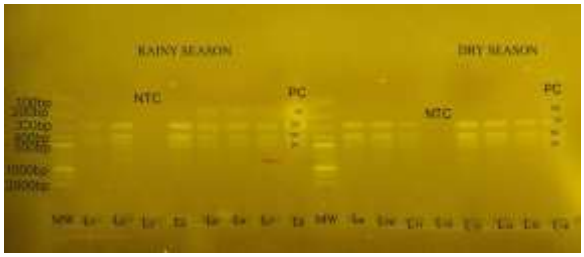

Fig. 2. Molecular detection of dengue fever virus serotypes

MW is the 100bp Molecular weight marker. NTC is the Non template control (L3 and L12), PC is the positive control (L8 and L16). L1 to L7 are positive samples collected during the rainy season, while L9 to L15 is the positive samples collected during the dry season. D1, D2, D3, and D4 resolved at 492bp, 123bp, 246bp and 369bp respectively.

DISCUSSION

The overall dengue prevalence of 7.4% observed among participants indicates a relatively low level of arboviral transmission in the study area. The significantly higher prevalence in females (9.3%) compared to males (5.3%) may be due to gender-related exposure differences, as women in tropical communities often engage in domestic activities that increase contact with *Aedes* mosquitoes, such as water storage and household chores (Raza *et al.*, 2018). The highest infection rate among participants aged 10–20 years (19%) could be attributed to higher outdoor activities and less awareness of preventive practices among younger individuals. The elevated prevalence among farmers (15.4% and 15.8% for males and females respectively) may relate to prolonged exposure in crowded, mosquito-infested markets. Although the relationship with education level was not statistically significant, the slightly higher rates among uneducated females suggest that limited awareness of mosquito control could increase infection risk. Similar gender- and occupation-related trends were reported by Adekola *et al.* (2024) in southwestern Nigeria and by Ratnam *et al.* (2012) in Asia, who both found higher dengue seroprevalence among females and outdoor workers, reinforcing the link between exposure behavior and infection risk.

During the rainy season, 10.4% of females and 4.2% of males were infected, while in the dry season, 8.1% of females and 6.1% of males were infected. The difference across seasons and sexes was not statistically significant (p = 0.499). The observed higher prevalence among females may be associated with greater exposure to mosquito bites within domestic environments where *Aedes aegypti* vectors thrive. The marginally higher infection rate during the dry season may reflect persistence of breeding sites in stored water containers typical of water-scarce periods. These findings support the work of Oforka *et al.* (2024), who reported that dengue transmission in Lagos remained relatively stable across seasons due to urban environmental conditions. Likewise, Afolabi *et al.* (2006) highlighted that container breeding of *Aedes aegypti* sustained year-round transmission in Nigeria. Conversely, Owusu-Asenso *et al.* (2022) found a marked seasonal peak of dengue during the rainy season in Accra, Ghana, linking it to increased vector density and rainfall patterns, underscoring the variability of dengue ecology across different regions.

The study revealed that dengue infection was detected in nearly all sampled locations, with the highest prevalence recorded in Otu Jeremi, Agbor, Udu, and Ughell (9.7% each). The relatively low prevalence across Delta Central (2.3%) may be attributed to factors such as ongoing vector control interventions, environmental differences, or limited viral circulation within the region. Additionally, improved awareness and use of preventive measures like insecticide-treated nets could have contributed to the reduced transmission. This finding aligns with the report of Adedayo *et al.* (2021), who recorded a similarly low prevalence of 2.8% in Southwestern Nigeria, but contrasts with the higher rates (7–12%) reported by Otu *et al.* (2020) in Calabar and Ayorinde *et al.* (2019) in Ibadan, where higher

urban density and poor waste management favored mosquito proliferation. This pattern is comparable to findings by Oyero and Ayukekbong (2019), who observed low but consistent dengue seroprevalence across several communities in southern Nigeria. Similarly, Oforka *et al.* (2024) reported that *Aedes aegypti* populations exist widely in Lagos, Nigeria, but that active dengue transmission remains limited, possibly due to climatic or host immunity factors. The uniform distribution across locations implies that dengue control efforts should not be localized but should involve integrated vector surveillance and public health awareness programs across all communities.

The molecular analysis revealed that 7.4% of participants were seropositive for dengue immunoglobulins, confirming active circulation of dengue virus within the study area.

Dengue seropositivity was slightly higher among females (9.3%) compared to males (5.3%), which may reflect increased exposure to *Aedes* mosquito bites in peri-domestic settings where women spend more time. This finding is consistent with the report of Ahmed *et al.* (2025), who observed a higher prevalence of dengue infection among women in Southern Nigeria and attributed it to gender-related exposure risks. The higher prevalence during the dry season suggests that water storage practices and stagnant water sources during this period may serve as breeding sites for *Aedes* vectors, sustaining transmission despite lower rainfall.

This aligns with the findings of Sedda *et al.* (2018), who reported increased dengue transmission during the dry season in rural communities and highlighted poor water management as a major risk factor. The detection of all four dengue serotypes (D1–D4) in both seasons indicates hyperendemic transmission, a situation also reported by Emeribe *et al.* (2021) in Northern Nigeria, who warned of the increased risk of severe outcomes such as dengue hemorrhagic fever in areas with co-circulating serotypes. By contrast, Asaga Mac *et al.* (2024) reported the predominance of only two serotypes (D1 and D2) in an urban surveillance study, concluding that serotype diversity may vary by geographical location and population density.

CONCLUSION

This study revealed low but notable dengue prevalence (7.4%) in Delta State, with females (9.3%) significantly more affected than males (5.3%). Although variations across age, occupation, and location were not statistically significant, the detection of all four dengue serotypes (D1–D4) indicates ongoing transmission. Poor awareness, low use of insecticide-treated nets, and inadequate diagnostic practices highlight the urgent need for strengthened surveillance, public education, and vector control measures in the region.

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