

Characterization of acute dengue immune status and the role of serotypes in transmission dynamics in three regions of Burkina Faso: a hospital-based cross-sectional study

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Abstract

Introduction

In recent years, dengue has become a public health issue in Burkina Faso, associated with severe disease and death. Rapid characterization of acute dengue serostatus will be useful for identifying patients at risk, informing transmission dynamics, and supporting public health decision-making. The aim of this study was to characterize dengue immune status in three regions of Burkina Faso as well as pre-vaccine screening; evaluate the commercial combined DENV NS1, IgM, and IgG rapid diagnostic test (RDT) kit; and investigate transmission dynamics.

Methods

A multicenter study was conducted between 2023 and 2025 in Bobo-Dioulasso, Houndé, Ouagadougou, and Gaoua. Blood samples were collected from suspected dengue patients. Acute DENV infections and serotypes were screened using real-time RT-PCR, and immune status were characterized by enzyme-linked immunosorbent assays (ELISA) according to WHO criteria. Serum screening by reference tests was used to evaluate a commercial DENV NS1, IgM, and IgG RDT kit in dengue immune status characterization.

Results

Primary dengue was 75.9%, 80.4%, and 71.4% in 2023, 2024, and 2025, respectively. The sensitivity of RDT was 93.3% and 94.7% for primary and post-primary dengue determination during the first 5 days of the disease. DENV-1, DENV-2, and DENV-3 were 47.0%, 5.6%, and 47.4%, respectively. DENV-4 was not detected.

Conclusions

Primary dengue cases predominated, and severe dengue was associated with post-primary dengue cases. RDT is a useful point-of-care tool to discriminate dengue immune status. DENV-3 and DENV-1 were responsible for transmission dynamics in recent years. The Qdenga (TAK-003) vaccine may represent a relevant option in the Burkina context.

Introduction

Dengue is a mosquito-borne disease caused by four antigenically distinct serotypes (DENV1-4) [1, 2] and transmitted to humans mainly by *Aedes (Ae) aegypti* and *Ae. albopictus* [3]. According to the World Health Organization (WHO), more than 3.9 billion people are at risk of being infected by dengue virus (DENV) in the world [4]. In Burkina Faso, the first outbreak of dengue was reported in 1925 [5]. Then, multiple outbreaks were reported in 2013, 2016, and 2017 [6–8]. In 2023, Burkina Faso experienced an outbreak with a rise in dengue cases and deaths compared to previous outbreaks, making it the worst-affected country in the African region; 146,878 dengue suspected cases were reported, including 68,346 probable cases, and 688 deaths [9]. In recent years, dengue has become a major public health issue in Burkina. DENV infection can present as asymptomatic cases, mild illness with symptoms, or manifest as severe illness. Severe dengue is characterized by vascular permeability, plasma leakage, massive bleeding, and, in some cases, liver compromise, organ impairment, and even death [10]. It is thought that these symptoms result from host-induced cytokine storms due to viral replication response. Consequently, during post-primary infections, the patient has a high risk of developing severe disease [11].

Although the WHO has approved two dengue vaccines (Dengvaxia® CYD-TDV) and Qdenga® TAK-003), their efficacy and safety are influenced by serotype, pre-existing dengue immunity, and age, which limits their broader implementation. Therefore, accurate diagnosis during the early febrile phase of dengue is critical to prevent unnecessary and costly diagnostic procedures, avoid potentially harmful antibiotic use, ensure timely and appropriate interventions at both primary and post-primary care levels, and facilitate early detection of outbreaks. In order to improve dengue diagnosis and treatment, the WHO has recently recommended the use of rapid diagnostic tests (RDTs) in nations with low resources. Dengue non-structural protein 1 (NS1) and IgM and IgG antibodies can now be detected using several inexpensive commercial RDT kits [12–14]. However, their performance varies depending on the commercial kits available [15, 16].

In Burkina Faso, routine diagnosis is based on rapid diagnostic test (RDT), and laboratory-based surveillance includes only confirmation of suspected or probable cases. Nonetheless, it is crucial to incorporate the distinction between primary and post-primary dengue into the Burkina Faso dengue diagnosis and monitoring algorithm. Therefore, adopting point-of-care diagnostic techniques to report dengue immunity status could be crucial for supporting monitoring efforts. This information will be useful in identifying populations at risk of developing severe symptoms and could potentially be beneficial in assisting clinical case management [17]. Also, these data are essential for public health decision-making, such as predicting the impact of dengue vaccination at the population level [18].

In Burkina, despite the dengue burden, due to repeated outbreaks, including severe dengue and death, no data on dengue immune status are available, and the role of dengue serotypes in transmission dynamics is scarce. Therefore, tracking changes in dominant serotypes over time and multi-serotype circulation are essential for understanding the dynamics of dengue transmission and predicting variation in clinical burden. The aim of this study was to characterize the acute dengue immune status in three regions of Burkina Faso as well as associate risk factors and pre-vaccine screening; Second, evaluate how well the commercial combined DENV NS1, IgM, and IgG RDT kit distinguishes between acute primary and post-primary dengue cases at the point of care; and thirdly, investigate the role of DENV serotype in transmission dynamics.

Methods

Study sites description and period

This multicentric study was conducted from June to September in 2023, 2024, and 2025 across three regions of Burkina Faso, encompassing four cities (Bobo-Dioulasso, Houndé, Ouagadougou, and Gaoua) (Fig. 1). Participants were recruited from multiple healthcare facilities, including the Centre Médical avec Antenne Chirurgicale (CMA) of DO and Eureka Medical Center in Bobo-Dioulasso, the CMA of Houndé, the Progrès Lab in Ouagadougou, and the Centre Hospitalier Régional (CHR) of Gaoua. These health facilities are part of the sentinel surveillance network for dengue operated by the National Reference Laboratory for Viral Haemorrhagic Fevers of Burkina Faso. Burkina Faso is a West African country and has a tropical climate characterized by a dry season (from November to May) and a rainy season (from June to October). The study period is known to be favorable to the propagation of *Aedes* mosquitoes in Burkina and therefore to arbovirus transmission. The selection of these study sites was therefore based on their distinct demographic, economic, and epidemiological characteristics, all of which are conducive to dengue transmission dynamics.

Study design

The study population consisted of patients with suspected dengue according to WHO criteria, including persons with an acute febrile illness lasting between 2 and 7 days, accompanied by at least 2 of the following symptoms (headache, retro-orbital pain, muscle pain, joint pain, rash, haemorrhagic manifestations, shock syndrome). A standardized questionnaire was administered to all participants to collect epidemiological data, including age, sex, provenance, date of admission, date of illness onset, history of vaccination, travel, and clinical symptoms (including no warning signs, warning signs, and severe). Infants under 6 months of age were excluded, probably due to persistence of maternal DENV antibodies.

For each participant, 3–5 mL of whole blood was collected in serum separation tubes and centrifuged at 1500 rpm for 5 minutes to obtain serum. The serum was aliquoted into two vials (200 µL per vial) and stored at -80°C until further analysis. Laboratory investigations included RNA extraction, real-time RT-PCR, enzyme-linked immunosorbent assay (ELISA), and RDT.

Molecular screening of dengue virus serotypes

Viral RNA extraction

The QIAamp Viral RNA Mini Kit (Qiagen, Hilden, Germany) was used to extract viral RNA from 140 µL of human serum in accordance with the manufacturer's instructions. Prior to real-time RT-PCR analysis, the RNA extracts were stored at -80°C .

Multiplex One-Step real-time RT-PCR

Multiplex One-Step real-time RT-PCR was performed to screen DENV and serotypes using the QuantiTect SYBR Green PCR Kit (Qiagen, Hilden, Germany), according to the previously described method [19]. Briefly, a reaction mixture containing 25 µL of SYBR Green master mix, 0.5 µL of enzyme, 1.4 µL (10 µM) of forward conserved primers targeting DENV-1, DENV-2, and DENV-4; 0.46 µL (10 µM) each of DENV-3 forward and reverse primers; 0.5 µL (10 µM) of reverse primers for DENV-1 and DENV-4; 0.44 µL (10 µM) of the DENV-2 reverse primer, 3 µL of RNA, and H_2O PCR-grade was added to complete the reaction mixture to 50 µL. Real-time RT-PCR was carried out using the CFX96 Real-Time PCR Detection System (Bio-Rad, California, USA) under the following cycling conditions: reverse transcription at 50°C for 30 min, initial denaturation at 95°C for 10 min, followed by 40 cycles of denaturation at 95°C for 30 s, annealing at 62°C for 30 s, and extension at 72°C for 30 s, with a final extension step at 60°C for 30 s. Samples were considered positive when the cycle threshold (Ct) value was ≤ 33 . DENV serotypes were subsequently determined based on melting temperature (T_m) analysis.

ELISA assays and dengue immune status determination criteria

Serum of patients confirmed to have acute dengue cases by real-time PCR was subjected to ELISA test using commercial ELISA kits (DRG International, Inc., Springfield, NJ). Dengue immune status was discriminated by quantified DENV-specific IgM and IgG. Patients with positive IgM and negative IgG were classified as primary infection, whereas patients who had negative IgM and positive IgG were classified as post-primary infection. Patients positive with both IgM and IgG, with a ratio of IgM/IgG > 1.2 , were classified as primary infection, and IgM/IgG < 1.2 were post-primary infection, at a 1:100 serum dilution, according to the WHO (2009) criteria [20].

Rapid diagnostic test of dengue

Patient serum samples were also tested by a commercial combined dengue NS1 antigen, IgM and IgG RDT kit (Wondfo, Guangzhou, China). The procedure and interpretation were performed according to the manufacturer's instructions.

Data management and statistical analysis

Proportions and ratios were calculated for categorical variables, including sex, age, geographic area, clinical manifestations, dengue immune status, and DENV serotype. Fisher's exact test was applied for categorical variables with expected counts less than five, while the Chi-square test was performed for

variables with expected counts of five or more. A logistic regression model was used to calculate the association of risk factors with dengue immune status. Concordance between diagnostic tests was assessed using Cohen’s Kappa coefficient. Subsequently, the proportions of discordant results between these diagnostic methods were compared using McNemar’s test. Statistical significance was defined as $p \leq 0.05$. All analyses were conducted using R version 4.3.1.

Results

Patients characteristics and spatiotemporal distribution of acute dengue immune status

Among suspected (1250) cases, molecular testing confirmed 216, 148, and 98 dengue cases in 2023, 2024, and 2025, respectively. The distribution of primary and post-primary dengue varied by study site and year.

In 2023, primary dengue cases were 76.56% (49/64), 72.72 (40/55), 77.27% (17/22), 72.22% (26/36), and 82.05% (32/39) at the CMA of DO, Eureka Medical Center, CMA of Houndé, Progrès Lab, and CHR of Gaoua, respectively (Table 1).

In 2024, primary dengue cases were 83.8% (31/37), 67.44% (29/43), 73.68% (14/19), 93.33% (28/30), and 89.4% (17/19) at the CMA of DO, Eureka Medical Center, CMA of Houndé, CHR of Gaoua, and Progrès Lab, respectively (Table 1).

In 2025, primary dengue cases were 80.9% (17/21), 68.18% (15/22), 72.72% (8/11), 65.38% (17/26) and 72.22% (13/18) at the CMA of DO, Eureka Medical Center, CMA of Houndé, Progrès Lab and CHR of Gaoua, respectively (Table 1).

Table 1
Demographic characteristics and primary and post-primary dengue case distribution

Variable	2023				2024				2025			
	Confirmed (N = 216), n	Primary (N = 164), n (%)	Post- primary (N = 52), n (%)	P Value	Confirmed (N = 148), n	Primary (N = 119), n (%)	Post- primary (N = 29), n (%)	P Value	Confirmed (N = 98), n	Primary (N = 70), n (%)	Post- primary (N = 28), n (%)	P Value
Sex	1				0.07426				0.7469			
Male	122	90 (41.6)	32 (14.8)		98	79 (53.3)	19 (12.8)		52	39 (39.7)	13 (13.2)	
Female	94	74 (34.2)	20 (9.4)		50	40 (27.02)	10 (6.88)		46	31 (31.6)	15 (15.5)	
Age (year)	0.125				0.3865				0.8238			
Median	32	33	24		28	27	32		32	31	33	
Age groups												
]5–20]	35	27 (12.5)	8 (3.7)		25	21(14.2)	4(2.7)		16	14(14.3)	2 (2.04)	
[21–30]	70	51(23.6)	19 (8.8)		53	42(28.4)	11(7.4)		34	23 (23.5)	11 (11.2)	
[31–40]	54	39 (18.1)	15 (6.9)		37	29 (19.6)	8(5.4)		22	15(15.3)	7 (7.1)	
[41–50]	36	28 (13.0)	8 (3.7)		20	18(12.2)	2(1.3)		15	11 (11.2)	4 (4.08)	
≥ 51	21	19 (8.8)	2 (0.9)		13	9(6.1)	4(2.7)		11	7 (7.1)	4 (4.08)	
Sites	0.8485				0.1576				0.9851			
CMA DO	64	49 (76.56)	15 (23.44)		37	31 (83.8)	6 (16.2)		21	17 (80.9)	4 (19.1)	
Eureka Medical Center	55	40 (72.72)	15(27.28)		43	29 (67.44)	14 (32.56)		22	15 (68.18)	7 (31.82)	
CMA Houndé	22	17 (77.27)	5 (22.73)		19	14 (73.68)	5 (26.32)		11	8 (72.72)	3 (27.27)	
Progrès Lab	36 (100)	26 (72.22)	10 (27.78)		19	17(89.4)	2(10.6)		26	17 (65.38)	9 (34.62)	
CHR of Gaoua	39	32 (82.05)	7 (17.95)		30	28 (93.33)	2 (6.67)		18	13 (72.22)	5 (27.78)	

Risk factors associated according to dengue immune status

Among confirmed acute dengue cases, investigated potential risk factors included age, where in the age group 41–50, 4.8% presented warning signs and 0.8% had severe dengue among primary cases, whereas 7.3% and 3.7% for warning signs and severe dengue among post-primary cases, respectively (Table 2). By sex, 7.6% of males presented with warning signs and 0.8% with severe dengue among primary cases, compared to post-primary cases, where 22.9% had warning signs and 8.2% had severe dengue (Table 2).

Table 2
Distribution of risk factors according to dengue immune status

Risk Factor	Primary	Post-primary				
	No warning sign, n (%)	Warning sign, n (%)	Severe, n (%)	No warning sign, n (%)	Warning sign, n (%)	Severe, n (%)
Age						
[5–20]	60 (17.)	2 (0.7)	0 (0.0)	4 (3.7)	10 (9.2)	0 (0.0)
[21–30]	107 (30.3)	9 (2.5)	0 (0.0)	21 (19.3)	18 (16.5)	2 (1.8)
[31–40]	71 (20.1)	12 (3.4)	0 (0.0)	25	2 (1.8)	3 (2.7)
[41–50]	37 (10.5)	17 (4.8)	3 (0.8)	2 (1.8)	8 (7.3)	4 (3.7)
≥ 51	29 (8.2)	5 (1.4)	1 (0.3)	2 (1.8)	4 (3.7)	4 (3.7)
Sex						
M	178 (50.4)	27 (7.6)	3 (0.8)	30 (27.5)	25 (22.9)	9 (8.2)
F	126 (35.7)	18 (5.1)	1 (0.3)	24 (22.01)	17 (15.6)	4 (3.7)
Disease day						
1–2	87 (24.6)	22 (6.2)	3 (0.8)	16 (14.7)	25 (22.9)	9 (8.2)
3–4	42 (11.9)	16 (4.5)	1 (0.3)	17 (15.6)	13 (11.9)	3 (2.7)
5	175 (49.6)	7 (2.0)	0 (0.0)	21 (19.3)	4 (3.7)	1 (0.9)

Logistic regression analyses shown severe disease manifestation in post-primary dengue opposed to primary (OR: 18.296 95%IC [6.215–66.880], $p \leq 0.05$) (Table 3).

Table 3
Association of risk factors with post-primary dengue

Post primary				
Risk factors	OR	95% CI	p-value	Global p-value
Age				0.5696
[5–20]	Ref			
[21–30]	1.565	0.808–3.178	0.197	
[31–40]	1.601	0.795–3.348	0.197	
[41–50]	1.088	0.474–2.494	0.841	
≥ 51	1.265	0.498–3.132	0.613	
Clinical manifestation				3.326e-14 ***
No Warning sign	Ref			
Warning sign	5.254	3.158–8.785	1.89e-10 ***	
Severe	18.296	6.215–66.880	8.56e-07 ***	
Sex				0.969
M	Ref			
F	0.991	0.642–1.54	0.969	
Disease day				9.376e-07 ***
1–2	Ref			
3–4	1.253	0.727–2.149	0.414	
5	0.320	0.186–0.539	2.44e-05 ***	

Performance of commercial RDT in acute dengue immune status characterization

Statistical models show high concordance between RT-PCR and RDT NS1(K = 0.9264) to detect acute dengue on days 1–3 and days 4–5 (K = 0.8908), but the reference test remains more sensitive (Table 4). Better concordance was also obtained between ELISA IgM vs RDT IgM (K = 0.9763), ELISA IgG vs RDT IgG (K = 0.9823) in disease days 1–3 (Table 4).

Table 4
Concordance between reference tests and RDT in dengue immune status determination

Variable		Kappa		McNemar	
		Value	p- value	χ²	p- value
Disease day 1–3	RT-PCR vs RDT NS1	0.9264	0.0001***	15.059	0.0001042*
	ELISA IgM vs RDT IgM	0.9763	0.0001***	4.1667	0.04123*
	ELISA IgG vs RDT IgG	0.9823	0.0001***	0.5	0.4795
	ELISA IgM + IgG vs RDT IgM + IgG	0.8947	1.061e-49	1.3333	0.2482
Disease day 4–5	RT-PCR vs RDT NS1	0.8908	0.0001***	32.029	1.519e-08*
	ELISA IgM vs RDT IgM	0.9429	0.0001***	14.062	0.0001768*
	ELISA IgG vs RDT IgG	0.9489	1.441e-228***	1.3333	0.2482
	ELISA IgM + IgG vs RDT IgM + IgG	0.7453	7.984e-18***	6.125	0.01333*

Primary dengue was 71.8% (332/462) for RT-PCR and ELISA IgM positive, whereas 67.1% for RDT NS1 + IgM positive. Post-primary dengue was 20.3% (94/462) for RT-PCR and ELISA IgG positive, whereas 19.3% for RDT NS1 + IgG positive (Table 5). The sensitivity of RDT was 93.3% and 94.7% for primary and post-primary dengue determination during the first 5 days of the disease, respectively. All samples negative by reference tests were also negative for RDT; the specificities were 100% (Table 5).

Table 5
Performance of acute dengue immune status characterization of commercial RDT

Variable	Reference test				RDT		
	RT PCR + ELISA IgM+	RT PCR + ELISA IgM + IgG+	RT PCR + ELISA IgG+	RT PCR + ELISA IgM + IgG+	NS1 + IgM Positive	NS1 + IgG positive	NS1 + IgM + IgG positive
		IgM/IgG > 1.2	n (%)	IgM/IgG < 1.2	n (%)	n (%)	n (%)
	n (%)	n (%)		n (%)			
Disease day							
1–3	154 (33.3)	7 (1.5)	62 (13.4)	9 (1.9)	148 (32.03)	60 (13.0)	13 (2.8)
4–5	178 (38.5)	14 (3.03)	32 (6.9)	6 (1.47)	162 (35.1)	29 (6.3)	12 (2.6)
Total (N)	332 (71.8)	21 (8.4)	94 (20.3)	15 (3.37)	310 (67.1)	89 (19,3)	25 (5,4)
DENV immune status	Primary	Primary	Post-primary	Post-primary	Primary	Post-primary	NA
Sensitivity (%)	NA	NA	NA	NA	93.3	94.7	NA
Specificity (%)	NA	NA	NA	NA	100	100	100
NA : not applicable							

Temporal distribution of dengue virus serotypes and transmission dynamics

Globally, DENV-1, DENV-2, and DENV-3 were 47.0%, 5.6%, and 47.4%, respectively. In 2023, DENV-3 was the predominant serotype, responsible for outbreak accounting for 76.0% (164/216), followed by DENV-1 at 20.4% (44/216) and DENV-2 at 3.8% (8/216) (Fig. 2). In 2024, DENV-1 became the dominant serotype, representing 69.6% (103/148), followed by DENV-3 at 27.02% (40/148) and DENV-2 at 3.4% (5/148) (Fig. 2). In 2025, DENV-1 remained the most prevalent serotype, accounting for 71.4% (70/98), while DENV-2 and DENV-3 represented 15.3% (15/98) and 13.3% (13/98) of cases, respectively (Fig. 2). No cases of DENV-4 were detected during the study period.

Discussion

In this study, primary dengue cases predominated over post-primary cases over the three years (2023, 2024, 2025), with 2023 recording the highest number of cases. This peak corresponds to the most important dengue outbreaks reported in Burkina Faso between August and November 2023 [9, 21]. The highest

prevalence of primary dengue cases was observed in the 21-30-year age group, followed by the 31-40-year age group. More dengue cases with warning signs (7.3%) and severe dengue (3.7%) were observed among post-primary cases than primary in the age group 41–50. This may be explained by post-primary infections, as people in this age group have often been exposed to dengue on several occasions during their lifetime, and the type of serotype. It may also be due to the presence of comorbidities in this age group, such as high blood pressure, diabetes, and cardiovascular disease [22]. Some studies have shown that dengue hemorrhagic fever (DHF) rates are higher among children than in adults during secondary DENV-2 infection, potentially due to age-related differences in susceptibility to vascular permeability. Additionally, elderly individuals may be at increased risk of disease complications [23, 24].

In our study, males constituted the majority of both primary and post-primary dengue cases. In post-primary dengue cases, more severe dengue (8.2%) was observed among males than females. The most common warning signs and severe symptoms were observed on disease days 1–4. This may reflect a high initial viral load and early presentation by patients with more severe symptoms. This study has shown, using logistic regression analysis, that there is a higher risk of developing warning signs that can progress to severe dengue in post-primary than primary infection (OR: 18.296, 95%IC [6.215–66.880], $p \leq 0.05$). Secondary dengue infection is known to be associated with an increased risk of severe disease, potentially mediated by antibody-dependent enhancement (ADE) [25].

In this study, primary dengue dominated across all study sites, with the highest proportions observed in Bobo-Dioulasso and Ouagadougou, the economic and political capitals of Burkina Faso, respectively. These major urban centers experience substantial population movement because the road linking Ouagadougou to Bobo-Dioulasso and continuing to Côte d'Ivoire strongly supports migration and economic growth, which may facilitate dengue transmission [26]. Dengue is strongly linked to the urban environment due to the proliferation of mosquito vectors, particularly *A. aegypti*, whose breeding is promoted by inadequate waste management, prolonged water storage in domestic containers for routine household use, high population density, and human mobility. These factors contribute to increased transmission in urban compared with rural settings [27, 28]. Furthermore, understanding the spatial distribution of prior DENV exposure is critical for public health decision making [29].

Globally, they are concordance between the reference test and RDT. Also, the sensitivity of RDT was 93.3% and 94.7% for primary and post-primary dengue determination during the first 5 days of the disease, respectively. These data suggest that this RDT kit has high sensitivity and concordance with reference laboratory metrics (RT-PCR, IgM, IgG) to discriminate dengue immune status in the acute phase. The limitation of this kit is that it cannot quantify IgM and IgG levels in samples that are positive for both antibodies, unlike the ELISA test. Subsequently, this study demonstrated the usefulness of this RDT for use in the point-of-care dengue diagnostic algorithm to discriminate dengue immune status in the first 5 days and to be combined with reference tests (RT-PCR and ELISA) for surveillance purposes across Burkina Faso and other endemic regions. Similar work has been carried out, and the high sensitivity of another RDT has also been demonstrated [17]. All these results suggest the importance of RDTs in determining the immune status of dengue infection. This kit can play an important role in ensuring patients receive appropriate care. Rapid determination of the patient's current dengue immune status would therefore be beneficial in enabling the provision of additional care to protect patients from severe symptoms and death. This RDT could strengthen regional surveillance systems in resource-limited countries where laboratory testing is not feasible. Moreover, it could also be used for pre-vaccination screening by establishing a link between patients' ages and cases of primary dengue.

Burkina Faso is currently experiencing dengue outbreaks characterized by dynamic shifts in circulating DENV serotypes. In 2023, the country reported a major outbreak marked by the predominance of DENV-3, followed by DENV-1. In 2024, DENV-1 became the dominant serotype, with DENV-3 detected at a lower frequency. This trend persisted in 2025, when DENV-1 remained predominant, followed by DENV-2. Globally, DENV-1 and DENV-3 were responsible for the transmission dynamics of dengue in Burkina Faso between 2023 to 2025. These temporal changes in serotype distribution likely contributed to the high proportion of primary dengue infections observed during the study period. DENV infection confers long-term immunity against that specific serotype; however, it does not provide cross-protective immunity against the other serotypes, leaving individuals susceptible to subsequent heterologous infections [30]. Prior to 2023, DENV-1 and DENV-2 were the principal circulating serotypes in Burkina Faso [7]. The emergence and predominance of DENV-3 in 2023 consequently represent a significant epidemiological shift, which may explain the increase in primary dengue cases that year. Notably, post-primary dengue infections were also particularly frequent in 2023. The increased severity of dengue reported during this period may be attributable to the high rate of post-primary dengue in combination with the predominance of DENV-3, a serotype previously associated with more severe clinical outcomes[31]. The concurrent circulation of multiple serotypes in this study suggests sustained viral introduction and/or endemic transmission, which may progressively shift the immune landscape toward an increasing proportion of post-primary dengue over time. Historically, DENV-2 predominated in 2016 and 2017[7, 32]. In 2021 and 2022, all four DENV serotypes co-circulated in Burkina Faso, with DENV-1 predominating[33]. Sporadic cases of DENV-4 were reported between 2020 and 2022 [33, 34]. In the present study, DENV-4 was not detected, consistent with the findings reported by Ouattara et al. (2025) [33]. DENV-4 has not yet been implicated in outbreaks in Burkina Faso or in the West African region. Studies have suggested that DENV-4 replicates less efficiently in certain contexts and is associated with lower viral loads than those observed with DENV-2 or DENV-3. Lower viraemia could reduce the likelihood of a mosquito acquiring the virus during a blood meal and transmitting it[35, 36]. This explains its limited spread in Burkina Faso and West Africa. However, this hypothesis varies depending on genotypes and regions.

This study provides critical evidence to inform dengue diagnostic strategies, clinical management, and vaccine implementation policies in Burkina Faso. Dengue incidence has increased in recent years in this setting, likely reflecting the combined effects of tropical climatic conditions, vector breeding, and competence and enhanced viral circulation. The high prevalence of primary DENV infections observed, together with the circulation of multiple serotypes, underscores an elevated risk for future severe disease and has important implications for the timing and targeting of dengue vaccination strategies. Serological status is a key determinant of vaccine eligibility and performance, as individuals with prior dengue exposure (seropositive) may derive greater benefit from vaccination. The first dengue vaccine that the WHO approved was Dengvaxia. Its application in populations with low baseline seroprevalence is limited, nevertheless, as its use in dengue-naïve persons has been linked to an elevated risk of severe dengue [37]. Qdenga (TAK-003) was recently approved as a vaccine against DENV by the WHO. According to Tricou et al. (2024), its five-year cumulative efficacy was 61.2% against virologically confirmed dengue and 84.1% against dengue-related hospitalization. In those with prior DENV exposure, TAK-003 showed favorable efficacy and safety against all four

serotypes (DENV1 to DENV-4), while in seronegative individuals, it provided protection against DENV-1 and strong protection against DENV-2, but no significant efficacy against virologically confirmed dengue or dengue-related hospitalization due to DENV-3 and DENV-4 [38]. The findings of this study provide evidence that can inform the Burkina Faso Ministry of Health in strengthening dengue diagnostic capacity and surveillance systems, as well as in guiding decisions regarding the introduction of the dengue vaccine in the country's two big largest urban centers. In particular, the tetravalent dengue vaccine Qdenga (TAK-003) may be a relevant option in the Burkinabe context, based on the sero-epidemiological patterns and serotypes observed. Given reports of homotypic reinfections with DENV serotypes [39, 40], implementation of vaccination could contribute to reducing the risk of severe dengue and related complications, especially among children and other high-risk groups, thereby strengthening public health protection.

This study has some limitations; the analysis did not include samples from all regions of the country and did not cover all months of the year. However, as a pilot investigation focused on acute dengue patients, it provides important preliminary insights. Future studies will include nationwide sampling and year-round data collection. In addition, molecular characterization of DENV genotypes will be undertaken to better understand serotype diversity, viral evolution, and transmission dynamics.

Conclusion

This study reports the predominance of primary dengue cases, and severe dengue was associated with post-primary dengue cases. The commercial dengue RDT (NS1, IgM, and IgG RDT) kit shows the best performance, and it can be used as a point-of-care test to discriminate dengue immune status. The study reveals the role of DENV-3 and DENV-1 transmission dynamics in recent years. These findings underscore the importance of distinguishing infection status for patient management and provide data for vaccine strategy introduction. The Qdenga (TAK-003) vaccine may represent a relevant option in the Burkina context.

Declarations

Ethical approval

This study was approved by the Regional Health Department of Guiriko (No. 2021 – 0294/MS/RHBS/DRS) and the Health Science Research Institute of Burkina Faso Ethics Committee (No. A026-2023/CEIRES/IRSS). Written informed consent was obtained from all participants, and confidentiality was strictly maintained. For minors included in this study, consent was provided by the parents or legally authorized representatives.

Consent for publication

Not Applicable

Competing interests

The authors declare no competing interests.

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Data availability

Data are included in this manuscript, and data base can be provided if request.

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Figures

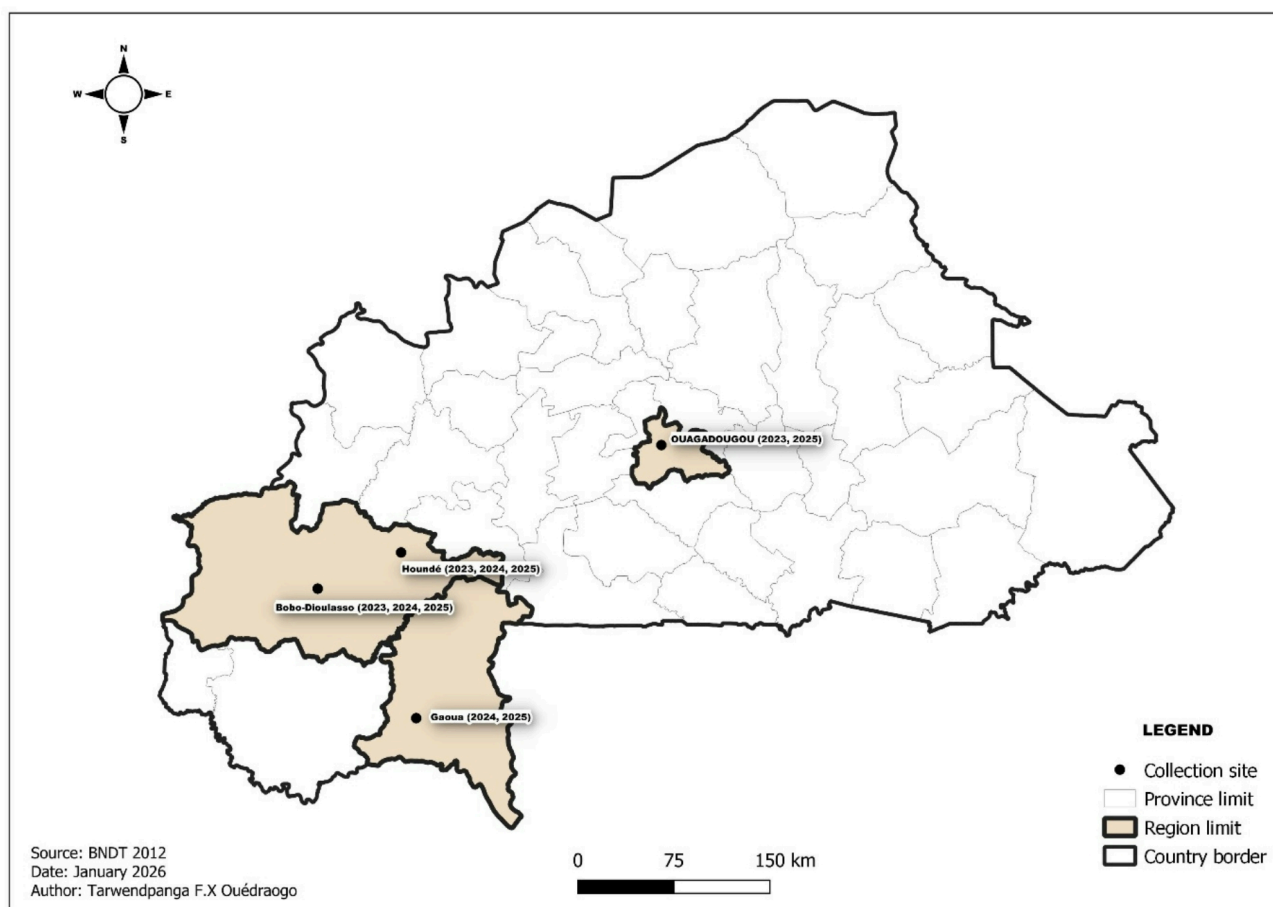


Figure 1

Study areas location

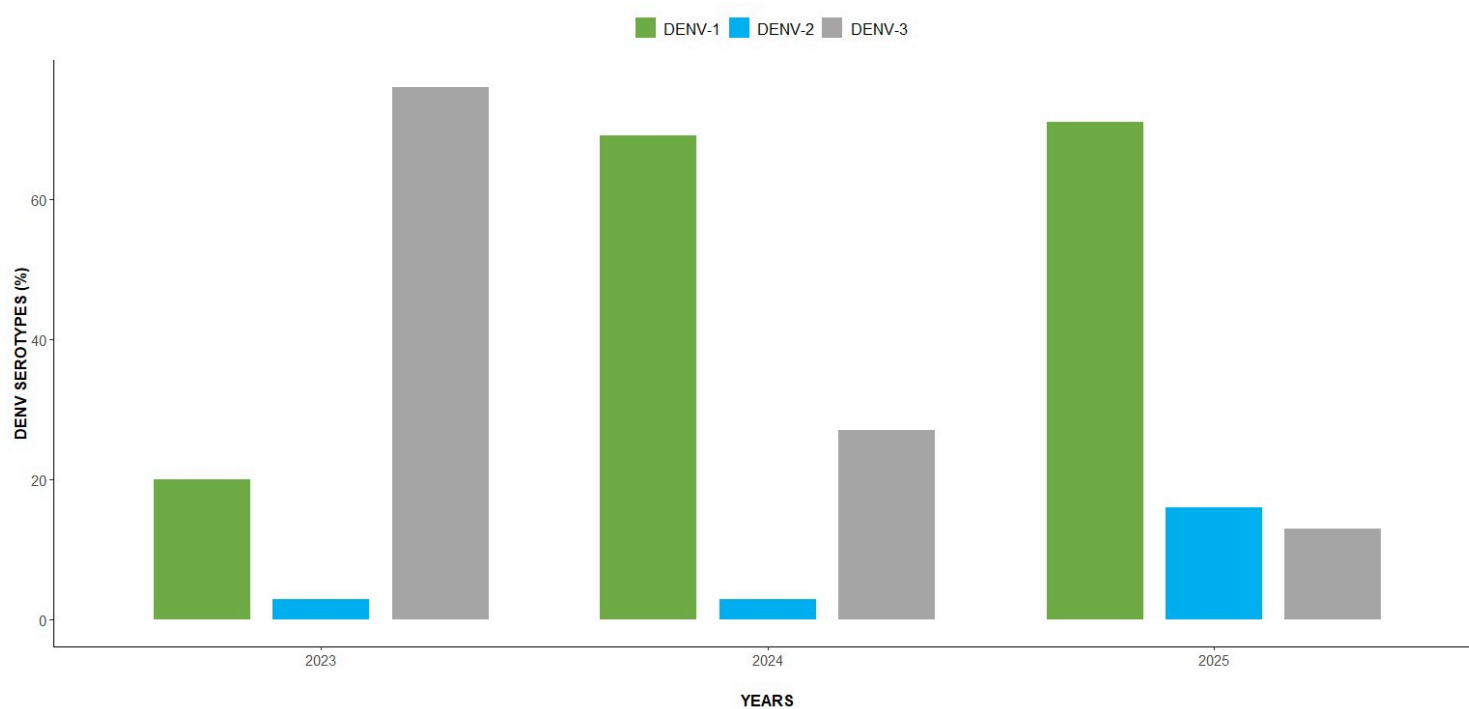


Figure 2

Distribution of dengue virus serotypes responsible for the outbreak

