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Epidemiology of Dengue in patients with febrile syndrome at Saint Camille Hospital, Ouagadougou, Burkina Faso from 2020 to 2021

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Abstract:

Background: Dengue is still a public health problem in tropical countries. This disease, which had almost disappeared in some areas of the world, has become re-emergent in certain parts of the world including Africa. The aim of this study is to determine the seroprevalence and evolution of Dengue virus (DENV) infection from 2020 to 2021 at the Hospital Saint Camille de Ouagadougou (HOSCO), Burkina Faso.

Methodology: This was a descriptive analytical study of patients seen in general practice with febrile syndrome referred for serological diagnosis of Dengue at the HOSCO laboratory over a period of 2 years (January 1, 2020 – December 31, 2021). The "Dengue Duo (AgNS1/IgM/IgG)" kit from SD Bioline was used for the rapid diagnosis through the detection of NS1 antigen and IgM/IgG antibodies in plasma. Data were analysed with SPSS version 20.0 software. Association between demographic data and prevalence of DENV infection was determined by Chi square test and odds ratio (with 95% confidence interval). P value less than 0.05 was considered statistical significance.

Results: A total of 2957 patients aged 0-94 years were referred for serological diagnosis of DENV infection at the HOSCO laboratory over the period 2020-2021, comprising 56.3% females and 43.7% males. The overall prevalence of acute DENV infection (NS1Ag positive) was 5.4% (159/2957), with 2.4% (41/1700) in 2020 and 9.4% (118/1257) in 2021 (OR=4.192, 95% CI=2.915-6.028, $p<0.0001$). The prevalence of acute DENV infection of 7.0% (91/1292) in the males was significantly higher than 4.1% (68/1665) in the females (OR=1.779, 95% CI=1.288-2.458, $p=0.0005$), and also significantly higher in age groups 20-29 years (7.6%), 10-19 years (6.9%) and 40-49 years (5.8%) than other age groups ($X^2=14.928$, $p=0.0107$). The overall prevalence of DENV IgM and IgG antibodies was 3.2% and 37.3% respectively. The prevalence of DENV IgG antibodies was significantly higher in males (44.0%) than females (32.1%) (OR=1.667, 95%CI=1.434-1.938, $p<0.0001$) and in age groups 30-39 (43.4%), 40-49 (44.0%) and >50 years (49.3%) than other age groups ($X^2=121.0$, $p<0.0001$), indicating that past exposure to DENV infection is higher among males and older age groups. The peak of DENV infection was between October and November with 84.3% (134/159) of NS1Ag positivity occurring during this period.

Conclusion: The present study reports a high prevalence of acute Dengue virus infection in patients from October to November. To eradicate Dengue which has become a tropical silent epidemic, interventions such as vector control, availability of and accessibility to diagnostic tests, and good therapeutic management are of great importance.

Keywords: Epidemiology; Dengue; NS1Ag; Burkina Faso

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Epidémiologie de la Dengue chez les patients atteints du syndrome fébrile à l'Hôpital Saint Camille, Ouagadougou,

Burkina Faso de 2020 à 2021

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Résumé:

Contexte: La dengue reste un problème de santé publique dans les pays tropicaux. Cette maladie, qui avait quasiment disparu dans certaines régions du monde, est devenue ré-émergente dans certaines parties du monde dont l'Afrique. Le but de cette étude est de déterminer la séroprévalence et l'évolution de l'infection par le virus de la Dengue (DENV) de 2020 à 2021 à l'Hôpital Saint Camille de Ouagadougou (HOSCO), Burkina Faso.

Méthodologie: Il s'agissait d'une étude analytique descriptive de patients vus en médecine générale avec syndrome fébrile adressés pour diagnostic sérologique de la Dengue au laboratoire HOSCO sur une période de 2 ans (1er Janvier 2020 – 31 Décembre 2021). Le kit "Dengue Duo (AgNS1/IgM/IgG)" de SD Bioline a été utilisé pour le diagnostic rapide grâce à la détection de l'antigène NS1 et des anticorps IgM/IgG dans le plasma. Les données ont été analysées avec le logiciel SPSS version 20.0. L'association entre les données démographiques et la prévalence de l'infection par le DENV a été déterminée par le test du chi carré et l'Odds ratio (avec un intervalle de confiance à 95%). Une valeur P inférieure à 0,05 a été considérée comme une signification statistique.

Résultats: Au total, 2957 patients âgés de 0 à 94 ans ont été référés pour un diagnostic sérologique de l'infection par le DENV au laboratoire HOSCO sur la période 2020-2021, comprenant 56,3% de femmes et 43,7% d'hommes. La prévalence globale de l'infection aiguë par le DENV (NS1Ag positif) était de 5,4% (159/2957), avec 2,4% (41/1700) en 2020 et 9,4% (118/1257) en 2021 (OR=4,192, IC à 95%=2,915-6,028, $p < 0,0001$). La prévalence de l'infection aiguë par le DENV de 7,0% (91/1292) chez les hommes était significativement supérieure à 4,1% (68/1665) chez les femmes (OR=1,779, IC à 95%=1,288-2,458, $p = 0,0005$), et également significativement plus élevée dans les tranches d'âge 20-29 ans (7,6%), 10-19 ans (6,9%) et 40-49 ans (5,8%) que les autres tranches d'âge ($\chi^2 = 14,928$, $p = 0,0107$). La prévalence globale des anticorps IgM et IgG contre le DENV était de 3,2% et 37,3% respectivement. La prévalence des anticorps IgG DENV était significativement plus élevée chez les hommes (44,0%) que chez les femmes (32,1%) (OR=1,667, IC à 95%=1,434-1,938, $p < 0,0001$) et dans les tranches d'âge 30-39 (43,4%), 40-49 (44,0%) et > 50 ans (49,3%) que les autres groupes d'âge ($\chi^2 = 121,0$, $p < 0,0001$), ce qui indique que l'exposition antérieure à l'infection par le DENV est plus élevée chez les hommes et les groupes d'âge plus âgés. Le pic d'infection au DENV a eu lieu entre octobre et novembre avec 84,3% (134/159) de positivité NS1Ag survenant au cours de cette période.

Conclusion: La présente étude rapporte une prévalence élevée d'infection aiguë par le virus de la dengue chez les patients d'octobre à novembre. Pour éradiquer la Dengue qui est devenue une épidémie tropicale silencieuse, des interventions telles que la lutte antivectorielle, la disponibilité et l'accessibilité des tests de diagnostic, et une bonne prise en charge thérapeutique sont d'une grande importance.

Mots clés: Epidémiologie; Dengue; NS1Ag; Burkina Faso

Introduction:

Dengue is an arbovirolosis transmitted to humans by diurnal mosquitoes of the genus *Aedes* subgenus *Stegomyia*, particularly the species *Aedes aegypti* and *Aedes albopictus*. Dengue is the most widespread arbovirolosis in tropical and subtropical countries of the world (1). Dengue virus (DENV), the etiological agent of dengue fever, belongs to the genus *Flavivirus*, and to the family *Flaviviridae*. DENVs are grouped into four genetically related but antigenically distinct serotypes; DEN-1, DEN-2, DEN-3 and DEN-4 (2), which are single-stranded RNA viruses with positive polarity. They are extremely limited in their

natural vertebrate host range, which includes only primates (3). Recently a fifth serotype, DENV-5 was isolated in 2013 in Sarawak in the Malaysian part of the island of Borneo without having caused any human cases to date, because it follows a purely sylvatic cycle unlike the other four serotypes which follow the human cycle (4).

This disease, which had almost disappeared in some areas of the world, is appearing again with high incidence, that qualifies it as a re-emerging infection (5). Thus, given the increase in its incidence over the last fifteen years, it is one of the infectious diseases of public health today (5). According to the World Health Organization (WHO), 3.9 billion people

(40 to 50% of the world's population) are exposed to the risk of DENV infection, with 500,000 cases of severe forms of the disease per year, and approximately 30,000 deaths (6). Dengue is a major public health threat in low-and-middle-income countries where the disease is endemic. It has been reported in 34 countries in Africa over the past decades (7). West Africa has been identified as a potential dengue hotspot due to a rapid growth of urban areas without proper sanitation that creates large areas in which the *Aedes aegypti* vector proliferates (8,9).

In Burkina Faso, the first Dengue epidemic occurred in 1925. Subsequently, a significant number of cases were identified in the 1980s. Burkina Faso is one of 34 countries in Africa where Dengue cases have been reported since 2000 (7), and is considered by the WHO to be an endemic country. Due to under-reporting of the disease and under-utilization of health services, particularly in resource-limited countries, the true health and economic burden of DENV infections is difficult to estimate (10). There is a real problem of differential diagnosis with the risk of misdiagnosis of Dengue as malaria. More than 70% of febrile illnesses are treated as suspected malaria without laboratory diagnosis in areas where malaria is prevalent (11).

Forecasts in Africa are notoriously underestimated. However, the most severe forms of the disease are Dengue hemorrhagic fever (DHF) and the Dengue shock syndrome (DSS) characterized by thrombocytopenia and vascular leakage leading to hypervolemia, with high mortality without prompt management. Although severe Dengue disease has historically been associated with pediatric populations in areas of hyper-endemia (12,13), recent trends indicate that adults may also be at risk (14,15).

There is currently no specific viral drug treatment for Dengue, therefore, treatment is symptomatic. Clinical signs are not specific to a serotype and infection by a serotype confers prolonged immunity to that same serotype but there is no cross-protection between serotypes. Therefore, a person may present several episodes of infection with more severe symptoms with each new infection by a different serotype than the one of the presenting infections. Vaccination could be one of the ideal methods to fight dengue, and it is interesting to note the progress made in developing vaccines against dengue viruses (16). The first licensed Dengue vaccine CYD-TDV (Dengvaxia®), has been registered in several countries but is not yet widely used and other vaccine candidates are being tested.

Biological diagnosis of Dengue involves detection of the virus, its genome or viral antigens, which is the direct diagnosis reserved for the early stage of the disease. Anti-

body detection, or indirect diagnosis, is preferred from day 5 of the disease (17). The detection of IgM antibodies uses capture ELISA technique, while the detection of IgG antibodies uses indirect ELISA technique (18). Molecular methods based on reverse transcriptase-polymerase chain reaction (RT-PCR) have helped to improve the diagnosis of Dengue in the symptomatic phase and to detect the serotypes involved (19). Viral isolation combined with sequencing allows for molecular epidemiological studies useful for health authorities and for understanding the circulation of dengue virus strains.

In 2013, three serotypes were isolated after another Dengue epidemic in Burkina Faso (18). Dengue remains a public health problem in Burkina Faso, therefore, regular data on the circulation of the virus and cases of infection are necessary for proper surveillance of a possible epidemic. The objective of this study was to determine the seroprevalence and evolution of Dengue infection from 2020 to 2021 at the Hospital Saint Camille de Ouagadougou (HOSCO), Burkina Faso.

Materials and method:

Study setting and design

This is a descriptive analytical study conducted over a period of 2 years (January 1, 2020 to December 31, 2021) at the Hospital Saint Camille de Ouagadougou (HOSCO) in Ouagadougou, the capital of Burkina Faso. HOSCO is one of the major health centers of the Burkinabe capital and receives patients from all over the city and from surrounding towns.

Study population and sampling

The study population consisted of 2957 patients (children and adults) of both sexes seen consecutively at the HOSCO general medical clinic with a febrile syndrome and at the laboratory of Hospital Saint Camille in Ouagadougou for the serological diagnosis of Dengue over the period of study. Demographic informations of each subject were collected from registers and patients' files. Blood samples from each patient were collected into ethylene diamine tetra-acetic acid (EDTA) bottles. After centrifugation at 4000g for 5min, the plasma was separated and used for the serological diagnosis of Dengue fever.

Ethical considerations

All participants in the study gave their free and informed consent. The confidentiality and anonymity of the information obtained from the various registers and patient files are kept strictly confidential.

Serodiagnosis of Dengue fever

The detection of Dengue virus from

the plasma sample was performed using the "Dengue Duo (NS1Ag+IgM/IgG)" from SD Bio-line (Standard Diagnostic Inc., Korea) according to the protocols provided by the manufacturer. The test is based on detection of NS1 antigen of Dengue virus in serum as well as IgG and IgM antibodies produced by the body against the virus. The principle is immunochromatography on cassette. The anti IgG and IgM antibodies of the sample react with the recombinant envelope proteins present in the colloid conjugate to form an Ag-Ab complex. This complex migrates by capillary action and captured by human anti IgG and/or anti IgM antibodies immobilized on the two lines, generating a colored line.

For AgNS1 detection using a micropipette, 100 μ l of plasma was deposited in the sample deposit area of the cassette dedicated to AgNS1 detection. Still on the same cassette but in the compartment dedicated to IgG and IgM detection, 5 μ l of plasma was also deposited in the square S sample well followed by 90 μ l of diluent in the diluent deposit area. After 15 to 20 minutes the result was interpreted according to the manufacturer's prescription. The presence of a single-colored line in the control window indicated a negative result and when the control line did not appear the result was invalid. The presence of a colored line in the test window for any of the markers AgNS1, IgG, IgM indicated a positive result for that marker.

Data analysis

Data were entered into Microsoft Excel 2016 software, and SPSS version 20.0 software was used for data analysis. The results were considered statistically significant at $p < 0.05$. The Odds ratio (OR) and 95% confidence

intervals (CI) were calculated to estimate the effect of patient sex and age on Dengue virus infection using EPI INFO 7.0.

Results:

Socio-demographic characteristics of the study population

The study included 2,957 patients who were referred for serological diagnosis of Dengue at the HOSCO laboratory, with age range of 0 to 94 years. The study population was composed of 56.3% females and 43.7% males; 56.1% (953/1,700) females and 43.9% (747/1,700) males in 2020, and 56.6% (712/1,257) females and 43.4% (545/1,257) males in 2021. The age group 20-39 years was the most represented with 43.8% (746/1700) and 51.9% (652/1,257) in 2020 and 2021 respectively. Adolescents and children under 20 years of age represented 30.9% (525/1700) in 2020 versus 23.3% (293/1257) in 2021 (Table 1).

Prevalence of Dengue virus infection by NS1 antigen and IgG/IgM antibody tests

Three Dengue virus markers (NS1 Ag, IgM, IgG) were tested in symptomatic patients with febrile syndrome. The overall prevalence of acute Dengue infection (NS1 Ag+) is 5.4% (159/2957), with 7.0% (91/1292) in males and 4.1% (68/1665) in females ($\chi^2=11.946$, OR=1.779, 95% CI=1.288-2.458, $p=0.0005$) (Table 2). The prevalence of acute DENV infection was significantly higher in age groups 20-29 years (7.6%), 10-19 years (6.9%) and 40-49 years (5.8%) than other age groups ($\chi^2=14.928$, $p=0.0107$). Univariate analysis shows that the prevalence was significantly higher in age group 20-29 years ($p=0.01$) (Table 3).

Table 1: Demographic characteristics of the study population

Demographics/ Year	2020		2021		Combined 2020 and 2021	
	Number	Percentage	Number	Percentage	Number	Percentage
Gender						
Male	747	43.9	545	43.4	1,292	43.7
Female	953	56.1	712	56.6	1,665	56.3
Total	1700	100.0	1257	100.0	2957	100.0
Age group (years)						
<10	328	19.3	144	11.5	472	16.0
10-19	197	11.6	149	11.8	346	11.7
20-29	389	22.9	323	25.6	712	24.1
30-39	357	21.0	329	26.2	686	23.2
40-49	171	10.0	138	11.0	309	10.4
≥ 50	258	15.2	174	13.9	432	14.6
Total	1700	100.0	1257	100.0	2957	100.0

Table 2: Prevalence of Dengue infection by the NS1 antigen, IgG and IgM antibodies in the study population in 2020 and 2021

DENV serology	NS1 Ag+ (%)	IGM+ (%)	IGG+ (%)
Gender			
Male (n=1292)	91 (7.0)	50 (3.9)	569 (44.0)
Female (n=1665)	68 (4.1)	45 (2.7)	534 (32.1)
Total (n=2957)	159 (5.4)	95 (3.2)	1103 (37.3)
χ^2	11.946	2.823	44.045
OR (95% CI)	1.779 (1.288 - 2.458)	1.449 (0.9622-2.183)	1.667 (1.434-1.938)
p value	0.0005*	0.0929	< 0.0001*
Age group (years)			
< 10 (n=472)	19 (4.0)	6 (1.3)	85 (18.0)
10-19 (n=346)	24 (6.9)	14 (4.0)	119 (34.4)
20-29 (n=712)	54 (7.6)	27 (3.8)	252 (35.4)
30-39 (n=686)	28 (4.1)	25 (3.6)	298 (43.4)
40-49 (n=309)	18 (5.8)	11 (3.6)	136 (44.0)
≥ 50 (n=432)	16 (3.7)	12 (2.8)	213 (49.3)
Total (n=2957)	159 (5.4)	95 (3.2)	1103 (37.3)
χ^2	14.928	8.057	121.10
p value	0.0107*	0.1531	< 0.0001*

OR = Odds Ratio; χ^2 = Chi square; CI = Confidence interval; * = Statistically significant; DENV=Dengue virus

Table 3: Univariate analysis of gender and age group with prevalence of acute Dengue infection (Ag NS1+)

DENV serology	NS1 Ag+	NS1 Ag-	OR	95% CI	p value
Gender					
Male	91	1128	Réf		
Female	68	1501	1.78	1.28 - 2.46	0.0005*
Age group (years)					
< 10	19	453	Réf		
10-19	24	322	0.56	0.30 - 1.04	0.08
20-29	54	658	0.51	0.29 - 0.87	0.01*
30-39	28	658	0.98	0.54 - 1.78	1.00
40-49	18	291	0.67	0.35 - 1.31	0.30
-* ≥ 50	16	416	1.09	0.55 - 2.14	0.86

NS1+ = NS1 positive antigen; NS1- = NS1 negative antigen; OR = Odds Ratio; CI = Confidence interval; * = statistically significant; DENV = Dengue virus

The overall prevalence of DENV IgM and IgG antibodies was 3.2% and 37.3% respectively. The prevalence of DENV IgG antibodies was significantly higher in the males (44.0%) than in females (32.1%) (OR=1.667, 95%CI=1.434-1.938, p <0.0001) and in age groups 30-39 (43.4%), 40-49 (44.0%) and >50 years (49.3%) than the other age groups (χ^2 =121.0, p <0.0001), indicating that past exposure to DENV infection is higher among males and older age groups (Table 2).

Of 1,700 samples analyzed in 2020, 2.4% (41/1,700) had recent or acute DENV infection (NS1 Ag+), 35.5% (603/1700) had secondary infection or past exposure to DENV (IgG+), 1.5% (25/1,700) had late primary or

recent secondary DENV infection (IgM+/IgG+), 0.1% (2/1700) had primary acute DENV infection (NS1 Ag+/IgM+) and 0.1% (2/1700) of patients were positive for all the three markers (NS1+/IgM+/IgG+) (Table 4).

Of 1257 samples analyzed in 2021, 9.4% (118/1,257) had recent or acute DENV infection (NS1 Ag+), 39.8% (500/1,700) had secondary infection or past exposure to DENV (IgG+), 5.0% (63/1,700) had late primary or recent secondary DENV infection (IgM+/IgG+), 2.3% (29/1257) had primary acute DENV infection (NS1 Ag+/IgM+), and 2.1% (27/1257) of the patients were positive for the three DENV serological markers (NS1+/IgM+/IgG+) (Table 4).

Table 4: Comparative prevalence of Dengue infection by the NS1 antigen, IgG and IgM antibodies in the study population in 2020 and 2021

Year/ DENV serology	2020			2021			
	NS1 Ag+ (%)	IgM+ (%)	IgG+ (%)	NS1 Ag+ (%)	IgM+ (%)	IgG+ (%)	
All subjects (n=1700)	41 (2.4)	27 (1.5)	603 (35.5)	118 (9.4)	68 (5.4)	500 (39.8)	
Gender				Gender			
Male (n=747)	23 (3.1)	14 (1.9)	366 (49.0)	Male (n=545)	68 (12.5)	36 (6.6)	203 (37.2)
Female (n=953)	18 (1.9)	13 (1.4)	237 (24.9)	Female (n=712)	50 (7.0)	32 (4.5)	297 (41.7)
χ^2	2.040	0.4089	105.45	χ^2	10.116	2.292	2.387
OR (95% CI)	1.65 (0.9-3.1)	1.38 (0.6-2.9)	2.90 (2.3-3.6)	OR (95% CI)	1.89 (1.3-2.8)	1.50 (0.9-2.5)	0.83 (0.7-1.0)
p value	0.1532	0.5225	< 0.0001*		0.0014*	0.1300	0.1223
Age group (years)				Age group (years)			
< 10 (n=328)	8 (2.4)	2 (0.6)	60 (18.3)	< 10 (n=144)	11 (7.6)	4 (2.8)	25 (17.4)
10-19 (n=197)	9 (4.6)	4 (2.0)	67 (34.0)	10-19 (n=149)	15 (10.1)	10 (6.7)	52 (34.9)
20-29 (n=389)	9 (2.3)	5 (1.3)	130 (33.4)	20-29 (n=323)	45 (13.9)	22 (6.8)	122 (37.8)
30-39 (n=357)	5 (1.4)	7 (2.0)	154 (43.1)	30-39 (n=329)	23 (7.0)	18 (5.5)	144 (43.8)
40-49 (n=171)	4 (2.3)	5 (2.9)	69 (40.4)	40-49 (n=138)	14 (10.1)	6 (4.3)	67 (48.6)
\geq 50 (n=258)	6 (2.3)	4 (1.6)	123 (47.7)	\geq 50 (n=174)	10 (5.7)	8 (4.6)	90 (51.7)
χ^2	5.473	4.755	70.918	χ^2	13.466	4.213	49.218
p value	0.3609	0.4465	< 0.0001*	p value	0.0194*	0.5191	< 0.0001*

OR = Odd Ratio; χ^2 = Chi square; CI = Confidence interval; * = Statistically significant

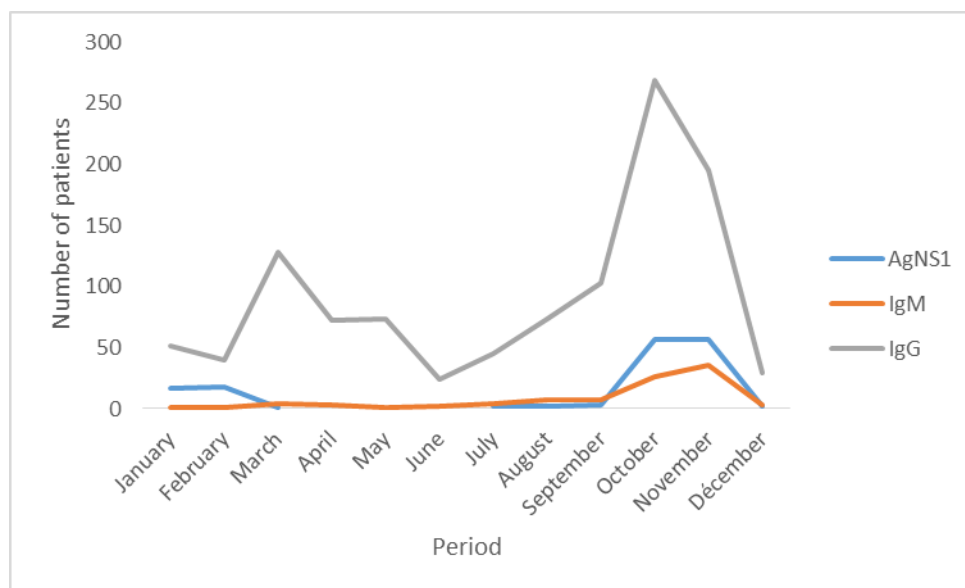


Fig 1: Evolution of dengue infection markers from 2020 to 2021 according to months

Majority of suspected DENV infections were reported during the last months (September-November) of the year. Patients positive for NS1 Ag during this period accounted for 84.3% (134/159) of all the positive patients in the entire study (Fig 1).

Discussion:

In this study, female represented the majority of the study population with 56.3% (56.1% in 2020 and 56.6% in 2021). Our res-

ults are similar to those of a previous study conducted at HOSCO where Ouattara et al., (21) reported 56.2% and 57.3% of females in 2016 and 2017 respectively, but slightly lower than the 69.2% reported in another study conducted in Ouagadougou (22). The predominance of females could be explained by the high representation of women in the general population of Burkina Faso (51.7%) (23) as well as the fact that females are more likely than males to attend health facilities for care.

The age of the study population ranged from 0 to 94 years with a means age of 29 ± 14.46 years. Adolescents and children under 20 years of age represented 30.9% (525/1700) in 2020 and 23.3% (293/1257) in 2021. These results agree with 24.1% in 2016 and 17.8% in 2017 reported by Ouattara et al., (21). The prevalence of acute Dengue (NS1 Ag+) infection in our study population was 5.4%; 2.4% (41/1,700) in 2020 and 9.4% (118/1,257) in 2021, showing significantly higher rate in 2021 than 2020 (OR= 1.779, 95% CI = 1.288-2.458, $p = 0.0005$). A previous study conducted at HOSCO reported a prevalence of 17.3% over the period 2016 to 2017 (21), another study in Togo reported a prevalence of 17% in 2017 (24) and 15.1% in Ivory Coast (25). The decrease in the prevalence of Dengue in Burkina Faso could be explained by various reasons, including the COVID-19 pandemic, which has kept some patients away from health centers, forcing them to take care of asymptomatic or mild cases of Dengue themselves, and also the effect of the sensitization of the population and healthcare personnel on Dengue and the prevention strategies (urban sanitation, anti-vectorial fight) put in place by the Burkina Faso health authorities since the Dengue peaks of 2013 (21,26).

Our study shows that males were significantly more infected with DENV 7.0% (91/1,292) compared to 4.1% (68/1,665) in females (OR = 1.779, 95% CI = 1.288 - 2.458, $p=0.0005$). Previous studies have reported higher prevalence of DENV infection in men than in women (21,27,28). On the other hand, a study conducted in Vietnam found that males were underrepresented among Dengue cases, but with higher risk of developing the severe form of the disease than females (29), while in Nigeria, Ayolabi et al., (30) reported that women were significantly more infected than men in their study population.

Adolescent and children < 20 years of age ($n=818$) in our study also appeared to be affected by acute DENV infection (NS1 Ag+), with prevalence of 5.3% (43/818); 3.2% (17/525) in 2020 and 8.9% (26/293) in 2021 (OR = 2.90, 95%CI = 1.551 - 5.459, $p=0.001$). According to some studies, children are the most affected by severe forms of DENV infection associated with mortality (31,32). However, in our study, the prevalence of DENV infection was high in age group 20-29 years with 7.6% (54/712), which was statistically significant on univariable analysis (OR=0.51, 95%CI=0.29-0.87, $p=0.01$). These results are similar to those of a study conducted in Malaysia which showed that adults are not spared from the threat of Dengue (33). Also in Burkina Faso, a study reported that adults are at risk of Dengue virus infections (34).

In the semi-urban areas of Kaya and Zorgho, DENV prevalence was 9.9% and 2.7% respectively (35). The level of urbanization between localities could explain these differences, especially since it is known that the population density is a factor conducive to the expansion of the DENV due to the insalubrity that favors the development of *Aedes*, which are the vectors (36,37). However, the difference between the results of 2014 Ridde et al., (35) study and the current study could be explained by the fact that the former only considered children aged 0 to 10 years.

Approximately 35% of the patients in 2020 and 39.8% in 2021 had secondary or prior DENV infection with positive IgG while IgM was positive in 1.5% in 2020 versus 5.4% in 2021, suggesting recent DENV infection. The prevalence of DENV IgG was significantly higher in males (44.0%) than females (32.1%) (OR=1.667, 95% CI = 1.434-1.938, $p<0.0001$) and in age groups 30-39 (43.4%), 40-49 (44.0%) and >50 years (49.3%) than other age groups ($\chi^2=121.0$, $p<0.0001$). This indicates that past exposure to DENV infection is higher among males and older age groups. The results of the three Dengue virus markers also showed that 42.9% of the patients were positive for at least one of the three markers. Ouattara et al., (21) reported 40.1% in the same facility.

It was noted in our study that acute DENV infections were rare from January to August but became increasingly common from September onwards. The majority of NS1 Ag positive patients were reported during the months of September to December, representing 84.3% (134/159) of total DENV infections, with peak infections in October and November. Our findings are similar to those of Ouattara et al., (21) who reported the peak of Dengue evolution between mid-October and mid-November. High prevalence of acute DENV infection was reported between September and December in Burkina Faso (38,39). The peak of the infection at this period is justified by the fact that after the rainy season, the climate is favorable to the multiplication of breeding sites and the proliferation of *Aedes*.

Conclusion:

The results of this study showed that the Dengue viral infection in Burkina Faso is a re-emerging disease and still constitutes a public health challenge. Constant surveillance to control the spread of DENV infection is necessary. The high prevalence of acute DENV infection reported during the last three months of the year, especially from October to November suggests an overlap between Dengue virus and malaria parasite transmissions at the end of the rainy season. In a

context of endemicity of both diseases, it is recommended to perform adequate tests to diagnose them in febrile patients. In addition, the proliferation of the vector and the transmission of the virus must be controlled. But with the resistance of *Aedes aegypti* and *Aedes albopictus* to insecticides, would it not be appropriate to explore new avenues of research such as "genes drive" technology (genetic forcing), nano-biotechnology or trials of larvicidal plant extracts for better prevention strategy of Dengue?

Contributions of authors:

SOTB wrote the first draft of the manuscript and revised the different versions of the manuscript AAZ, LT, AKO, and TMZ performed statistical analysis of all the data and revised different versions of the manuscript. AH, SZ, AA, and ST collected the data and revised the different versions of the manuscript. AD and JS designed the work and revised the different versions of the manuscript.

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Conflict of interest:

No conflict of interest is declared.

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