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A Study of Dengue Fever: Prevalence and Factors Associated to Infection in Pediatric Environment at the Bogodogo Teaching Hospital (CHU-B)

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ABSTRACT

Introduction: *Dengue fever is a real public health problem worldwide, particularly in Burkina Faso, due to its high morbidity and mortality. The country regularly experiences outbreaks with enormous consequences. The objective of this study was to determine the prevalence and factors associated with infection in children in 2023.*

Methodology: *This was a descriptive, cross-sectional study with retrospective data collection conducted over a 12-month period from January 1, 2023, to December 31, 2023, on suspected dengue cases admitted to the pediatric ward.*

Results: *Of a study population of 206 patients, dengue serology was positive in 82, representing a prevalence of 39.8%. Children in the [61-180] month age group were the most represented (43.2%), and also had the highest number of positive cases (58.4%). The sex ratio (M/F) was 1.22. The majority of patients (52.43%) were IgM-positive, and nearly 38% had NS1 antigen serology. Most positive cases were observed during and just after the rainy season. Dengue fever was associated with malaria in 28% of cases.*

Conclusion: *The prevalence of dengue fever is high among children. The majority had primary dengue fever and did not seek medical attention at the onset of the illness. It is necessary to strengthen hygiene measures and educate mothers to seek medical attention at the onset of fever associated with headaches in children during the rainy season.*

Keywords

Dengue fever, Prevalence, Associated factors, Pediatrics, Children.

Introduction

Dengue fever is an endemic viral disease caused by an arbovirus, which infects humans through the bite of a diurnal female mosquito of the genus *Aedes*. Dengue fever is one of the most actively spreading diseases and constitutes a real public health problem despite vector control efforts.

It is one of the so-called "re-emerging" diseases and is classified among the main neglected tropical diseases [1]. The virus responsible belongs to the *Flaviviridae* family and the *Flavivirus* genus. It is an RNA virus with 4 distinct serotypes: DENV 1, DENV 2, DENV 3 and DENV 4. In 2007, a 5th serotype with very limited spread was discovered in the state of Sarawak, Malaysia [2]. The vast majority of dengue virus infections are asymptomatic or result in a febrile syndrome without signs of severity, however, the virus can cause a more severe disease manifesting as plasma leakage with or without hemorrhage

In the absence of adequate treatment, the most severe forms can develop into a potentially fatal shock syndrome. There has been a resurgence of dengue cases, which tend to emerge or re-emerge

in regions where it was previously absent and to worsen where it was present. Dengue fever constitutes a significant global health threat, particularly in subtropical regions and tropical climates [3]. According to estimates by the World Health Organization (WHO), there are 50 to 100 million cases of dengue fever worldwide each year. This virus is responsible for 20,000 to 30,000 deaths per year, occurring mainly in children [4].

Due to underreporting of the disease and underutilization of health services, particularly in resource-limited countries, the true health and economic burden of DENV infections is difficult to estimate [5].

Like other countries in the region, Burkina Faso has reported cases of dengue fever in studies over the past five years [6]. The dengue virus has been circulating there for many years according to some authors [6,7]. The 2016 epidemic was the first major epidemic experienced by the country and resulted in approximately 2,526 suspected cases, including 1,561 probable cases (positive by rapid diagnostic test) and 20 deaths according to data from the Ministry of Health [8]. In 2023, it was the most affected country in the African region where a significant increase in dengue cases was observed compared to the same periods in 2021 and 2022 with 146,878 suspected cases, including 68,346 probable cases and 688 deaths among suspected cases [9].

Several studies on dengue fever have been conducted, but very few of them focus on children. Although they represent the most vulnerable age group, there is not enough specific data on this subpopulation. It is with this in mind that this work aims to study the prevalence and factors associated with dengue virus infection in children aged 0 to 15 years at the Bogodogo University Hospital in order to contribute to improving their care.

Materials and Methods

Study Setting

The study took place in the pediatric ward of the Bogodogo University Hospital (CHU-B) in Ouagadougou, Burkina Faso.

Type and Period of Study

This was a descriptive, cross-sectional study with retrospective data collection, which took place over a 12-month period from 1 January, 2023, to 31 December, 2023.

Study Population

This population consisted of patients admitted to the Pediatrics Department of Bogodogo University Hospital for suspected dengue fever, aged between 0 and 15 years.

Inclusion Criteria

-Patients whose personal information was correctly recorded in their records;
-Patients whose dengue serology test was performed and the results were available;
-Patients whose laboratory test results were performed, recorded, and available and complete.

Sampling

The sample was exhaustive and included only patients who met the inclusion criteria.

Variables: Sociodemographic, Symptoms, Malaria-dengue coinfection, Bacterial coinfection, Medical history, Disease progression, Biological characteristics.

Data Collection Tools and Techniques

An individual data sheet was developed for this purpose and served as a data collection tool. It consisted of collecting the information entered in the patient's file. The collected information was then transferred to the individual data collection sheets.

Data Processing and Statistical Analysis

The collected data were processed using Epi-info software, version 7.2.5. The Microsoft Office suite (Word 2019 and Excel 2019) was used for text entry and graphic production.

Ethical and Professional Considerations

The study received data collection authorization from the Director General of Bogodogo University Hospital and the head of the pediatrics department. The anonymity and confidentiality of the data collected were respected.

Results

Dengue Fever Prevalence

A total of 206 suspected cases of dengue fever out of 703 records were recorded in the pediatrics department, representing 29.3% of patients admitted to the pediatrics unit. Of these 206 suspected cases, dengue serology was positive in 82 cases, representing a prevalence of 39.8%.

Sociodemographic Characteristics of Positive Dengue Cases

The average age of patients was 85.55 months, with a range of 28 days to 168 months. More than half (58.4%) of the positive serologies were in the 61-180 month age group, followed by the 30-60 month age group (30.9%). Among those who tested positive, 41% were male and (58.9%) resided in urban areas. Table 1 shows the distribution of dengue cases by socio-demographic characteristics.

Distribution of dengue fever cases by month

The periods of high endemicity occurred from August to December, with a peak in October (63%). Table 2 shows the change in the number of dengue cases by month

Clinical Characteristics of Dengue Patients

Clinical symptoms were polymorphic in 82 patients with positive serology. Among these clinical signs, headache (n=76) (92.6%), fever (91.4%), nausea/vomiting (n=66) (80.4%), and asthenia (n=62) (75.6%) were the most common clinical manifestations. The clinical symptoms observed are shown in Table 3.

Table 1: Distribution of dengue fever cases according to socio-demographical characteristics (n=206).

Cases of dengue fever	*Positive* Number (%)	*Negative* Number (%)	Total
Age Group (months)			
[0; 28]	13 (20.9)	49 (79)	62
[29; 60]	17 (30.9)	38 (69.1)	55
[61; 180]	52 (58.4)	37 (41.6)	89
Total	**82 (39.8)**	**124 (60.2)**	**206**
Sex			
Male	47 (41.6)	66 (58.4)	113
Female	35 (37.6)	58 (62.4)	93
Total	**82 (39.8)**	**124 (60.2)**	**206**
Residence			
Rural	5 (13.8)	31 (86.1)	36
Semi-urban	4 (8.7)	42 (91.3)	46
Urban	73 (58.9)	51 (41.1)	124
Total	**82 (39.8)**	**124 (60.2)**	**206**

Table 2: Change in the number of dengue cases (suspected and positive) by month.

Dengue Case	Positive Number (%)	Negative Number (%)	Total
months			
January	0	8 (100)	8
February	0	5 (100)	5
March	0	7 (100)	7
April	0	1 (100)	1
May	0	0	0
June	0	3 (100)	3
July	0	6 (100)	6
August	1 (8.3)	11 (91.7)	12
September	22 (44)	28 (56)	50
October	29 (63)	17 (37)	46
November	27 (45.8)	32 (54.2)	59
December	3 (33.3)	6 (66.7)	9
Total	**82 (39,8)**	**124 (60,2)**	**206**

Table 3: Distribution of patients according to clinical symptoms.

Dengue case	Positive (%) n=82	Negative (%) n=124
Clinical syndromes		
headaches	76 (92.6)	44 (35.5)
Nauseas and vomiting	66 (80.5)	33 (26.6)
Asthenia	62 (75.6)	38 (30.6)
Anorexia	61 (74.4)	23 (18.5)
Orbital pains	36 (43.9)	16 (12.9)
Joint pains	35 (42.7)	23 (18.5)
Shock syndrome	2 (2.4)	4 (3.2)
Hemorrhage	25 (30.5)	16 (12.9)
Fever	75 (91.5)	68 (54.8)

Laboratory abnormalities

These abnormalities were recorded in all 206 (100%) of the suspected cases. Among the 82 people who tested positive for dengue, 33 (40.2%) had thrombocytopenia and 9 (11%) had thrombocytosis. 64 (78%) had a hematocrit value below normal. The CRP value was above normal in 75% of cases (n=62). Table 4 presents the laboratory abnormalities of the cases during dengue.

Table 4: Below and Above Normal Values of Laboratory Parameters During Dengue.

Dengue Case	Positive Number (%)	Negative Number (%)
Parameters (Values < normal)		
Leukocytes	23 (28)	21 (16.9)
Hemoglobin	42 (51.2)	17 (13.7)
Platelets	33 (40.2)	18 (14.5)
Creatinemia	3 (3.7)	6 (4.8)
Hematocrit	64 (78)	28 (22.6)
Parameters (Values > normal)		
Leukocytes	13 (15.9)	83 (66.9)
Hemoglobin	2 (2.4)	6 (4.8)
Platelets	9 (11)	58 (46.7)
Creatinemia	23 (28)	12 (9.7)
Hematocrit	3 (3.7)	5 (4)
AST	25 (30.5)	23 (18.6)
ALT	11 (13.4)	16 (12.9)

Distribution of positive dengue cases according to serological markers, comorbidities, and disease progression

Among the cases testing positive for dengue, 31/82 (37.80%) had NS1 positive; more than half (43/82 (52.43%)) of those tested had IgM and 29/82 (35.36%) had IgG. Among comorbidities, malaria was found in 23 cases (28%) of the 82 dengue cases. Regarding disease progression, 78/82 patients (95.12%) were cured.

Dengue and Associated Factors

Table 5 presents the statistical association between dengue, sociodemographic parameters, and malaria.

Table 5: Association of dengue, sociodemographic parameters, and coinfection.

Dengue	Yes Number (%)	N Number (%)	P - value	OR	IC 95 %
Age (months)					
[0-28]	13 (15.8)	49 (39.5)			
[29-60]	17 (20.7)	38 (30.7)	0.017	2.5	1.60-3,90
[61-180	52 (63.4)	37 (29.8)			
Sex					
Male	47 (57.3)	66 (53.2)	0.4	0.7	0.60-1.67
Female	35 (42.7)	58 (46.8)			
Dengue-Malaria Coinfection					
Yes	23 (28)	31 (25)	0.55	1.24	0.61-2.54
No	59 (72)	93 (75)			

Discussion

The 61- to 180-month-old age group was the most represented (43.2%) among suspected cases and also the one with the most positive cases (58.4%). This age group has a 2.5-fold increased risk of developing dengue fever ($p < 0.017$; OR = 2.5). Soudré et al. showed in a 2020 study that young children were the most represented (41.9%) with a mean age of 4.77 years [10]. *Aedes* mosquito bites occur preferentially during the day, especially in areas with stagnant puddles. Children are overly exposed to *Aedes*

mosquito bites at this age. This is a period of life when children lose maternal antibodies that protect against many attacks, especially viral ones.

Our study reported a male predominance in the study population but also among those who tested positive (57.3%). These results are similar to those of Soudré et al., in 2020 in Ouagadougou [10] and those of Prasad et al., [11] who reported a predominance of young boys positive for dengue of 57.14% and 64.7% respectively. This could be explained by the fact that boys are very mobile and could easily find themselves in spaces where there are puddles which constitute mosquito habitats. In the present study, the majority of positive patients (58.9%) resided in urban areas.

These data could be directly linked to the urban setting of our study and the vector distribution mode. Junxiong et al. [12], found in their study that dengue fever was mainly prevalent in populated urban areas where many people live. Indeed, the extension of urban areas in urban areas favors the proliferation of larval breeding sites. Also, urban areas constitute the preferred areas of *Aedes aegypti.* The prevalence of positive dengue cases in the study was 39.8%. DOHO et al. [13], in Burkina Faso, reported a prevalence of 30.47% in a study conducted at the Charles De Gaulle Pediatric University Hospital (CHUPCDG) in children aged 0 to 5 years. The same is true for Aoussi et al. [14], in Ivory Coast, who reported a prevalence of 25% of positive cases. However, Sergeeva in Russia [15], Djossou et al. in French Guiana [16], reported frequencies of 51.02%, 56.12% respectively.

These significant variations are probably linked to many factors, including the geographical location of the countries where these studies were conducted (high endemicity areas where there is a significant presence of vectors and medium or low endemicity areas). During the year, the prevalence of dengue fever varies considerably from one month to the next. The number of cases increased during the period from September to November 2023, with peaks in October (63%) and November (45.8%). Our results are comparable to those of Monnin et al., in Martinique [17], Soudré et al. in 2020 [10], Mistry et al. [18] in 2019 who observed an increase in cases from August with a peak in October.

The rainy season, which usually runs from July to September, favors the proliferation of the dengue vector. Indeed, during the rainy season there is stagnation of water in gutters, on roads or on objects that retain water (tire holes) and these puddles of water, which can remain for several months after the rainy season, favor the proliferation of the dengue vector. It is imperative to implement an effective prevention strategy to reduce the transmission of the virus, in particular the elimination of mosquito habitats and the mosquitoes themselves. This must be supplemented by individual prevention measures such as the application of repellents and the use of insecticide-treated mosquito nets.

In our study, the NS1 antigen was detected in only (31/82) cases, i.e., nearly 38% of positives. Other studies carried out in Burkina Faso found percentages of NS1 Ag lower than ours, notably that carried out by Ilboudo et al. in 2019 [19] who noted, in their study, a positivity of 30.77%., Soudré et al. (19.05%) [10]. The non-structural protein (NS1) specific to the dengue virus is secreted during viral replication by all four serotypes. It is an early diagnostic marker that is detectable from the first moments of clinical signs (7 days). These low proportions of people in whom NS1 Ag was detected could be explained by the fact that mothers consult late in the face of non-specific signs such as fever (91.5%), headaches (92.6%), nausea and vomiting (80.5%). They only consult when clinical signs persist. Also, in health facilities, dengue is suspected after eliminating other febrile pathologies such as malaria and respiratory infections.

These findings are similar to those noted by other authors, including Amarasinghe et al. and Sondo et al. [20,21]. Immunoglobins M were detected in 52.43% of the people tested (43/82). However, the teams of Soudré and Ilboudo reported the presence of IgM in 15.24% and 23.08% of the people tested positive, respectively. During a primary infection by the dengue virus, specific IgM appear around the 5th day after the first clinical signs [22]. These antibodies would be detectable in 50% of patients after 3 to 5 days, in approximately 80% on the 5th day and 99% on the 10th day [23]. From these results we could affirm that more than half of the children were in contact with the virus for the first time, therefore had primary dengue. Primary dengue fever appears to manifest itself classically asymptomatically in the majority of cases and progresses towards recovery with fewer complications. This could explain the high number of recovered cases (94%) and the biological disturbances observed, particularly in creatinine levels, transaminases (AST, ALT), and platelets.

The values of these parameters were lower than normal in 28%, 30%, 13% and 40% respectively. However, during secondary dengue the IgM level is lower or even undetectable. Immunoglobin G is found in (35.36%) of cases (29/82). Our results corroborate with those of the Soudré team which reported 39.05%, however, they are higher than those of Ilboudo et al. who observed 15.38% of positive IgG cases. In primary dengue, IgG appears around the 10th day after the onset of clinical signs and then gradually decreases while remaining detectable for several years [23]. During a secondary infection with the dengue virus, IgG appears faster from the acute phase (1 to 2 days) after the onset of clinical signs. Their titer is higher than during a primary infection and they will persist longer [22]

In the present study, less than half of the children had produced IgG antibodies, which could indicate a low proportion of secondary dengue, but this remained to be confirmed since IgG titration was not performed. Malaria, which is also a vector-borne disease, was found in 28% of dengue cases (n=23). Our results were comparable to those of DOHO et al. [13] who found 30.69%. Sondo et al. [21] in Ouagadougou reported a co-infection of 24.6%. This high proportion in the present study is explained by the fact that Burkina Faso is located in an area of high malaria endemicity.

Conclusion

This study determined the high prevalence of dengue fever among children in 2023 at the CHU-B. This high prevalence was

observed during and just after the rainy season. More than half of the children had primary dengue fever and had not consulted a health facility during the early stages of the illness. Given this situation, it is imperative to strengthen hygiene measures in cities to reduce the proliferation of vectors responsible for transmission and to educate mothers to seek medical attention in cases of fever, headaches, and vomiting.

Current State of Knowledge on the Subject

- The results of this study highlighted the high prevalence of dengue fever in children, and most had primary dengue fever;
- The majority of infected children did not undergo serology testing at the onset of the disease.
- Contribution of Our Study to Knowledge
- This study demonstrated children's exposure to dengue fever. It is much higher during and after the rainy season.
- This finding should encourage the improvement of hygiene measures in urban centers throughout the year, particularly after the rainy season, and the awareness of mothers to consult health facilities if they experience any fever or severe headache during or after the rainy season.

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