

Capitalisation- Mortality by dengue virus at the Regional Hospital of the city of Koudougou in 2023.

Kabore Ahmed¹, Manindji Akofodji Yalonwan Frégice Kévin¹, Soubyabiga Rayende Juste¹, Meda Nicolas^{1,2} Yameogo Relwende Aristide^{1,2}, Djiguemde Nebnomyid boumbou Norbert Wenceslas³, Togbe Alihonou Serges Eric³, Sana Moussa⁴,

¹Health Sciences Research and Training Unit (UFR/SDS) - Department of Public Health, Joseph KI University - ZERBO, Ouagadougou, Burkina Faso

²Health Sciences Research and Training Unit (UFR/SDS) - Medicine Section, Joseph KI University - ZERBO, Ouagadougou, Burkina Faso

³Koudougou Regional Hospital (CHR) - Obstetric Gynecology Service, Koudougou, Burkina Faso

⁴Regional Health Directorate (RHD) - Centre-West Region, Burkina Faso

Corresponding author

Name: KABORE Ahmed, Address: 09 BP 168 Ouagadougou 09, Telephone: 70 33 33 24

E-mail: ahmedkaboreza@gmail.com

Keywords

Mortality,
dengue,
Koudougou

ABSTRACT:

Introduction: Dengue, also known as "tropical flu", is an acute viral infection caused by an arbovirus of the flaviviridae family and genus Flavivirus. It is a public health problem in Burkina Faso.

Objective: The aim of this study was to understand the determinants of dengue mortality at the CHR in Koudougou in 2023.

Methods: This was a cross-sectional study with analytical purpose on probable dengue cases at the CHR of Koudougou from January 1, 2023 to December 31, 2023. The sampling was based on a census of all probable dengue cases received and treated at the CHR in Koudougou during the study period. A validated questionnaire was used for data collection.

Results: The mean age of patients was 33.16 years with extremes of 2 and 96 years. The age group 21-31 years was predominant in 33.55% (n=105) of cases; and males in 54.95% (n=172). The majority of cases lived in urban areas in 89.78% (n=281). The study also showed that the probable cases found were most often positive for NS1 antigen in 92.33% (n=289); and presented primary dengue in 84.35% (n=264). The mortality rate was 9.9%. The results of the final multivariate logistic regression model showed that baseline delay (p=0.013), respiratory distress (p=0.002), impaired consciousness (p=0.001), acute renal failure (p=0.041) and comorbidity (p=0.011) were significantly associated with the death of probable dengue cases at the CHR in Koudougou.

Conclusion: The lethality of probable dengue cases was high. Baseline delay, respiratory distress, altered consciousness, acute renal failure and co-morbidity were the factors influencing mortality. To better understand these determinants and improve clinical outcomes, more in-depth studies are essential.

1. Introduction

Dengue fever, also known as "tropical flu", is an acute viral infection caused by a flaviviridae arbovirus, and the genus Flavivirus. There are four serotypes of dengue virus (DENV for dengue virus): DENV-1, DENV-2, DENV-3 and DENV-4 [1,2]. It is transmitted to humans by the bite of infected female mosquitoes of the genus Aedes, mainly by Aedes aegypti and Aedes albopictus [2,3]. It is classified as a neglected tropical disease and currently represents a major public health concern, especially in the tropics and subtropics [4–6].

Dengue is the most widespread arboviral disease in the world, with an estimated incidence of about 390 million cases per year, of which 75.38% are asymptomatic [2]. The 2021 World Health Organization (WHO) report indicates that over the past twenty years there has been a significant increase in active dengue cases, from 505,430 in 2000 to 5.2 million in 2019 [4]. The disease has now

become endemic in more than 100 countries in Africa, the Americas, the Eastern Mediterranean, Southeast Asia and the Western Pacific; the latter two regions being the most affected [7].

Global deaths from dengue fever have increased by almost 50%, resulting in approximately 18,500 deaths each year [6].

Dengue mortality in Africa is very worrying. Carabali et al., 2015 found a mortality rate of 2.6% in Africa [8]. Outbreaks have been reported in various African countries and diagnostic capabilities were limited [9]. In sub-Saharan Africa, dengue patients are likely to be neglected due to lack of awareness among health professionals and difficulty distinguishing the disease from other common febrile conditions such as malaria [2].

To better understand the impact of dengue in Koudougou, Burkina Faso, we conducted a study on cases of dengue confirmed by RDT (Rapid Diagnostic Test) that were received and treated at the CHR in Koudougou during the 2023 outbreak.

2. Objectives

The general objective was to study the determinants of dengue mortality at the Koudougou Regional Hospital Centre in 2023. More specifically, it was:

- Determine the lethality of dengue at the CHR in Koudougou in 2023;
- Identify the factors associated with the occurrence of probable dengue cases at the CHR in Koudougou in 2023.

3. Methods

Type of study and period of study

This was a cross-sectional study with analytical focus on probable dengue cases at the CHR of Koudougou from January 1, 2023 to December 31, 2023.

Sampling

Sampling was based on the census of all probable dengue cases received and treated at the CHR in Koudougou during the study period.

Criteria for inclusion of patients

The patients included in this study were those whose RDT dengue test was positive.

- **Primary dengue case:** Patients with negative IgG for dengue and IgM and/or Ag NS1 were positive for RDT.
- **Secondary dengue case:** Patients with positive IgG for dengue and IgM and/or Ag NS1 were positive for RDT.

Patients with IgG positive in isolation, in the absence of titration techniques, were considered immune to previous dengue infection and were excluded from the study.

Data collection and variables studied

The data collection technique in the study was literature review; and the data were extracted from patient hospital records as well as consultation records, of the laboratory and hospitalization using a data extraction sheet including socio-demographic characteristics (age, sex, marital status, occupation, level of education, residence area), clinical data (warning signs, signs of severity, existence of associated pathologies and comorbidity), biological data, therapeutic data, as well as the classification of cases according to the severity or death of patients.

Operational definitions of dengue cases

Suspected case: Any person with an acute febrile disease characterized by a temperature above 39°C, persisting for 2 to 7 days and accompanied by at least two of the following clinical manifestations: headache, retro-orbital pain, myalgia, arthralgia, rash, bleeding, or shock [10].

Probable case: A suspected case that gives a positive result to a RDT. A dengue positive RDT is defined as the presence of IgM and/or IgG positive serology and/or NS1 antigen positivity [10].

Confirmed case: This includes any suspected or probable cases confirmed by laboratory tests: IgM positive serology (ELISA), high IgG titers, virus identification by RT-PCR (reverse transcriptase polymerase chain reaction) or viral isolation by culture techniques [10].

Data processing tools

Statistical analysis of these data was performed with STATA 16.0 software. The figures and tables were created using Excel software.

Data analysis

Descriptive analysis:

The quantitative variables with a normal distribution were expressed as an average with their standard deviation after completion of a normality test. Variables that had an abnormal distribution were expressed as a median with their interquartile interval. Qualitative variables were expressed as a percentage or proportion.

Bivariate analysis:

The existence of association between dependent and independent variables was investigated using the KHI-II test. The strength of this association was assessed through odds ratio (OR) and their 95% confidence interval. The threshold of materiality was chosen at 20%.

Multivariable analysis:

In logistic regression, all variables with a 20% p-value during the bivariate analysis were introduced into the final model. Then, based on the step-by-step modelling strategy, all variables with a p-value greater than 5% (significance threshold) were eliminated. The variables that were selected in the final model were those with a p-value of less than or equal to 5%.

Ethical and deontological aspects

The study was approved by the National Ethics Committee for Health Research; then obtained the authorization of the Director-General of the CHR in Koudougou. We are committed to ensuring the confidentiality of the data collected, while ensuring anonymity through the collection tool.

4. Results

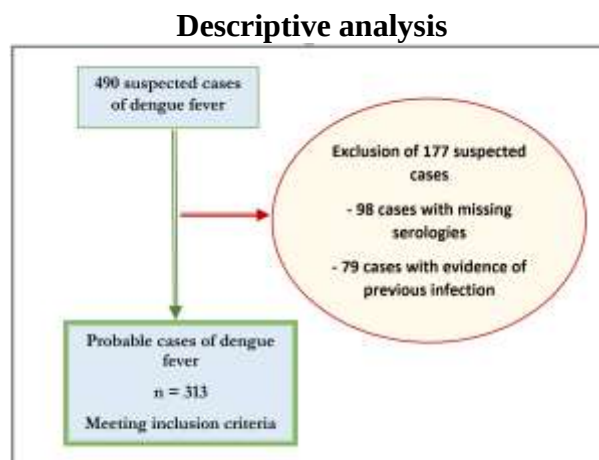


Figure 1: Flow diagram of the study population

Dengue lethality at the CHR of Koudougou in 2023

During the study period, 31 deaths were recorded out of 313 probable dengue cases; a mortality rate of 9.9%.

Socio-demographic characteristics

The mean age of patients was 33.16 years with extremes of 2 and 96 years. Table 1 presents the sociodemographic characteristics of patients.

Table 1: Sociodemographic characteristics of patients.

Features	Staff (n=313)	Percentage (%)
Age group (years)		
[2 - 21[	64	20,45
[21 -31[	105	33,55
[31 - 41[	64	20,45
[41 - 51[	38	12,14
Over 50 years old	42	13,42
Sex		
Female	141	45,05
Male	172	54,95
Pregnant woman		
Non	139	98,58
Yes	2	1,42

Table : Sociodemographic characteristics of patients (rest).

Features	Staff (n=313)	Percentage (%)
Occupation		
Farmer	17	5,43
Merchant	16	5,11
Student	102	32,59
Homemaker	61	19,49
Employee in the public sector	55	17,57
Other	62	19,81
Marital status		
Single	118	37,7
Married	195	62,3
Level of education		
None	99	33,11
Primary	54	18,06
Secondary	54	18,06
Post-secondary	92	30,77
Area of residence		
Rural	32	10,22
Urban	281	89,78
Delay consultation and onset of disease		
Less than one week	197	65,02
More than a week	106	34,98
Location of the first consultation		
CHR	129	41,21
CMA/CM	2	0,64

CSPS	182	58,15
------	-----	-------

Reference delay

No < 72h	170	92,9
----------	-----	------

Yes > 72h	13	7,1
-----------	----	-----

Self-medication

No	246	84,54
----	-----	-------

Yes	45	15,46
-----	----	-------

Clinical characteristics of patients

Table 2: clinical characteristics of patients

Features	Staff (n=313)	Percentage (%)
Warning sign		
Infectious syndrome	310	99,04
Algesic syndrome	228	72,84
Sign of gravity		
Hemorrhagic syndrome	111	35,46
Jaundice	13	4,15
State of shock	6	1,92
Respiratory distress	44	14,06
Disorders of consciousness	45	14,38
Kidney failure	83	26,52
Oligo-anuria	15	4,79
Associated malaria		
No	207	66,13
Yes	106	33,87
Existence of comorbidity		
No	288	92,01
Yes	25	7,99
RDT dengue		
AgNS 1	289	92,33
TIgM	45	14,38
IgG	48	15,34
Type of dengue		
Primary	264	84,35
Secondary	49	15,65
White blood cells		
Hyperleucocytosis	66	25,1
Leukopenia	97	36,88
Normal	100	38,02
Anemia		
Mild anemia	95	35,98

Features	Staff (n=313)	Percentage (%)
Moderate anemia	36	13,64
Severe anemia	23	8,71
Absent	110	41,67

Therapeutic and patient data

Table 4: patient therapeutic and evolutionary data

Features	Staff (n=313)	Percentage (%)
Patient Treatment		
Platelet transfusion	40	70,18
CGR Transfusion	24	42,11
Availability of labile blood product within 24 hours	57	100
Length of hospitalization		
Less than one week	224	85,82
More than a week	37	14,18
Hospital Discharge Status		
Alive	282	90,1
Deceased	31	9,9

Multivariate logistic regression

The determinants associated with dengue death are summarized in Table 5.

Table 5: Results of multivariate logistic regression between model-independent variables and patient deaths

Features	OR	95% IC	p-value
Age	1,02	0,98 – 1,07	0,3
Reference delay			
No (<72h)	—	—	
Yes (>72h)	22	2,27 – 348	0,013
Respiratory distress			
No	—	—	
Yes	11,9	2,68 – 71,6	0,002
Disorders of consciousness			
No	—	—	
Yes	19,9	4,04 – 156	0,001

Table 5: Results of multivariate logistic regression between model-independent variables and patient deaths (rest)

Features	OR	95% IC	p-value
Acute renal failure			
No	—	—	
Yes	6,68	1,26 – 52,2	0,041
Existence of comorbidity			
No	—	—	
Yes	18,8	2,23 – 222	0,011

5. Discussion

Limitations of the study

The study has many limitations. Also, we were unable to obtain RT-PCR results to confirm cases on the one hand and to identify the serotype of the virus on the other. Despite these constraints, our results are innovative in the context of Burkina Faso. This study is, to our knowledge, one of the few studies on probable dengue cases at the CHR in Koudougou.

Dengue lethality at the CHR of Koudougou in 2023

The fatality rate of probable dengue cases at the CHR in Koudougou in 2023 was 9.9%.

This high lethality in our context could be explained first by environmental factors. Indeed, the majority of probable dengue cases in the study were reported from early August 2023 to late December 2023; corresponding to climatic conditions favourable to mosquito proliferation [11], may lead to an increase in dengue cases and, therefore, overload of health systems. Also, the rapid and uncontrolled urbanization of the city of Koudougou could be the cause of precarious living conditions, such as lack of drinking water and sanitation, exacerbating the transmission of the virus and the severity of the disease [12]. Secondly, the lack of a technical platform could explain this high lethality. Finally, the circulation of more virulent strains could contribute to more severe forms of the disease and thus to increased lethality [13,14]. During previous outbreaks in Burkina Faso, dengue virus serotype 1 (DENV-1) and DENV-2 were the predominant serotypes. But it is clear that the 2023 epidemic was the most deadly with a death rate of 0.46%; with an appearance and predominance of serotype 3 [10]. In Brazil, a longitudinal and multicentre study of a series of cases in laboratory-confirmed dengue patients admitted to intensive care units (ICU) in 2015, to assess the factors associated with death found a lethality of 2.3% [15]. Our results corroborate those found by Sondo et al. in 2021 in Burkina Faso, which were 9.8% in a study carried out almost in the same contexts as ours, with the same methodology [6].

This high lethality will lead to a decrease in the labour force with a reduction in economic productivity. Given the lack of targeted antiviral treatments or vaccines against dengue, vector control and public awareness of clinical manifestations of dengue, appears to be the only effective strategy for preventing and managing this disease [16].

Factors associated with the occurrence of deaths of probable dengue cases at the CHR in Koudougou in 2023

Reference delay

The reference delay was significantly associated (**OR=22; p=0.013**) with the death of probable dengue cases at the Koudougou CHR.

Patients with a referral delay were twenty-two times more likely to die than those who did not.

This could be explained by difficulties in accessing care for populations with delays in diagnosis and management. Indeed, Burkina Faso is currently facing a security challenge throughout its territory. In the Centre-Ouest region, several CSPS have been closed due to the context of insecurity, limiting access to health care for the population. In addition, the deterioration of the road network would complicate access to health care during the winter season. Patient referral makes much more sense than reference delay.

In the literature, several authors have also noted this significant association between delay and death [8,17].

This reference delay will lead to the occurrence of complications and serious cases, hence the need to create initiatives to improve access to care, and encourage early consultation.

Respiratory distress

Respiratory distress was significantly associated (**OR=11.9; p=0.002**) with the death of probable dengue cases at the CHR in Koudougou.

Patients with respiratory distress had an eleven-fold higher risk of death compared to those who did not.

Our results could be explained by the creation of a third sector (significant plasma leak) in patients, causing hypovolemia and shock [18]. Also, by limited access to medical care which will lead to an aggravation of complications including respiratory distress.

Our results corroborate those found in the literature. In Thailand in 2014, Laoprasopwattana et al. noted that all deaths were caused by respiratory distress [19]. Salvi and Vaidya in 2022, objectified in India that respiratory distress was a key predictor of dengue-associated mortality with a mortality rate of 43.5% [20]. Studies conducted in Brazil in 2015 [15], and Vietnam in 2017 [21], also identified respiratory distress as a risk factor associated with mortality in patients with dengue.

Respiratory distress associated with dengue fever may indicate a more severe epidemic with increased mortality; and, on the other hand, a significant psychological impact it can cause through anxiety and stress in patients and their families, thus affecting the healing process.

The presence of respiratory distress requires increased surveillance and rapid response by health authorities, allowing for early identification of those who may develop into more severe forms of the disease.

Impaired consciousness

The disorders of consciousness were significantly associated (**OR=19.9; p=0.001**) with the death of probable dengue cases at the CHR in Koudougou.

Patients with impaired consciousness were nineteen times more likely to die than those without.

Our results could be explained first by the presence of respiratory distress and hypoxia that can affect the brain and cause alterations in consciousness. Secondly by severe anemia caused by hemorrhagic syndrome and leading to cerebral hypoxia.

Medagama et al. in 2020 in Sri Lanka [22] and Nurnaningsih et al. in 2022 in Indonesia [23] noted that disturbances of consciousness were associated in 20% and 36% of deaths, respectively. Acharya et al. in 2018, objectified that encephalopathy was associated with a significant increase in the risk of death with a p-value of 0.001 in India, highlighting its critical impact [24]. Other authors have also reported this association in the literature [25,26].

Altered consciousness is a sign of organ failure, increasing the risk of death. The change in the patient's mental status can cause emotional and psychological stress to the family and caregivers, affecting their ability to provide appropriate care. All this can lead to overloading the health system and limiting resources available for other patients.

Patients with impaired consciousness require early intensive care to prevent progression to complications. Data on consciousness disorders can help inform public health policies, with a focus on the prevention and management of severe dengue cases.

Acute renal failure (ARF)

Acute renal failure was significantly associated (**OR=6.68; p=0.041**) with the death of probable dengue cases at the CHR in Koudougou.

Patients with acute renal failure were six times more likely to die than those who did not have renal failure.

Our results could be explained by several mechanisms [27]. Dehydration, shock and hemorrhagic complications caused by dengue will cause renal hypoperfusion, leading to acute renal failure (ARF). Also, toxins released from damaged cells or the breakdown products of globules can damage renal

tubules, resulting in acute tubular necrosis, which is a cause of ARF. Finally, patients with a history of kidney disease or other comorbidities may be likely to develop ARF.

Our results corroborate those of Coulibaly et al. in 2020 in Burkina Faso, which found a 9% mortality rate among patients with ARF during dengue virus infection. Other authors in the literature have also reported this significant association between ARF and death from dengue [28–31].

ARF associated with dengue fever can worsen mortality statistics in epidemics. In the long term, the management of patients with ARF can result in high medical costs, which represents an economic burden for health systems and families. In the long term, these patients may require extended medical follow-up, increasing the burden on health services and requiring additional resources.

The recognition of ARF as a serious complication of dengue will influence prevention and awareness strategies, encouraging better early detection of cases. Also, the Government of Burkina Faso's funding for kidney dialysis will allow more patients to receive appropriate care; this will improve their quality of life and increase their life expectancy.

Existence of comorbidity

The existence of comorbidity was significantly associated (**OR=18.8; p=0.011**) with the death of probable dengue cases at the CHR in Koudougou.

Patients with comorbidity were 18 times more likely to die than those who did not have.

Our results could be explained by the fact that patients with comorbidities may have a weakened immune system, which makes them more vulnerable to infections and can aggravate the severity of dengue.

Macias et al. in 2021, a study in Mexico, Brazil, and Colombia noted that the risk of hospital mortality is 3 to 17 times higher in patients with dengue and a comorbidity [32]. In 2018, in Brazil, Werneck et al. found an 11-times higher risk of hospital mortality among patients with comorbidity and dengue [33]. Other authors [34,35] also highlighted this association in the literature.

Comorbidities increase the risk of serious complications and lead to higher medical costs, affecting public health budgets and family finances.

Dengue awareness campaigns should include information on managing comorbidities, to educate at-risk populations and promote preventive health behaviours.

6. Conclusion

In conclusion, the lethality of dengue at CHR Koudougou is high. The study highlights several key factors that affect mortality, such as referral delay, respiratory distress, consciousness disorder, acute renal failure and co-morbidity. To better understand these determinants and improve clinical outcomes, more in-depth studies are essential.

They will shed light on underlying mechanisms and optimize prevention and management strategies, thus contributing to reducing dengue-related mortality.

References

1. **Sinha R, Datta MR, Singh V.** A study on maternal and foetal prognosis and predictive factors for adverse outcome in pregnant patients with dengue in an endemic state of India. *J Fam Med Prim Care*. Mar 2022;11(3):912-7. https://journals.lww.com/10.4103/jfmpc.jfmpc_633_21
2. **Tinto B, Kania D, Samdapawindé Kagone T, Dicko A, Traore I, De Rekeneire N, Bicaba BW, Hien H, Van De Perre P, Simonin Y, Salinas S.** Circulation of the dengue virus in West Africa: An emerging public health issue. *medicine/science*. Feb 2022;38(2):152-8. <https://www.medicinesciences.org/10.1051/medsci/2022007>
3. **Mounica K, Pai TS, D'Sa S, Bhat KG.** Acute Dengue fever in a Neonate Secondary to Perinatal Transmission. *Iran J Neonatol IJN*. Jul 2021;12(3):100-3. <https://doi.org/10.22038/ijn.2020.45886.1766>
4. **Cahyati WH, Setiawan AW, Maharani C.** Intrinsic Factors of Mortality Due to DHF in 2018-2021. *J Kesehatan Masyarakat*. 11 Jul 2022;18(1):92-8. <https://journal.unnes.ac.id/nju/index.php/kemas/article/view/36720>
5. **Diallo I, Sondo KA, Tieno H, Tamelokpo EY, Zoungrana J, Sagna Y, Savadogo M, Poda A, Guira O, Diendéré EA, Sakandé J, Drabo YJ.** About 98 cases of dengue hospitalized in a private clinic in Ouagadougou: epidemiological, diagnostic and evolutionary aspects. *Bull Pathol Corporation* Oct. 2017;110(5):291-6. <http://link.springer.com/10.1007/s13149-017-0585-7>

6. **Sondo AK, Diendéré EA, Meda BI, Diallo I, Zoungrana J, Poda A, Manga NM, Bicaba B, Gnamou A, Kagoné CJ, Sawadogo G, Yaméogo I, Benzekri NA, Tarnagda Z, Kouanda S, Ouédraogo-Traoré R, Ouédraogo MS, Seydi M.** Severe dengue in adults and children, Ouagadougou (Burkina Faso), West Africa, October 2015–January 2017. *IJID Reg.* Dec 2021;1:53-9. <https://linkinghub.elsevier.com/retrieve/pii/S2772707621000138>
7. **Aubry P, Gaüzère BA, Vanhecke C.** Dengue. *Trop Medicine* May 7, 2024;1-11 <http://medecinetropicale.free.fr/cours/dengue.pdf>
8. **Carabali M, Hernandez LM, Arauz MJ, Villar LA, Ridde V.** Why are people with dengue dying? A scoping review of determinants for dengue mortality. *BMC Infect Dec.* 30 Jul 2015;15(301):1-14. <http://bmcinfect.biomedcentral.com/articles/10.1186/s12879-015-1058-x>
9. **Tchuandom SB, Tchadji JC, Tchouangueu TF, Biloa MZ, Atabonkeng EP, Fumba MIM, Massom ES, Nchinda G, Kuiate JR.** A cross-sectional study of acute dengue infection in paediatric clinics in Cameroon. *BMC Public Health.* Dec 2019;19(958):1-7. <https://bmcpublichealth.biomedcentral.com/articles/10.1186/s12889-019-7252-9>
10. **Ministry of Health and Public Hygiene.** National Public Health Bulletin [Internet]. 2023 [cited 29 Jan 2024]. Available at: https://www.sante.gov.bf/fileadmin/user_upload/bsp_301223_num__ro_1_final.pdf
11. **Ouattara CA, Traore TI, Traore S, Sangare I, Meda CZ, Savadogo LGB.** Climate factors and dengue fever in Burkina Faso from 2017 to 2019. *J Public Health Afr.* 24 mai 2022;13(1):58-61. <https://publichealthinafrica.org/index.php/jphia/article/view/387>
12. **Mekuriaw W, Kinde S, Kindu B, Mulualem Y, Hailu G, Gebresilassie A, Sisay C, Bekele F, Amare H, Wossen M, Woyessa A, Cross CL, Messenger LA.** Epidemiological, Entomological, and Climatological Investigation of the 2019 Dengue Fever Outbreak in Gewane District, Afar Region, North-East Ethiopia. *Insects.* 18 Nov 2022;13(11):1-13. <https://www.mdpi.com/2075-4450/13/11/1066>
13. **Lee JC, Cia CT, Lee NY, Ko NY, Chen PL, Ko WC.** Causes of death among dengue patients causes of death among hospitalized adults with dengue fever in Tainan, 2015: Emphasis on cardiac events and bacterial infections. *J Microbiol Immunol Infect.* avr 2022;55(2):207-14. <https://linkinghub.elsevier.com/retrieve/pii/S1684118221000621>
14. **Mwanyika GO, Mboera LEG, Rugarabamu S, Ngingo B, Sindato C, Lutwama JJ, Paweska JT, Misinzo G.** Dengue Virus Infection and Associated Risk Factors in Africa: A Systematic Review and Meta-Analysis. *Viruses.* March 24, 2021;13(4):1-17. <https://www.mdpi.com/1999-4915/13/4/536>
15. **Amâncio FF, Heringer TP, Oliveira CDCHBD, Fassy LB, Carvalho FBD, Oliveira DP, De Oliveira CD, Botoni FO, Magalhães FDC, Lambertucci JR, Carneiro M.** Clinical Profiles and Factors Associated with Death in Adults with Dengue Admitted to Intensive Care Units, Minas Gerais, Brazil. Jin X, editor. *PLOS ONE.* June 19, 2015;10(6):1-16. <https://dx.plos.org/10.1371/journal.pone.0129046>
16. **Liaqat I, Jahan N, Ahmad SI.** Challenges and future prospects for Dengue vector control. *Afr J Microbiol Res.* 16 Aug 2013;7(33):4220-7. https://academicjournals.org/article/article1380273127_Liaqat%20et%20al.pdf
17. **Linn NN, Kyaw KKY, Shewade HD, Kyaw AMM, Tun MM, Khine SK, Linn NYY, Thi A, Lin Z.** Notified dengue deaths in Myanmar (2017-18): profile and diagnosis delays. *F1000Research.* 9 juin 2020;9:1-14. <https://f1000research.com/articles/9-579/v1>
18. **Preeprem N, Phumeetham S.** Paediatric dengue shock syndrome and acute respiratory failure: a single-centre retrospective study. *BMJ Paediatr Open.* nov 2022;6(1):1-7. <https://bmjpaedsopen.bmj.com/lookup/doi/10.1136/bmjpo-2022-001578>
19. **Laoprasopwattana K, Chaimongkol W, Pruekprasert P, Geater A.** Acute Respiratory Failure and Active Bleeding Are the Important Fatality Predictive Factors for Severe Dengue Viral Infection. Ooi EE, editor. *PLOS ONE.* 2 Dec 2014;9(12):1-10. <https://dx.plos.org/10.1371/journal.pone.0114499>
20. **Salvi S, Vaidya A.** Patient Characteristics and Outcome of Multi-organ Involvement in Dengue with Reference to SOFA Score. *Asian J Res Infect Dis.* 26 sept 2022;11(2):47-54. <https://journalajrid.com/index.php/AJRID/article/view/216>
21. **Yacoub S, Trung TH, Lam PK, Thien VHN, Hai DHT, Phan TQ, Nguyet OPK, Quyen NTH, Simmons CP, Broyd C, Screatton GR, Wills B.** Cardio-haemodynamic assessment and venous lactate in severe dengue: Relationship with recurrent shock and respiratory distress. Rothman AL, publisher. *PLoS Negl Trop Dis.* 10 Jul 2017;11(7):1-14. <https://dx.plos.org/10.1371/journal.pntd.0005740>

22. **Medagama A, Dalugama C, Meiyalakan G, Lakmali D.** Risk Factors Associated with Fatal Dengue Hemorrhagic Fever in Adults: A Case Control Study. *Can J Infect Dis Med Microbiol.* 5 mai 2020;2020:1-8. <https://www.hindawi.com/journals/cjidmm/2020/1042976/>
23. **Nurnaningsih, Sunbanu SE, Rusmawatiningtyas D, Arguni E, Makrufardi F, Kumara IF.** Disseminated intravascular coagulation initial score as a predictor of mortality in children with dengue shock syndrome: A retrospective cohort study. *Ann Med Surg.* Jul 2022;79:1-6. <https://journals.lww.com/10.1016/j.amsu.2022.103890>
24. **Acharya V, Khan MF, Kosuru S, Mallya S.** Predictors of mortality in adult patients with dengue: a study from South India. *Int J Res Med Sci.* 25 avr 2018;6(5):1605-10. <http://www.msjonline.org/index.php/ijrms/article/view/4918>
25. **Lee IK, Liu JW, Yang KD.** Fatal Dengue Hemorrhagic Fever in Adults: Emphasizing the Evolutionary Pre-fatal Clinical and Laboratory Manifestations. Halstead SB, publisher. *PLoS Negl Trop Dis.* 21 Feb 2012;6(2):1-8. <https://dx.plos.org/10.1371/journal.pntd.0001532>
26. **Osnaya-Romero N, Perez-Guille MG, Andrade-García S, Gonzalez-Vargas E, Borgaro-Payro R, Villagomez-Martinez S, De Jesús Ortega-Maldonado J, Arredondo-García JL.** Neurological complications and death in children with dengue virus infection: report of two cases. *J Venom Anim Toxins* Dec 2017;23(25):1-7. <http://jvat.biomedcentral.com/articles/10.1186/s40409-017-0115-x>
27. **Coulibaly G, Lengani HYA, Sondo KA, Konvolbo HP, Diendéré ÉA, Nitiéma IJ, Karambiri AR, Sanou G, Lengani A.** Epidemiology of acute renal failure during dengue in the city of Ouagadougou. *Therapeutic Nephrology.* Feb 2020;16(1):27-32. <https://linkinghub.elsevier.com/retrieve/pii/S1769725519305012>
28. **Basu B, Roy B.** Acute renal failure adversely affects survival in pediatric dengue infection. *Indian J Crit Care Med.* Jan 2018;22(1):30-3. https://www.ijccm.org/doi/10.4103/ijccm.IJCCM_94_17
29. **Bignardi PR, Pinto GR, Boscaroli MLN, Lima RAA, Delfino VDA.** Acute kidney injury associated with dengue virus infection: a review. *Braz J Nephrol.* Jun 2022;44(2):232-7. http://www.scielo.br/scielo.php?script=sci_arttext&pid=S0101-28002022000200232&tlng=en
30. **Mallhi TH, Khan AH, Sarrieff A, Adnan AS, Khan YH.** Association of Ward Acquired, On-admission, Progressive and Non-progressive AKI with Death among Dengue Patients: A Hidden Relationship. *Acta Médica Port.* 29 Feb 2016;29(2):157-8. <http://www.actamedicaportuguesa.com/revista/index.php/amp/article/view/6900>
31. **Sikesa GPH, Ayu NP, Loekman JS.** Acute Kidney Injury in Patients with Dengue Shock Syndrome. *Gazi Med J.* 1 Jan 2022;33(1):73-4. <http://medicaljournal.gazi.edu.tr/index.php/GMJ/article/view/2463>
32. **Macias AE, Werneck GL, Castro R, Mascareñas C, Coudeville L, Morley D, Recamier V, Guergova-Kuras M, Etcheto A, Puentes-Rosas E, Baurin N, Toh ML.** Mortality among Hospitalized Dengue Patients with Comorbidities in Mexico, Brazil, and Colombia. *Am J Trop Med Hyg.* May 10, 2021;105(1):102-9. <https://www.ajtmh.org/view/journals/tpmd/aop/article-10.4269-ajtmh.20-1163/article-10.4269-ajtmh.20-1163.xml>
33. **Werneck GL, Macias AE, Mascarenas C, Coudeville L, Morley D, Recamier V, Guergova-Kuras M, Puentes-Rosas E, Baurin N, Toh ML.** Comorbidities increase in-hospital mortality in dengue patients in Brazil. *Mem Inst Oswaldo Cruz.* 23 juill 2018;113(8):1-5. http://www.scielo.br/scielo.php?script=sci_arttext&pid=S0074-02762018000800404&lng=en&tlng=en
34. **Islam QT, Adnan SD, Munna NI, Ahasan HN, Amin R, Shamsad IA, Yasmin R, Islam MR, Noor N, Asimsaha.** Review of Dengue Deaths in Bangladesh: An Interim Analysis of the 2023 Outbreak. *Bangladesh J Med.* 6 June 2024;35(2):179. <https://www.banglajol.info/index.php/BJMED/article/view/73273>
35. **Sousa SCD, Silva TAMD, Soares AN, Carneiro M, Barbosa DS, Bezerra JMT.** Factors associated with deaths from dengue in a city in a metropolitan region in Southeastern Brazil: a case-control study. *Rev Soc Bras Med Trop.* 2022;55:1-7. http://www.scielo.br/scielo.php?script=sci_arttext&pid=S0037-86822022000100331&tlng=en