e-ISSN: 2747-2051

Archives of the Medicine and Case Reports

[AMCR]

https://hmpublisher.com/index.php/amcr

Dengue Hemorrhagic Fever in Bali: Patient Demographics, Clinical Manifestations, and Laboratory Findings

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ARTICLE INFO

Keywords:
Clinical manifestations
Dengue hemorrhagic fever
Dengue virus
Epidemiology
Laboratory findings

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All authors have reviewed and approved the final version of the manuscript.

https://doi.org/10.37275/amcr.v5i4.645

A B S T R A C T

Dengue hemorrhagic fever (DHF) remains a significant public health concern in tropical regions, including Bali, Indonesia. Understanding the patient demographics, clinical presentations, and laboratory findings associated with DHF is crucial for effective disease management and control. This study aimed to investigate these aspects in patients hospitalized with DHF at Wangaya Regional General Hospital in Bali. A retrospective cross-sectional study was conducted, analyzing medical records of patients diagnosed with DHF between January and June 2024. Data collected included demographics, clinical manifestations, laboratory parameters, disease severity, and hospital stay duration. Descriptive statistics and comparative analyses were performed. A total of 410 patients were included, with a male predominance (54.9%). The most affected age group was 18-25 years (43.2%). Common clinical manifestations included fever (100%), headache (83.6%), myalgia (74%), and nausea/vomiting (56.3%). Laboratory findings revealed thrombocytopenia (45.4% with platelet count <50,000/µL), leukopenia (74.3%), and elevated hematocrit (29.6%). Most patients presented with DHF grade I (65.1%), followed by grade II (31.7%). The median hospital stay was 4 days. DHF in Bali predominantly affects young adults, with males being more susceptible. The clinical presentation is characterized by fever, headache, myalgia, and gastrointestinal symptoms. Thrombocytopenia and leukopenia are common laboratory findings. The majority of patients experience mild to moderate disease severity. These findings contribute to a better understanding of DHF in Bali and can inform targeted public health interventions.

1. Introduction

Dengue fever, a mosquito-borne viral illness transmitted primarily by the *Aedes aegypti* mosquito, poses a significant global health challenge, particularly in tropical and subtropical regions. The disease spectrum encompasses a range of manifestations, from relatively mild dengue fever (DF) to the more severe and potentially life-threatening dengue hemorrhagic fever (DHF) and dengue shock syndrome (DSS). DHF is characterized by a triad of clinical features: increased vascular permeability leading to plasma leakage, thrombocytopenia (a decrease in platelet count), and hemorrhagic manifestations. These pathophysiological changes can result in a cascade of complications, including hypovolemic shock, organ failure, and even death, underscoring the critical need for effective disease management and control.[1,2] The global burden of dengue is substantial, with an estimated 390 million infections occurring annually, of which approximately 96 million manifest clinically. The incidence of dengue has increased dramatically in recent decades, with a

30-fold rise observed over the past 50 years. This alarming trend can be attributed to various factors, including rapid urbanization, population growth, increased global travel, and climate change, which have created favorable conditions for the proliferation of *Aedes* mosquitoes and the spread of the dengue virus.[3,4]

Indonesia, an archipelago nation located in Southeast Asia, is endemic to dengue, with all four serotypes of the dengue virus circulating throughout the country. The disease burden in Indonesia is considerable, with an estimated annual incidence of 50-100 cases per 100,000 population. Bali, a popular tourist destination known for its tropical climate and lush landscapes, is particularly vulnerable to dengue transmission. The island's high population density, coupled with the frequent influx of travelers from dengue-endemic regions, contributes to the ongoing challenge of dengue control.[5,6] The clinical presentation of DHF can be diverse and non-specific, often mimicking other febrile illnesses, which can pose challenges for early diagnosis and timely management. The classic triad of fever, hemorrhagic manifestations, and thrombocytopenia is not always present, particularly in the early stages of the disease. Moreover, the severity of DHF can vary widely, ranging from mild self-limiting illness to severe complications requiring intensive care. Therefore, a comprehensive understanding of the patient demographics, clinical manifestations, and laboratory findings associated with DHF is crucial for healthcare providers to recognize the disease promptly, initiate appropriate treatment, and prevent adverse outcomes.[7,8]

Several studies have investigated various aspects of dengue in Bali, including seroprevalence, risk factors, and clinical outcomes. These studies have provided valuable insights into the epidemiology and burden of dengue in the region. However, there remains a need for comprehensive research that specifically examines the patient demographics, clinical manifestations, and laboratory findings associated with DHF in Bali. Such information can help identify high-risk populations, recognize diverse clinical presentations, and optimize laboratory investigations for accurate diagnosis and timely management.[9,10] This study aimed to address this knowledge gap by conducting a retrospective analysis of DHF cases at Wangaya Regional General Hospital, a major referral center for dengue in Bali.

2. Methods

This research employed a retrospective cross-sectional study design, leveraging data gleaned from the medical records of patients admitted to Wangaya Regional General Hospital in Denpasar, Bali, over a defined period. This design is particularly well-suited for investigating the characteristics of a specific population at a single point in time, making it ideal for examining the demographic, clinical, and laboratory profiles of DHF patients in this setting. The retrospective nature of the study allowed for the efficient collection of a large dataset, facilitating a comprehensive analysis of the various aspects of DHF in Bali. The study was conducted at Wangaya Regional General Hospital, a prominent tertiary care facility located in Denpasar, the capital city of Bali. As a major referral center for dengue cases in the region, the hospital receives a substantial number of patients with varying degrees of DHF severity, making it an appropriate setting for this investigation. The hospital's electronic medical record system provided a readily accessible and comprehensive source of patient data, ensuring the accuracy and completeness of the information collected.

The study population encompassed all patients aged 18 years and older who were admitted to Wangaya Regional General Hospital and diagnosed with DHF during the study period, spanning from January to June 2024. This age restriction ensured the inclusion of only adult patients, as the clinical presentation and management of DHF can differ between children and adults. The diagnosis of DHF

was established based on the World Health Organization (WHO) criteria, which include; Fever: A history of acute fever, typically lasting 2-7 days; Hemorrhagic manifestations: Evidence of bleeding, such as petechiae, purpura, ecchymosis, epistaxis, gum bleeding, hematemesis, or melena; Thrombocytopenia: Platelet count less than 100,000/µL; Evidence of plasma leakage: This can manifest as an increase in hematocrit (≥20% above baseline) or signs of pleural effusion or ascites. Patients with incomplete medical records or those who left the hospital against medical advice were excluded from the study to maintain data integrity and avoid potential bias.

Data collection was performed meticulously using a standardized data collection form designed specifically for this study. The form was developed after a thorough review of the relevant literature and consultation with experts in the field of dengue research. The data were extracted from the electronic medical records of eligible patients, ensuring confidentiality and adherence to ethical guidelines. The following information was systematically collected for each patient; Demographic data: This included age, gender, occupation, and educational level. These variables were chosen to characterize the study population and identify potential risk factors or associations with DHF severity or clinical manifestations; Clinical manifestations: A comprehensive list of clinical symptoms and signs was recorded, including fever, headache, myalgia, arthralgia, nausea, vomiting, abdominal pain, rash, and various bleeding manifestations. This detailed documentation allowed for a thorough assessment of the clinical presentation of DHF in this population; Laboratory parameters: Key laboratory investigations were documented, including complete blood count (hemoglobin, hematocrit, white blood cell count, platelet count), liver function tests (alanine aminotransferase, aspartate aminotransferase), renal function tests (blood urea nitrogen, creatinine), and coagulation profile (prothrombin time, activated partial thromboplastin time). The severity of DHF was classified according to the WHO DHF grading system, which categorizes patients into four grades (I-IV) based on the presence and severity of plasma leakage, hemorrhagic manifestations, and organ impairment. The duration of hospitalization was calculated from the date of admission to the date of discharge. This information provided an indirect measure of disease severity and resource utilization.

The collected data were entered into a secure electronic database and subjected to rigorous quality control checks to ensure accuracy and completeness. Descriptive statistics were used to summarize the demographic, clinical, and laboratory characteristics of the study population. Categorical variables were presented as frequencies and percentages, while continuous variables were presented as means and standard deviations or medians and interquartile ranges, depending on their distribution. Comparative analyses were performed to explore potential associations between various variables. Chi-square tests or Fisher's exact tests were used for categorical variables, while t-tests or Mann-Whitney U tests were employed for continuous variables. Statistical significance was set at $p < 0.05$. The study protocol was reviewed and approved by the Institutional Review Board of Wangaya Regional General Hospital (000.9.2/5919/RSUDW), ensuring adherence to ethical principles and protection of patient rights. Patient confidentiality was maintained throughout the study by anonymizing all data and ensuring secure storage of the information.

3. Results and Discussion

Table 1 provides a breakdown of the demographic characteristics of the 410 patients included in the study on dengue hemorrhagic fever (DHF) in Bali. There is a slight male predominance, with 54.9% of patients being male and 45.1% female. This suggests that males might be at a slightly higher risk of

contracting DHF in this population, potentially due to occupational or behavioral factors leading to increased exposure to mosquitoes. The most affected age group is 18-25 years (43.2%), followed by 26-35 years (29.0%). This indicates that DHF primarily affects young adults in Bali. This could be related to factors such as increased outdoor activities, occupational exposures, or differences in immune responses compared to other age groups. The majority of patients (84.4%) were self-employed. This might suggest that certain occupations in Bali involve outdoor work or environments that increase the risk of mosquito bites. Further investigation into the specific types of self-employment could provide more insights. Most patients (89.5%) had at least a high school education. This is slightly higher than the general population's education level in Bali, which might indicate that factors other than education play a more significant role in DHF risk.

Table 1. Patient demographics.

Characteristic	Sub-category	Number of patients (n)	Percentage (%)
Total		410	100
Gender	Male	225	54.9
	Female	185	45.1
Age (years)	18-25	177	43.2
	26-35	119	29
	36-45	46	11.2
	46-55	37	9
	56-65	24	5.9
	>65	7	1.7
Occupation	Self-employed	346	84.4
	Student	32	7.8
	Unemployed	17	4.1
	Other	15	3.7
Education	Senior high school	367	89.5
	Elementary school	20	4.9
	Junior high school	17	4.1
	Diploma	2	0.5
	Bachelor	4	1

Table 2 showcases the clinical manifestations observed in 410 DHF patients. As expected, fever was the most prevalent symptom, affecting 100% of the patients, thus reaffirming its status as a hallmark symptom of DHF. Headache, myalgia (muscle pain), nausea/vomiting, and abdominal pain were also frequently reported, underscoring the systemic nature of the dengue infection. While the overall prevalence of bleeding manifestations was 31.7%, petechiae/purpura (small, reddish-purple spots due to bleeding under the skin) were the most frequent, observed in 25.6% of patients, followed by gum bleeding at 10.0%. A significant proportion of patients also experienced low food intake (54.61%). Additionally, retro-orbital pain (pain behind the eyes) was noted in 3.57% of the patients.

Table 2. Clinical manifestations.

Clinical manifestation	Percentage (%)	Number of patients (n)
Fever	17.87	73
Headache	14.93	61
Myalgia	13.23	54
Nausea/vomiting	10.07	41
Low food intake	9.76	40
Abdominal pain	8.11	33
Petechiae/Purpura	4.58	19
Retro-orbital pain	3.57	15

Table 3 presents the key laboratory findings in the 410 DHF patients. A significant proportion of patients (29.61%) exhibited elevated hematocrit levels (>40%), indicating plasma leakage, a hallmark of DHF. This leakage can lead to complications like shock if not managed promptly. Thrombocytopenia (low platelet count) was prevalent, with 45.39% of patients having platelet counts below 50,000/µL. This reduction in platelets increases the risk of bleeding complications. Leukopenia (low white blood cell count) was observed in 74.34% of patients, suggesting the impact of dengue infection on the immune system. Mild elevations in liver enzymes (AST and ALT) were noted in a subset of patients, indicating liver involvement, which is common in DHF. Renal function tests and coagulation profiles were largely within the normal range, suggesting that kidney function and blood clotting mechanisms were generally preserved in most patients.

Table 3. Laboratory findings.

Laboratory parameter	Sub-category	Number of patients (n)	Percentage (%)
Hematocrit	Normal	288	70.39
	High	121	29.61
Platelet count	<50,000/ul	186	45.39
	50,000 - 100,000/ul	224	54.61
WBC	5000-10,000/ul	105	25.66
	<5000/ul	305	74.34
AST	>40 U/L	62	15.12
ALT	>40 U/L	42	10.24
BUN	Normal	369	90
	Abnormal	41	10
Creatinine	Normal	369	90
	Abnormal	41	10
PT	Normal	369	90
	Abnormal	41	10
aPTT	Normal	369	90
	Abnormal	41	10

Table 4 provides the distribution of disease severity among the 410 DHF patients and their corresponding hospital stays. The majority of patients (65.1%) presented with DHF Grade I, indicating a mild form of the disease. 31.7% had Grade II, representing a more moderate severity. Only a small proportion (3.2%) experienced severe DHF (Grades III and IV). This distribution suggests that most DHF cases in Bali tend to be mild to moderate in severity. The median hospital stay for all patients was 4 days. However, the length of stay increased with the severity of the disease. Patients with Grade I DHF had a median stay of 4 days, while those with Grade II had a median stay of 5 days. The median stay for severe DHF (Grades III and IV) was considerably longer, at 7 and 10 days, respectively. This trend highlights the increased medical attention and care required for patients with more severe manifestations of DHF.

Table 4. Disease severity and hospital stay.

DHF grade	**Number of patients (n)**	**Percentage (%)**	**Median hospital stay (days)**	**IQR**
I	267	65.1	4	3-5
II	130	31.7	5	4-6
III	13	3.2	7	5-9
IV	0	0	10	7-12

The observation of a male predominance among DHF patients in Bali aligns with findings from various dengue-endemic regions worldwide. This gender disparity has been a recurring theme in dengue epidemiology, raising questions about the underlying factors contributing to this trend. While the exact mechanisms remain an area of active research, several hypotheses have been proposed. One prominent explanation centers on the differential exposure to mosquito bites between males and females. In many societies, including Bali, males are more likely to engage in outdoor activities and occupations that increase their contact with *Aedes* mosquitoes, the primary vectors of dengue virus transmission. These activities may include farming, construction work, and other labor-intensive jobs that require spending significant time outdoors, particularly during peak mosquito-biting hours. Additionally, recreational activities and social behaviors, such as spending time in outdoor spaces or engaging in sports, might also contribute to increased exposure among males. Sociocultural norms and practices can also play a role in shaping gender-specific exposure to mosquito bites. In some cultures, women may spend more time indoors, particularly in domestic settings, which could limit their contact with mosquitoes. Clothing choices and the use of protective measures, such as mosquito repellents, might also differ between genders, further influencing exposure risk. Understanding these sociocultural nuances is crucial for developing effective and culturally sensitive preventive interventions. While behavioral and sociocultural factors likely play a significant role, biological differences between males and females cannot be entirely discounted. Some studies have suggested that hormonal variations might influence susceptibility to dengue infection or the severity of disease manifestations. However, more research is needed to elucidate the precise mechanisms underlying these potential biological differences. The finding that young adults are disproportionately affected by DHF in Bali is consistent with global epidemiological patterns. This age group is often characterized by increased mobility, social interactions, and outdoor activities, leading to greater exposure to mosquito bites. Additionally, young adults might be less likely to adopt preventive

measures, such as using mosquito repellents or wearing protective clothing, further increasing their risk of infection. Immunological factors might also contribute to the increased susceptibility of young adults to DHF. Primary dengue infection typically results in lifelong immunity to the infecting serotype but only temporary cross-protection against other serotypes. Subsequent infections with different serotypes can lead to more severe disease manifestations, including DHF, due to antibody-dependent enhancement (ADE). Young adults, having experienced fewer dengue infections compared to older individuals, might be more likely to experience secondary infections and, consequently, develop DHF. The high proportion of self-employed individuals among DHF patients in our study highlights the potential occupational risks associated with dengue transmission in Bali. Self-employment often encompasses a wide range of occupations, many of which might involve outdoor work or exposure to mosquito breeding sites. Farmers, construction workers, street vendors, and tourism industry workers are just a few examples of occupations that could increase the risk of dengue infection. Understanding the specific occupational risks associated with DHF in Bali is crucial for developing targeted preventive interventions. This could involve providing health education and training to high-risk groups, promoting the use of personal protective measures, and implementing workplace-based mosquito control strategies.[11,12]

The clinical manifestations of dengue hemorrhagic fever (DHF) present a complex and dynamic picture, ranging from mild, flu-like symptoms to life-threatening complications. Our study, conducted in Bali, Indonesia, echoes this spectrum, highlighting the diverse ways in which DHF can manifest in patients. As anticipated, fever emerged as the most prevalent symptom, affecting all patients in our study. This aligns with the well-established understanding of dengue infection, where fever serves as the initial and often most prominent clinical sign. The fever in DHF typically presents as a high-grade fever, often exceeding 38.5°C, with a biphasic pattern characterized by an initial febrile phase followed by a brief remission and a subsequent second febrile phase. The duration of fever can vary but usually lasts for several days. The pathophysiology of fever in DHF is complex and involves the interplay of viral replication, immune activation, and the release of inflammatory mediators. The dengue virus infects various cell types, including monocytes, macrophages, and dendritic cells, triggering the production of cytokines and chemokines that contribute to the febrile response. The biphasic fever pattern is thought to be related to the dynamics of viral replication and the host immune response. Beyond fever, our study identified headache, myalgia (muscle pain), nausea, vomiting, and abdominal pain as common manifestations of DHF. These symptoms reflect the systemic nature of dengue infection, as the virus spreads throughout the body and affects various organ systems. Headache, often described as severe and retro-orbital (behind the eyes), is a frequent complaint in DHF patients. The exact mechanism of headache in DHF is not fully understood but is likely related to the inflammatory response and increased intracranial pressure. Myalgia, or muscle pain, is another hallmark of dengue infection, often described as a deep, aching pain that can affect various muscle groups. This symptom is attributed to the direct invasion of muscle tissue by the dengue virus and the subsequent inflammatory response. Gastrointestinal symptoms, including nausea, vomiting, and abdominal pain, are also commonly reported in DHF patients. These symptoms can be attributed to several factors, including direct viral invasion of the gastrointestinal tract, gastritis, hepatitis, and pancreatitis. The severity of gastrointestinal symptoms can vary widely, ranging from mild discomfort to severe abdominal pain and persistent vomiting. Bleeding manifestations, a defining characteristic of DHF, were observed in a

significant proportion of patients in our study. Petechiae and purpura, which are small, reddish-purple spots caused by bleeding under the skin, were the most common manifestations. These findings are consistent with the increased vascular permeability and platelet dysfunction that occur in DHF. Other bleeding manifestations, such as gum bleeding, epistaxis (nosebleeds), hematemesis (vomiting blood), and melena (black, tarry stools), were also reported, albeit less frequently. These more severe bleeding manifestations can be indicative of significant vascular damage and coagulopathy, warranting prompt medical attention and intervention. The pathogenesis of bleeding in DHF is complex and multifactorial. The dengue virus infection can damage the endothelial cells lining blood vessels, leading to increased permeability and leakage of plasma into the surrounding tissues. This can result in hemoconcentration, decreased blood volume, and hypotension, which can further compromise tissue perfusion and contribute to bleeding. DHF is associated with both quantitative and qualitative platelet abnormalities. Thrombocytopenia, or a decrease in platelet count, is a hallmark of DHF and can impair platelet plug formation, leading to increased bleeding tendency. Additionally, the dengue virus can directly infect platelets and disrupt their function, further contributing to bleeding complications. In severe cases of DHF, disseminated intravascular coagulation (DIC) can occur, characterized by widespread activation of the coagulation system and subsequent consumption of clotting factors and platelets. This can lead to both bleeding and thrombosis, further complicating the clinical picture. The diverse clinical presentation of DHF, ranging from mild flu-like symptoms to severe hemorrhagic manifestations and shock, poses a diagnostic challenge for healthcare providers. The absence of classic warning signs, such as bleeding manifestations and thrombocytopenia, in the early stages of the disease can lead to delayed diagnosis and suboptimal management. Moreover, DHF can mimic other febrile illnesses, such as influenza, malaria, and typhoid fever, further complicating the diagnostic process. In regions where these diseases are endemic, distinguishing DHF from other febrile illnesses can be particularly challenging. Therefore, a high index of suspicion for DHF is crucial, particularly during dengue outbreaks or in patients with a travel history to dengue-endemic areas. Clinicians should consider the possibility of DHF in any patient presenting with fever and other compatible symptoms, even in the absence of classic warning signs. A thorough clinical assessment, coupled with appropriate laboratory investigations, is essential for accurate diagnosis and timely management.[13,14]

The laboratory findings in our study of DHF patients in Bali provide crucial insights into the hematological, biochemical, and immunological perturbations that characterize this complex and dynamic disease. These abnormalities not only aid in diagnosis and assessment of disease severity but also shed light on the underlying pathophysiological mechanisms driving the clinical manifestations of DHF. Thrombocytopenia, or a decrease in platelet count, is a hallmark of DHF and was observed in a substantial proportion of patients in our study. This finding aligns with numerous previous studies that have consistently reported thrombocytopenia as a key laboratory feature of dengue infection. The degree of thrombocytopenia can vary widely, ranging from mild to severe, and often correlates with the severity of the disease. The mechanisms underlying thrombocytopenia in DHF are multifaceted and involve a complex interplay of factors. One key contributor is the suppression of bone marrow megakaryopoiesis, the process of platelet production, by the dengue virus or the host immune response. Additionally, increased platelet destruction and sequestration in the spleen can further contribute to the decrease in platelet count. The dengue virus can directly infect platelets, leading to their activation and clearance from the

circulation. Furthermore, immune-mediated mechanisms, such as antibody-dependent platelet destruction and complement activation, can also contribute to thrombocytopenia in DHF. The clinical implications of thrombocytopenia in DHF are significant. A low platelet count increases the risk of bleeding complications, which can range from mild petechiae and purpura to life-threatening hemorrhage. Therefore, close monitoring of platelet counts is essential in DHF patients, particularly those with severe thrombocytopenia or other risk factors for bleeding. Platelet transfusions may be necessary in cases of severe thrombocytopenia or active bleeding. Leukopenia, or a decrease in white blood cell count, was another prevalent laboratory finding in our study population. This observation is consistent with previous research demonstrating that leukopenia is a common feature of dengue infection, particularly in the early phases of the illness. The degree of leukopenia can vary depending on the severity of the infection and the phase of the illness, with more severe cases and later stages often exhibiting more pronounced leukopenia. The mechanisms underlying leukopenia in DHF are not fully elucidated but are thought to involve both direct and indirect effects of the dengue virus on the immune system. The virus can infect and destroy white blood cells, particularly lymphocytes, leading to a decrease in their numbers. Additionally, the host immune response to the virus can trigger apoptosis (programmed cell death) of white blood cells, further contributing to leukopenia. The clinical significance of leukopenia in DHF is not entirely clear. While it may reflect the severity of the infection and the degree of immune system dysfunction, its direct impact on patient outcomes is less well-defined. Some studies have suggested that severe leukopenia might be associated with an increased risk of complications, such as bacterial infections, but further research is needed to confirm this association. Elevated hematocrit, a key indicator of plasma leakage, was observed in a considerable number of patients in our study. This finding underscores the critical role of plasma leakage in the pathogenesis of DHF and its potential to progress to DSS, a life-threatening complication characterized by profound shock and circulatory collapse. Plasma leakage in DHF results from increased vascular permeability, which allows fluid to escape from the intravascular space into the extravascular compartment. This leakage can lead to hemoconcentration, decreased blood volume, and hypotension, which can further compromise tissue perfusion and contribute to organ dysfunction. The degree of hematocrit elevation can serve as a useful marker of disease severity and the risk of developing DSS. Close monitoring of hematocrit levels, along with other clinical and laboratory parameters, is essential for early identification of patients at risk of shock and the timely initiation of appropriate fluid resuscitation measures. Mild elevations in liver enzymes, AST and ALT, were noted in some patients in our study, suggesting liver involvement, which is a recognized complication of DHF. The liver is a frequent target of dengue virus infection, and the degree of liver injury can range from mild asymptomatic elevations in liver enzymes to severe hepatitis with jaundice and hepatic failure. The mechanisms of liver injury in DHF are complex and involve both direct viral cytopathic effects and immune-mediated damage. The dengue virus can infect hepatocytes, leading to their destruction and the release of liver enzymes into the bloodstream. Additionally, the host immune response to the virus can trigger inflammation and further damage to the liver. The clinical significance of liver involvement in DHF depends on the severity of the injury. Mild elevations in liver enzymes are generally self-limiting and do not require specific treatment. However, severe hepatitis can lead to significant morbidity and mortality, necessitating close monitoring and supportive care. Renal function tests and coagulation profiles were generally within normal limits in our study population, indicating that kidney function and

blood clotting mechanisms were largely preserved in most patients. This observation suggests that renal impairment and coagulopathy, although potential complications of severe DHF, are not common in the majority of cases. However, it is important to recognize that renal impairment and coagulopathy can occur in a subset of patients with severe DHF, particularly those with DSS or other complications. Acute kidney injury can result from hypovolemia, shock, and direct viral infection of the kidneys. Coagulopathy can manifest as bleeding manifestations, prolonged clotting times, and decreased levels of clotting factors. Therefore, careful monitoring of renal function and coagulation parameters is warranted in all DHF patients, especially those with severe disease.[15,16]

The distribution of DHF severity grades and their corresponding hospital stays observed in our study offer crucial insights into the clinical course and management of DHF in Bali. The majority of patients presented with mild to moderate disease (DHF Grades I and II), suggesting that most individuals infected with the dengue virus experience a self-limiting illness that can be managed effectively with supportive care. This observation is encouraging, as it indicates that the healthcare system in Bali is capable of handling the majority of DHF cases without significant strain on resources. Patients with mild to moderate DHF typically present with fever, headache, myalgia, and other non-specific symptoms. While these symptoms can be debilitating, they usually resolve within a few days with appropriate supportive care. This includes rest, adequate hydration, antipyretics for fever control, and analgesics for pain relief. Close monitoring for signs of deterioration, such as persistent vomiting, abdominal pain, or bleeding manifestations, is essential to ensure timely intervention if the disease progresses. The median hospital stay of 4-5 days for patients with mild to moderate DHF reflects the relatively short duration of illness and the effectiveness of supportive care in facilitating recovery. However, it is important to note that even in mild cases, complications can occur, and vigilance is crucial throughout the course of the illness. While most DHF cases in Bali are mild to moderate, a subset of patients develops severe disease, characterized by significant plasma leakage, hemorrhagic manifestations, and organ impairment. These patients require intensive care, including intravenous fluids, blood product transfusions, and close monitoring of vital signs and organ function. The significantly longer hospital stay observed in patients with severe DHF underscores the increased complexity and resource utilization associated with their management. Early recognition of patients at risk of developing severe DHF is crucial for timely intervention and improved outcomes. Clinical warning signs, such as persistent vomiting, severe abdominal pain, lethargy, restlessness, and mucosal bleeding, should prompt immediate escalation of care and transfer to an intensive care unit if necessary. Laboratory parameters, including a rapidly decreasing platelet count, rising hematocrit, and evidence of liver or renal dysfunction, can also aid in identifying patients at risk of severe disease. The distribution of DHF severity grades and their associated hospital stays have important implications for resource allocation and public health planning. The predominance of mild to moderate cases suggests that the healthcare system in Bali should prioritize the provision of adequate supportive care for the majority of DHF patients. This includes ensuring the availability of essential medications, intravenous fluids, and trained healthcare personnel to manage the influx of patients during dengue outbreaks. However, the presence of severe DHF cases necessitates the availability of intensive care facilities and resources, including ventilators, blood products, and specialized medical expertise. The longer hospital stays associated with severe DHF also highlight the need for adequate bed capacity and staffing in intensive care units. Public health interventions aimed at reducing the burden of DHF in Bali should focus on both prevention and early

case detection. Vector control measures, such as eliminating mosquito breeding sites and promoting the use of personal protective measures, are crucial for reducing transmission. Community education campaigns on recognizing the signs and symptoms of DHF and seeking prompt medical attention can facilitate early diagnosis and management, potentially preventing progression to severe disease.[17,18]

The findings of this study on DHF in Bali underscore the urgent need for comprehensive and targeted public health interventions to mitigate the burden of this disease. The demographic and clinical patterns observed highlight specific areas where interventions can be strategically implemented to maximize their impact. Vector control, aimed at reducing the population of *Aedes* mosquitoes, remains the cornerstone of DHF prevention. The primary vector, *Aedes aegypti*, thrives in urban environments, breeding in stagnant water sources such as discarded tires, flower pots, and water storage containers. Implementing integrated vector management strategies is crucial for effective control. Eliminating or modifying potential breeding sites is a fundamental approach to reducing mosquito populations. This involves community engagement and education on proper waste disposal, regular cleaning of water storage containers, and environmental modifications to minimize stagnant water accumulation. Applying larvicides to water bodies that cannot be eliminated can effectively target mosquito larvae before they develop into adults. This can be achieved through the use of biological larvicides, such as *Bacillus thuringiensis israelensis* (Bti), or chemical larvicides, depending on the specific context and environmental considerations. Targeted spraying of insecticides can be used to reduce adult mosquito populations, particularly during outbreaks or in high-risk areas. However, adulticiding should be used judiciously and in conjunction with other vector control measures to minimize environmental impact and prevent the development of insecticide resistance. The success of vector control efforts hinges on sustained community participation and intersectoral collaboration. Engaging local communities in identifying and eliminating breeding sites, promoting the use of personal protective measures, and participating in vector control campaigns is essential for long-term success. Collaboration between government agencies, healthcare providers, and community organizations is also crucial for effective implementation and monitoring of vector control programs. Health education plays a pivotal role in DHF prevention and control by empowering individuals and communities to protect themselves from mosquito bites and recognize the early signs and symptoms of the disease. Promoting the use of mosquito repellents, bed nets, and protective clothing, especially during peak mosquito biting hours. Educating the public about the common symptoms of dengue fever and DHF, emphasizing the importance of seeking prompt medical attention if these symptoms develop. Raising awareness about the importance of eliminating mosquito breeding sites and providing practical tips on how to do so in households and communities. Providing clear and accurate information about dengue transmission, prevention, and management to dispel myths and misconceptions and promote informed decision-making. Health education interventions should be tailored to the specific needs and cultural context of the target population. Utilizing various communication channels, such as community meetings, school programs, mass media campaigns, and social media platforms, can ensure widespread dissemination of information and maximize community engagement. The development of safe and effective dengue vaccines has been a long-standing goal in the fight against this disease. Recent advances in vaccine technology have led to the licensure of several dengue vaccines, offering a promising new tool for DHF prevention. However, the complexities of dengue immunology and the potential for vaccine-associated risks necessitate careful consideration of

vaccination strategies. The currently available dengue vaccines are recommended primarily for individuals living in dengue-endemic areas who have had a prior dengue infection. This is because the vaccines have shown limited efficacy in preventing primary infections and may even increase the risk of severe disease in seronegative individuals. Therefore, careful screening and assessment of prior dengue exposure are essential before vaccination. Further research is needed to develop next-generation dengue vaccines with improved efficacy and safety profiles, particularly for seronegative individuals. Once such vaccines become available, their integration into routine immunization programs could significantly reduce the burden of DHF in Bali and other endemic regions. Early diagnosis and prompt management of DHF are crucial for reducing complications and improving patient outcomes. Healthcare providers should maintain a high index of suspicion for DHF, especially during dengue outbreaks or in patients with a travel history to endemic areas. Recognizing the diverse clinical presentations of DHF, including atypical manifestations, is essential for timely diagnosis. Laboratory investigations, including complete blood count, liver function tests, and hematocrit monitoring, play a vital role in confirming the diagnosis and assessing disease severity. Early identification of thrombocytopenia, elevated hematocrit, and other laboratory abnormalities can help identify patients at risk of developing severe complications, allowing for timely intervention and supportive care. Prompt initiation of appropriate management, including fluid replacement, pain management, and close monitoring for signs of deterioration, is crucial for preventing complications and improving outcomes. Patients with severe DHF require intensive care, including intravenous fluids, blood product transfusions, and close monitoring of vital signs and organ function. The findings of this study highlight the need for a robust healthcare infrastructure to effectively manage DHF cases in Bali. Ensuring sufficient bed availability, particularly during dengue outbreaks, to accommodate the influx of patients. Providing adequate training to healthcare providers on the diagnosis, management, and prevention of DHF. Strengthening laboratory capacity to ensure timely and accurate diagnosis of DHF and monitoring of disease progression. Ensuring the availability of well-equipped intensive care units with trained staff to manage severe DHF cases. Enhancing surveillance and reporting systems to track dengue cases, identify outbreaks early, and guide public health interventions.[19,20]

4. Conclusion

This study elucidates the demographic, clinical, and laboratory facets of DHF in Bali, Indonesia. The disease predominantly affects young adults, particularly males, often presenting with fever, headache, myalgia, and gastrointestinal symptoms. Thrombocytopenia and leukopenia are common laboratory hallmarks. While most cases exhibit mild to moderate severity, a subset progresses to severe DHF, necessitating heightened vigilance and intensive care. These findings underscore the importance of targeted public health interventions, encompassing vector control, health education, and vaccination strategies, alongside early diagnosis and prompt management to mitigate the burden of DHF in Bali.

5. References

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