



## ORIGINAL ARTICLE

# PREVALENCE OF DENGUE HEMORRHAGIC FEVER IN BALI FROM 2015 TO 2020 AND DURING THE COVID-19 PANDEMIC

*Prevalensi Kasus Demam Berdarah Dengue di Provinsi Bali Tahun 2015-2020 dan Selama Pandemi COVID-19*

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## ARTICLE INFO

Received August, 18<sup>th</sup>, 2021

Revised form August, 27<sup>th</sup>, 2021

Accepted May, 13<sup>th</sup>, 2022

Published online May, 30<sup>th</sup>, 2022

### Keywords:

Bali province;

COVID-19;

dengue hemorrhagic fever;

prevalence;

tropical disease;

### Kata Kunci:

provinsi bali;

COVID-19;

demam berdarah dengue;

prevalensi;

penyakit tropis;

## ABSTRACT

**Background:** Dengue hemorrhagic fever cases increased significantly during the COVID-19 pandemic phase. **Purpose:** This study defines, describes, and evaluates the dengue hemorrhagic fever incidence in Bali Province from 2015 to 2020 and in the context of the COVID-19 pandemic. **Methods:** The various types of descriptive study with case series design. The study used an environmental epidemiology approach to analyze the health profile of Bali Province. The number of DHF cases in 2015-2020, DHF-related morbidity and death rates, larva-free rates, climate, population and population density, and gender were variables in this study. The study took place in May and June 2021. **Results:** The prevalence of dengue hemorrhagic fever in the province of Bali fluctuated between 2015 and 2020. The highest number of dengue cases in 2016 was 20,306, and they fell from 2017 to 2019. Cases doubled in 2020, up by 12,173. The endemic areas with the highest prevalence of cases are in the districts of Buleleng and Badung. The highest incidence rate was in 2016 at 483/100,000 population, and for the last five years, it has not met the national target of 49/100,000 population. The highest CFR figure in 2020 was 0.43%, an increase of 1.5 times during the COVID-19 pandemic. **Conclusion:** The prevalence of dengue hemorrhagic fever cases in Bali in 2015 – 2020 fluctuated significantly, and mortality due to dengue during the COVID-19 pandemic experienced a significant increase.

**How to Cite:** Adnyana, I.M.D.M., Farachatus, S.S.A., & Sudaryati, N.L.G. (2022). Dengue Hemorrhagic Fever Prevalence In Bali from 2015 to 2020 and During COVID-19 Pandemic. *Jurnal Berkala Epidemiologi*, 10 (2), 169-178. <https://dx.doi.org/10.20473/jbe.v10i22002.169-178>

## ABSTRAK

**Latar belakang:** Peningkatan kasus demam berdarah dengue pada masa pandemi COVID-19 kian memprihatinkan. **Tujuan:** Penelitian ini bertujuan untuk menggambarkan, mendeskripsikan dan menginterpretasikan kejadian Demam Berdarah Dengue di Provinsi Bali tahun 2015-2020 dan selama pandemi COVID-19. **Metode:** Jenis penelitian deskriptif dengan rancang bangun case series. Penelitian dilakukan dengan menganalisis Profil Kesehatan Provinsi Bali dengan pendekatan kasus epidemiologi lingkungan. Jumlah kasus DBD tahun 2015-2020, angka kesakitan dan kematian terkait DBD, angka bebas jentik, iklim, populasi dan kepadatan penduduk, serta jenis kelamin merupakan variabel dalam penelitian ini. Penelitian dilakukan pada bulan Mei – Juni 2021. **Hasil:** Prevalensi kejadian demam berdarah dengue di Provinsi Bali berfluktuasi antara tahun 2015 sampai dengan tahun 2020. Kasus DBD tertinggi pada tahun 2016 berjumlah 20.306 dan melandai tahun 2017 -2019. Kasus meningkat dua kali lipat pada tahun 2020 sebanyak 12.173. Wilayah endemis dengan prevalensi kasus tertinggi berada di Kabupaten Buleleng dan Badung. Angka Incidence Rate tertinggi tahun 2016 sebesar 483/100.000 penduduk dan selama lima tahun terakhir tidak memenuhi target nasional (<49/100.000 penduduk). Angka CFR tertinggi pada tahun 2020 sebesar 0.43% dan mengalami peningkatan 1.5 kali lipat pada masa pandemi COVID-19. **Kesimpulan:** Prevalensi kasus demam berdarah dengue di provinsi Bali tahun 2015 – 2020 berfluktuasi signifikan dan mortalitas akibat DBD selama pandemi COVID-19 mengalami peningkatan signifikan.

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## INTRODUCTION

Dengue Hemorrhagic Fever (DHF) is a public health concern, particularly in Indonesia. Dengue fever occurs all year in the tropics and creates epidemics in various locations (Mertha Adnyana et al., 2021). Dengue virus is transmitted through the bites of *Aedes* spp, *Aedes aegypti*, and *Aedes albopictus* mosquitoes (Nath et al., 2021; Widjajanti et al., 2019) which are classified as arthropod-borne viruses (arbovirus) (Dhewantara et al., 2019; Jansen et al., 2021; Ong et al., 2021). Bali Province is a dengue fever endemic location, contributing to the most cases each year (Bali Health Department, 2021a). Furthermore, during the COVID-19 epidemic, the local Health Office saw an increase in dengue hemorrhagic fever patients. Because of the growth in endemic illnesses during the COVID-19 pandemic, the government and society have attempted to prevent the spread and transmission of SARS COV-2 because it is easy and rapid. (Brady & Wilder-Smith, 2021; Joubert et al., 2021; Nath et al., 2021).

Research by Garg & Meena (2021) and Luhulima et al. (2021) showed the prevalence of dengue cases during the COVID-19 pandemic in different regions due to a variety of factors such as climate, weather, temperature, humidity, community behavior, population density, environmental cleanliness, and body resistance, as well as misdiagnosis due to similar clinical manifestations between Albovirus and coronavirus infection. Cross-reactivity between the SARS-COV-2 antibody and the DENV antigen leads to false-positive findings, resulting in the primary disease's lack of attention, care, and treatment. (Araújo et al., 2021; Harapan et al., 2021). Because of the rising number of dengue cases in each district/city throughout the year, various levels of society and the government have collaborated to prevent, control, and manage dengue disease (Brady & Wilder-Smith, 2021; Masyeni et al., 2021; Satoto et al., 2020).

Through comprehensive research by analyzing previous case data, regional analyses, and disease vector habitats in predicting and

planning efforts to prevent and treat infectious diseases (DHF and COVID-19), epidemiological studies and disease prevalence are used to determine policymakers' strategic efforts to eradicate DHF and COVID-19 (Lim et al., 2021; Suryani, 2018; Vicente et al., 2021). This study aims to determine, describe, and evaluate the incidence of dengue hemorrhagic fever in Bali Province from 2015 to 2020 and during the COVID-19 pandemic. This study will likely serve as a model for building disease management policies and comprehensive plans in Bali Province that stress efficiency, effectiveness, and community engagement.

## METHODS

This research was a descriptive study with a case series design (Darwin et al., 2021). The study was conducted for two months (May-June 2021). The Health Research Ethics Commission of the Denpasar Health Polytechnic granted Ethics Eligibility to this study, with the number LB.02.03/EA/KEPK/0245/2021. The data in this study used secondary data, namely Bali Province Health Profile in 2015 - 2020, and data with dengue hemorrhagic fever during the COVID-19 pandemic period. Data were obtained from the Health Officer and the Central Bali Provincial Statistics Agency. This research was conducted by describing and interpreting the events of DHF cases in the province of Bali with an environmental epidemiology approach (Suryani, 2018; Yudhastuti & Lusno, 2020).

The variables studied in this study were the population by district/city in the working area of Bali Province and by gender in 2020 in units of a thousand people (Bali Health Department, 2021a). Data on climate, weather, and annual rainfall (mm/month) were obtained from projections and reports from the Meteorology, Climatology, and Geophysics Agency for Region III Denpasar (BMKG, 2021). Population density was calculated using the number of inhabitants per hectare (person/ha). The morbidity rate (incidence rate) was calculated based on the number of new cases divided by the population. As a result, the incidence rate (IR) per 100.000 residents was obtained. The mortality rate was obtained by calculating the number of people who died divided by the total district/city to get the percentage (%) case fatality rate (CFR). Inspection of the larva monitor yields the larva-free number. Negative home multiplied by 100%, then divided by the

number checked. The results of the larva-free number will be shown in percentage units (%), and the success indication for larva-free number will be > 95% (Bali Health Department, 2021a; Prata et al., 2021). The descriptive technique was used in data analysis, and data were displayed in tables, graphs, and narratives.

## RESULTS

The province of Bali consists of the island of Bali as a center of provinces and small islands around it as a companion islands like the islands of Nusa Penida, Nusa Ceningan, Nusa Lembongan, Nusa Serangan, dan Nusa Menjangan. In the area, Bali is in the position of coordinates 08°03'40" - 08°50'48" South Latitude and 114°25'53" - 115°42'40" East Longitude. On relief and topography, the island of Bali is equipped with mountainous areas that extend from west to east, and among these mountains, there is a volcano cluster. The area of Bali province is 5,780.06 km<sup>2</sup> or 0.30% of the broad Indonesian archipelago and has eight districts and one city.

The province of Bali has a tropical sea climate influenced by seasonal winds. Bali's climate and weather consist of rainy, dry, transition, and transaroba. Based on data submitted by the Meteorology, Climatology, and Geophysics Agency showed, the average temperature in the Bali Province of 26.3°C - 27.9°C, with humidity of 79-86%. Annual rainfall ranges from 1.119.02-3.321.57 mm, with the highest risk of rainfall occurring in November, December, January, and February. The lowest rainfall occurs in May, August, September, and October.

According to the study's findings, the population in the province of Bali will reach 4,336.9 million in 2020, according to the Central Statistics Agency's projections and reports. The population and population have continuously increased year after year. Natality rates are expected to be greater than death rates in 2019. During the COVID-19 pandemic phase in 2020, population mortality will exceed natality rates. Bali Province has 750 persons per square kilometer, with the highest concentrations in Badung, Gianyar, and Denpasar City. The region's population density results from the district, which serves as the province of Bali's administrative, tourism, and educational centers. The data for areas, population, gender ratio, and population density by the district are shown in Table 1.

According to the study's findings in Table 1, the region's area in Jembrana District, Tabanan District, and Bangli District shall expand by 2020. The expansion in the area resulted from land clearing and the identification of a new district region. Data from men and women has increased by 90.4 thousand people from 2018 to 2020. In terms of the population density level, Denpasar City (7.412), Badung District (1.601), and Gianyar District (1.392) have a high level of density in categories according to SNI 03-1733-2004. The high level of population density will result in increased mobility in the area. It can result in the explosion of larvae populations and imago in various districts/cities contained in the province of Bali.

Based on the study results, data on the case of dengue hemorrhagic fever in 2015-2020

experienced a fluctuating trend. Data on DHF cases of each district are presented in table 2. According to the study's findings in Table 2, the districts with the most significant number of Dengue Haemorrhagic Fever (DHF) cases in 2015 were Badung District, Gianyar, and Buleleng. Additional cases were reported in 2016 in five districts: Badung District, Gianyar, Karangasem, Buleleng, and Denpasar City. In 2017, three districts ranked first: Badung District, Buleleng, and Denpasar City. Then, there were four districts ranked first in DHF cases in 2018: Badung District, Buleleng, Klungkung, and Denpasar City. In 2019, three districts stood out: Badung District, Buleleng, and Denpasar City. Eventually, in 2020, four districts were identified as having the highest case, namely Badung, Buleleng, Gianyar, and Denpasar city.

**Table 1**

The Data for Areas, Population, Gender Ratio, and Population Density by District/City

District/City	Area (Km <sup>2</sup> )	Population (Thousands of people)			Gender Ratio	Population density (person/ha)
		Male	Female	Total		
Jembrana	841.80	138.00	140.10	278.10	98.50	330
Tabanan	1013.90	221.20	224.50	445.70	98.53	440
Badung	418.60	341.90	328.30	670.20	104.14	1601
Gianyar	368.00	258.50	253.70	512.20	101.89	392
Klungkung	315.00	88.60	90.50	179.10	97.90	569
Bangli	490.70	114.90	112.40	227.30	102.22	463
Karangasem	839.50	208.30	208.30	416.60	100.00	469
Buleleng	1362.70	329.00	331.60	660.60	99.22	484
Denpasar	127.80	483.70	463.40	947.10	104.38	7412
Bali Province	5780.10	2184.10	2152.80	4336.90	101.45	750

Source: Bali Health Department, 2021.

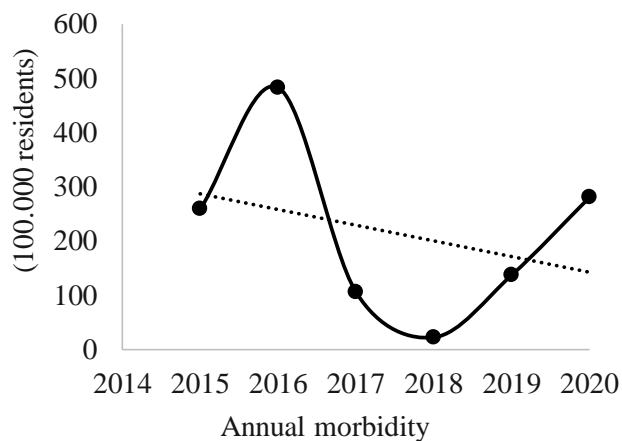
**Table 2**

Dengue Hemorrhagic Fever data in Bali Province from 2015 to 2020

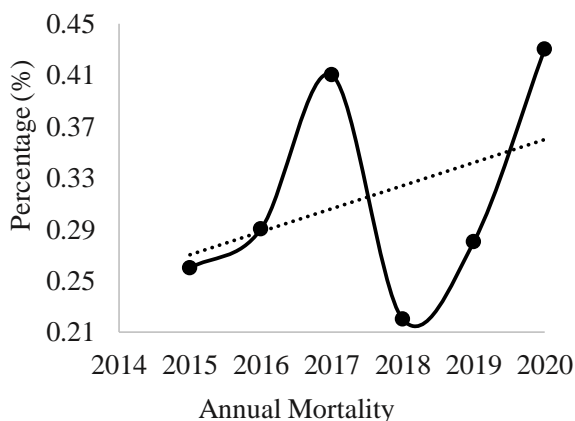
District/City	Cases of Dengue Hemorrhagic Fever (DHF)					
	2015	2016	2017	2018	2019	2020
Jembrana	366	858	140	36	213	267
Tabanan	846	918	316	44	172	340
Badung	2,178	2,178	941	366	1,275	2,767
Gianyar	2,198	3,673	511	72	715	1,747
Klungkung	451	1,564	219	147	340	815
Bangli	347	1,251	320	36	230	415
Karangasem	790	3,226	221	19	160	919
Buleleng	2,007	3,787	890	129	1,631	3,402
Denpasar	1,576	2,851	929	114	1,220	1,501
Bali Province	10,759	20,306	4,487	963	5,956	12,173

Source: Bali Health Department, 2021

Increased cases of dengue hemorrhagic fever in Bali Province resulted in morbidity and mortality rates experiencing a fluctuating trend depending on the total number of cases each year. The morbidity figures are generally shown in the data incidence rate per hundred thousand residents, while the mortality rate is shown in the data case fatality rate per percentage. Data Incidence Rate and Case Fatality Rate dengue hemorrhagic fever (DHF) in Bali Province from 2015 to 2020 are presented in Figures 1 and 2.



**Figure 1.** Incidence Rate Dengue Hemorrhagic Fever in Bali Province in 2015 – 2020.



**Figure 2.** Case Fatality Rate Dengue Hemorrhagic Fever in Bali Province in 2015 - 2020.

## DISCUSSION

Dengue hemorrhagic fever has increased each year significantly (Mertha Adnyana et al., 2021). Favorable environmental circumstances facilitated the development of *Aedes aegypti* and *Aedes albopictus* mosquito vectors, which increased dengue virus cases (Adnyana et al., 2021; Brady &

Wilder-Smith, 2021). Dengue hemorrhagic fever cases have increased significantly during the last five years due to various internal and external variables. Internal risk factors include a lack of self-cleanliness and practices that attract mosquitoes, poorly maintained bodily hygiene, and a person's weakened immune system or vulnerability to infection. These are all things that are outside of the person's control, like the number of open water reservoirs, how much rain and how fast it comes, how little sunlight there is, and how afraid people are of using chemical medications (Vicente et al., 2021; Widjajanti et al., 2019).

*Aedes aegypti* and *Aedes albopictus* mosquitoes prefer regions similar to their natural habitat and close to residential areas. It enables mosquitoes to search for food supplies (proteins found in the blood) (Adnyana et al., 2021). Mosquitoes that transmit dengue hemorrhagic fever are often anthropophilic, as they require human blood to complete their eggs, particularly female mosquitoes (Araújo et al., 2021). *Aedes aegypti* mosquitoes can produce eggs resistant to extremes in temperature and humidity (Adyatma et al., 2021; Satoto et al., 2020). This state occurs due to considerable ecological changes that enhance the survival of larvae and imago dengue vectors. Furthermore, changes in environmental conditions are commensurate with the high density and movement of the people. The tourism area, which comprises Badung district, Gianyar, Denpasar City, and Buleleng district, has the potential to be an endemic area. Moreover, tourism can be a risk factor for rapid transmission and dissemination of dengue hemorrhagic fever (DHF) and COVID-19 virus (Niriella et al., 2021; Rabiun et al., 2021; Yudhastuti & Lusno, 2020).

According to the trend analysis of dengue hemorrhagic fever cases in Bali Province, the maximum number of cases was reported in 2016, at 20,306 cases, and the lowest number was reported in 2020, at 12,173 cases. The lowest number of instances occurred in 2018 when 963 cases were reported. The region's identification revealed that Badung and Buleleng. The district has consistently seen an increase in dengue hemorrhagic fever cases over the last six years. Dengue hemorrhagic fever cases increased significantly in 2020 throughout the district of Bali (Bali Health Department, 2021a).

The high case of dengue hemorrhagic fever in 2020 in Bali is due to the season and rainfall with high intensity. Meteorological, Climatological, and Geophysical Agency-Region III Denpasar revealed

the highest rainfall occurred in January - March (300 mm/ month). While, low up to medium rainfall occurred in April-September (100-150 mm/month), and October - December is a dry season with low rainfall, namely <20 mm/month (Meteorology Climatology and Geophysics Agency, 2021). On climatic and weather variables, the surge in dengue hemorrhagic fever cases in the province of Bali resulted from the Pandemic COVID-19, which concentrated the attention of all segments of society and the government on pandemic countermeasures (Diarsvitri et al., 2020; Lorenz et al., 2020). The control of the eggs and larvae that transmit dengue hemorrhagic fever has deteriorated due to a lack of preventative measures taken by larva monitoring and the general public, allowing the vector to multiply quickly and resulting in an increase in the DHF vector population (Budiarti et al., 2020).

The study results in Figure 1 showed an increase and decrease in the incidence rate of dengue hemorrhagic fever in 2015-2020 in the province of Bali. The highest morbidity rate occurred in 2016, as many as 483 per 100,000 population, and in 2020 as many as 280.70 per 100,000 population. The lowest morbidity figure is indicated in 2018, 22.40 per 100,000 population. The incidence rate in 2015, 2016, 2017, 2019, and 2020 is still far above the national target, which the Directorate General of Prevention has launched and Disease Control of the Ministry of Health of the Republic of Indonesia, namely the value of the morbidity (IR) <49 per 100,000 population. In 2020, morbidity figures experienced a 2-fold increase from the previous year (Bali Health Department, 2021a).

Bali Province occupied the second position in terms of ranking the DHF cases in Indonesia, and Buleleng District scored the highest DHF cases in Bali. It shows that the government's preventive efforts, such as the 3M-plus program (draining, closing and burying, and sowing powder Temephos), have not been implemented optimally. The high level of pain taken by dengue hemorrhagic fever (DHF), especially in nine districts/city in Bali Province, need to get serious attention, given this endemic disease still appears throughout the year (Dhewantara et al., 2019; Suparyatha et al., 2021). Less-controlled environmental conditions resulted in the transmission of cases due to DHF increasing rapidly. In addition, during the COVID-19 pandemic, the community must always maintain the environmental conditions and immunity of the

body so that it is not infected with DHF and SARS CoV-2. (Budiarti et al., 2020; Niriella et al., 2021; Satoto et al., 2020).

The study results in Figure 2 showed an increase and decrease in mortality rates (case fatality rate (CFR) of dengue hemorrhagic fever from 2015 to 2020 in Bali. The highest CFR figure was shown in 2020 at 0.43%, then in 2017, the CFR number reached 0.41 %, while the lowest CFR figure was indicated in 2018 at 0.22%. The mortality rate (case fatality rate) in the province of Bali has fulfilled the target set in the strategic plan of the Bali Provincial Health Office for 2018-2023, which is <1% (Bali Health Department, 2021a).

The consistency of the CFR figure showed a fixed program carried out in a place of health services such as Integrated Health Care, Public Health Center (PHC), and hospitals in the management of dengue hemorrhagic fever already good enough (Syamsir & Pangestuty, 2020; Widjajanti et al., 2019). In 2020 mortality due to dengue hemorrhagic fever occurred in seven districts/cities—three districts with the most mortality, namely Buleleng District, Badung, and Gianyar. In terms of administrative areas the three districts/cities are areas with a high level of mobility. The region's proximity shows that there is spatial autocorrelation with the dispersed category in the area (Dhewantara et al., 2019).

Research conducted by Syamsir & Pangestuty (2020) showed that as the number of DHF cases increases in a highly-populated area, the likelihood of morbidity (IR) and mortality (CFR) increases, forming spatial autocorrelation. Additionally, the mortality rate of DHF patients increased 1.50 times during the COVID-19 epidemic period. This is because the rapid spread of arbovirus and coronavirus infection makes human-to-human transmission increasingly easy (Brady & Wilder-Smith, 2021; Masyeni et al., 2021). The clinical signs of DHF disease associated with COVID-19 have a high melipion level, including a temperature greater than 38°C, fatigue, abnormal blood components, muscle discomfort, bleeding, and skin rash, as well as shortness of breath (Garg & Meena, 2021; Liyanage et al., 2021; Niriella et al., 2021).

The high rainfall and moisture make it easy for the dengue virus to be carried by *Aedes spp*; *Aedes Aegypti*, and *Aedes Albopictus* mosquitoes that enter the human body through proboscis on the skin (Kesetyaningsih et al., 2018; Vicente et al., 2021). DHF sufferers who experienced death during the COVID-19 pandemic were caused by various factors such as thrombocytopenia (Garg &

Meena, 2021; Pranata et al., 2021), bleeding on the skin, dehydration, blood component abnormalities (Masyeni et al., 2021), and the decline in body immunity (Luhulima et al., 2021). The consistency of mortality rates (case fatality rate) in the province of Bali due to the local health department has made various efforts to reduce mortality from dengue viruses, including the role advocacy of districts/cities in the upstream efforts to carry out the eradication of mosquito nests, programs for draining, burying, stockpiling, plus sprinkling temephos powder, revitalizing the role of the Operating Working Group Coaching Post Development and Integrated Services of DHF until the village level workplace, vector resistance mapping, mapping the subtype of the virus and strengthening the role of larva monitoring (larva) to the household level. The strengthening of the effort has reduced mortality due to dengue hemorrhagic fever in Bali province from 2015 to 2020 (Bali Health Department, 2021b).

The investigation of dengue hemorrhagic fever cases in nine districts/cities within Bali Province revealed a rise in the incidence rate and mortality rate (case fatality rate) in 2020. It was influenced by the low number of available numbers, as determined by the Ministry of Health, namely > 95%, climate change, the establishment of new settlements in densely populated areas, extremely high population mobilization, and inconsistent diagnosis standards in hematologic and serological examinations. Furthermore, all the points were particularly at the district/city level (Satoto et al., 2020; Syamsir & Pangestuty, 2020). It used 2009 WHO criteria for diagnosis, treatment, prevention, and dengue control and the absence of categorizing dengue fever, dengue hemorrhagic fever, and COVID-19 cases (WHO, 2009).

During the COVID-19 Pandemic, if a patient with confirmed dengue hemorrhagic fever underwent a clinical hematological evaluation, an antigen swab and swab PCR would be advised to detect the presence of coronavirus exposure (Faridah et al., 2021; Garg & Meena, 2021). The COVID-19 handling task force report in Bali Province increased DHF cases accompanied by positive COVID-19. The strategic effort that can be made is to optimize the role and function of the larva monitoring in every household still implementing a program for draining, burying, stockpiling, plus sprinkling temephos powder during the Pandemic COVID-19 period. It can also maximize clean and healthy living programs on a household scale. This prevalence analysis is

expected to maximize and identify vulnerable and endemic district/ city areas of Dengue Haemorrhagic Fever.

### **Policy implication**

If appropriately promoted and incorporating many community-based linked sectors, the 4M Plus strategy (draining, closing, burying, and monitoring) will lower the population and stop the reproductive cycle of the vector that produces the dengue virus in the province of Bali. A household-based approach is required as an educational effort to improve knowledge and participation in lowering dengue virus infection cases. It is intended that educational initiatives on dengue control and prevention in educational, recreational, and public facilities will raise community awareness and minimize the risk of dengue transmission, which will impact local outbreaks.

### **Research Limitations**

This study used the 2015-2020 Bali Province Health Profile data to collect, record, and reduce data. The descriptive analysis was performed on the data collected according to the study variables. The restriction in this study is a descriptive study using a case series technique, which uses a population unit rather than an individual unit. As a result, it cannot be used to assess the presence of a causal link because there is no comparison of cases and non-cases in this sort of study.

### **CONCLUSION**

The prevalence of dengue hemorrhagic fever (DHF) in Bali Province from 2015 to 2020 experienced significant fluctuations. Cases occur throughout the year, with the highest incidence in 2016. The endemic areas of Badung and Buleleng have the highest incidence. The morbidity and mortality rates have not reached the target for the last five years. The COVID-19 Pandemic period had the most extraordinary mortality rate, increasing 1.5 times. Dengue hemorrhagic fever is very high in Bali due to increased population, population density, gender, incidence rate, case fatality rate, and larval free rate. Further study on the relationship between dengue hemorrhagic fever incidence associated with COVID-19 infection and the variables that cause simultaneous cases in Bali Province is intended to be carried out in the future.

## CONFLICT OF INTEREST

There are no conflicts of interest disclosed by all authors in this work.

## AUTHORS CONTRIBUTIONS

IMDMA: Research concepts, data processing, findings presentation, review, editing, and final paper acceptance. NLGS: resource management, manuscript editing, and last review; FSSA: data gathering, manuscript review, and proofreading. IMDMA, NLGS, FSSA: manuscript finalization.

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