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Dengue Hemorrhagic Fever in North Minahasa Regency in 2021-2022: Study Epidemiological

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ABSTRACT

Dengue Hemorrhagic Fever (DHF) is a disease that rapidly spreads, particularly in tropical and subtropical regions. One of the places affected by DHF cases is North Minahasa Regency, which is one of the top donors to cases in North Sulawesi Province. The purpose of this study is to describe the prevalence of DHF in North Minahasa Regency between 2021 and 2022 in terms of time, place, and person. This is a quantitative descriptive study. This study employed secondary data. This data was collected from the North Minahasa Regency Health Office. Data will be collected from July to October 2023. The data collected were examined univariately. The data showed that the most DHF cases occurred in 2022, with an increase in incidence in March and November. Furthermore, DHF cases were prevalent in Dimembe District (working area of Tatelu Health Center), Kauditan District (working area of Kauditan Health Center), Talawaan District (working area of Talawaan Health Center), Airmadidi District (working area of Airmadidi Health Center), and Kalawat District (working area of Puskesmas Kolongan). The prevalence of DHF cases in 2021-2022 was higher in men, with a total of 150 cases and an average of 76 instances. DHF incidences increased in 2021, particularly in February, August, and December. It can be determined that the largest frequency of DHF in North Minahasa Regency in 2021-2022 occurs between February-March and November-December, were identified in Dimembe District, and the majority of the DHF cases are male

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INTRODUCTION

Dengue hemorrhagic fever (DHF) is a form of infectious disease caused by dengue virus infection. DHF appears throughout the year and affects people of all ages. When *Aedes aegypti* and *Aedes albopictus* ingest infected human blood, the virus enters their bodies (Khormi & Kumar, 2012). Patients may get dengue fever again if they contract a secondary infection or are infected with dengue virus of a different serotype (DEN-1, DEN-2, DEN-3, or DEN-4). This disease is commonly found throughout the world with a tropical and subtropical environment, particularly in Southeast Asia, Central America, America, and the Caribbean. (Chandra 2010).

DHF cases reported nationally in 2019 were 138,127. This number is higher than the 65,602 instances reported in 2018. The DHF mortality increased in 2019 compared to 2018, from 467 to 919. Illness and death can be described using the incidence rate (IR) per 100,000 people and the case fatality rate (CFR) as a percentage. The incidence rate for 2019 was 51.48 per 100,000 people. This statistic represents an increase over the previous two years, namely 2016 and 2017, when the incidence rate of dengue was 26.1 and 24.7 per 100,000 population. In 2019, North Sulawesi province was rated sixth out of 34 provinces with a dengue morbidity rate per 100,000 inhabitants at 94.97 (Ministry of Health of the Republic of Indonesia 2021).

The North Sulawesi Province has been under attack for the past five years by DHF. The North Sulawesi Provincial Health Office reported 6,130 cases, with 74 deaths. The largest number of dengue cases in the last five years occurred in 2016, with 2,217. DHF cases surged again in 2018, reaching 1,713 after decreasing to 587 in 2017. In 2018, the highest number of deaths was recorded at 24. At the beginning of 2019, DHF attacked 24 persons, three of whom died. The North Sulawesi Provincial Health Office verified that the current condition has not been declared as an Extraordinary Event, but rather an increase in the number of dengue (Health Office of North Sulawesi 2019).

Area-based DHF prevention looks at the pattern of case distribution based on demographic and environmental factors that have the potential to raise DHF incidence broadly and particularly within the region. This is thought to make it easier for puskesmas officers and health cadres to identify DHF control efforts in specific areas based on the pattern of case distribution, which includes both demographic and environmental aspects. According to Farahiyah, in a DHF endemic area, the most relevant environmental factors are population density and housing density (Lumingas 2017; Lestanto 2018; Pearl 2016; Farahiyah 2014). This study aims to describe the prevalence of DHF in 2021-2022 in North Minahasa Regency based on time, place, and person.

LITERATURE REVIEW

Dengue Hemorrhagic Fever (DHF) is an infectious disease caused by the Dengue virus and transmitted by mosquito vectors of the species *Aedes aegypti* or *Aedes albopictus*. The importance of vectors in disease dissemination causes many instances to be detected during the rainy season, when large puddles form and become mosquito breeding places. In addition to climate and environmental factors, various studies have found that dengue fever is linked to mobility, population density, and community behavior. These influencing factors form the basis of attempts to prevent and control DHF. (Ministry of Health of the Republic of Indonesia 2021).

DHF is an infectious disease caused by the dengue virus, which is spread through the bite of an Aedes aegypti mosquito. This sickness affects everyone and can kill, particularly youngsters, and it frequently produces epidemics. When *Aedes aegypti* bites someone with dengue fever, the dengue virus enters the mosquito's body along with the blood (Sumampouw 2020). DHF is a mosquito-borne viral disease that has rapidly spread over the region in recent years. Female mosquitoes, specifically *Aedes aegypti* and *Aedes albopictus*, transmit the dengue virus. This mosquito also transmits chikungunya, yellow fever, and Zika virus. DHF is common across the tropics, with local risk differences caused by unanticipated rainfall, temperature, relative humidity, and rapid urbanization. DHF causes a variety of disorders. These can range from subclinical sickness (when people are unaware they are infected) to severe flu-like symptoms in those affected. Although less prevalent, severe dengue fever can result in serious bleeding, organ damage, and/or plasma leakage. Severe DHF has a higher risk of death if not properly treated (Ministry of Health of the Republic of Indonesia 2021; WHO 2020).

Several factors influence the transmission of dengue virus, including environmental, biological, and demography. Warm weather and excessive humidity have been linked to an increased risk of DHF. High temperatures can promote vector breeding and mosquito biting behavior. Furthermore, health services influenced by age group shifts, spread to rural regions, social and biological variables of race and gender are all important factors (Musfanto et al 2019).

The number of afflicted districts/cities indicates the spread of DHF disease. In 2018, there were 481 city districts, accounting for 93.58% of Indonesia's total number of districts and cities. The number of districts/cities infected with dengue shows a rising trend from 2010 to 2019 (Ministry of Health of the Republic of Indonesia 2021). *Aedes* sp. is prevalent in Southeast Asia's tropical and subtropical climates, and it can be found in practically any urban location. In desert places such as India, *Aedes aegypti* is a vector in urban areas, and its number varies with rainfall. Altitude plays an essential role in preventing the spread of Aedes aegypti. In India, *Aedes aegypti* can be found at elevations ranging from 0 to 1000 meters. Mosquito populations range from modest to high in lowlands (less than 500 meters), but are low in mountainous areas (more than 500 meters). In Southeast Asia, the proliferation of *Aedes aegypti* is limited to an altitude of 1000 to 1500 meters. (Ismail 2019).

The DHF transmission season often occurs at the start of the rainy season (the beginning and end of the year). This is because in the rainy season, the dengue fever vector population increases with the increasing number of mosquito nests outside the house as a result of unsanitary environmental sanitation, whereas in the dry season, *Aedes aegypti* nests in vessels that are always filled with water such as bathtubs, crocks, drums, and water reservoirs (Widyorini et al 2016).

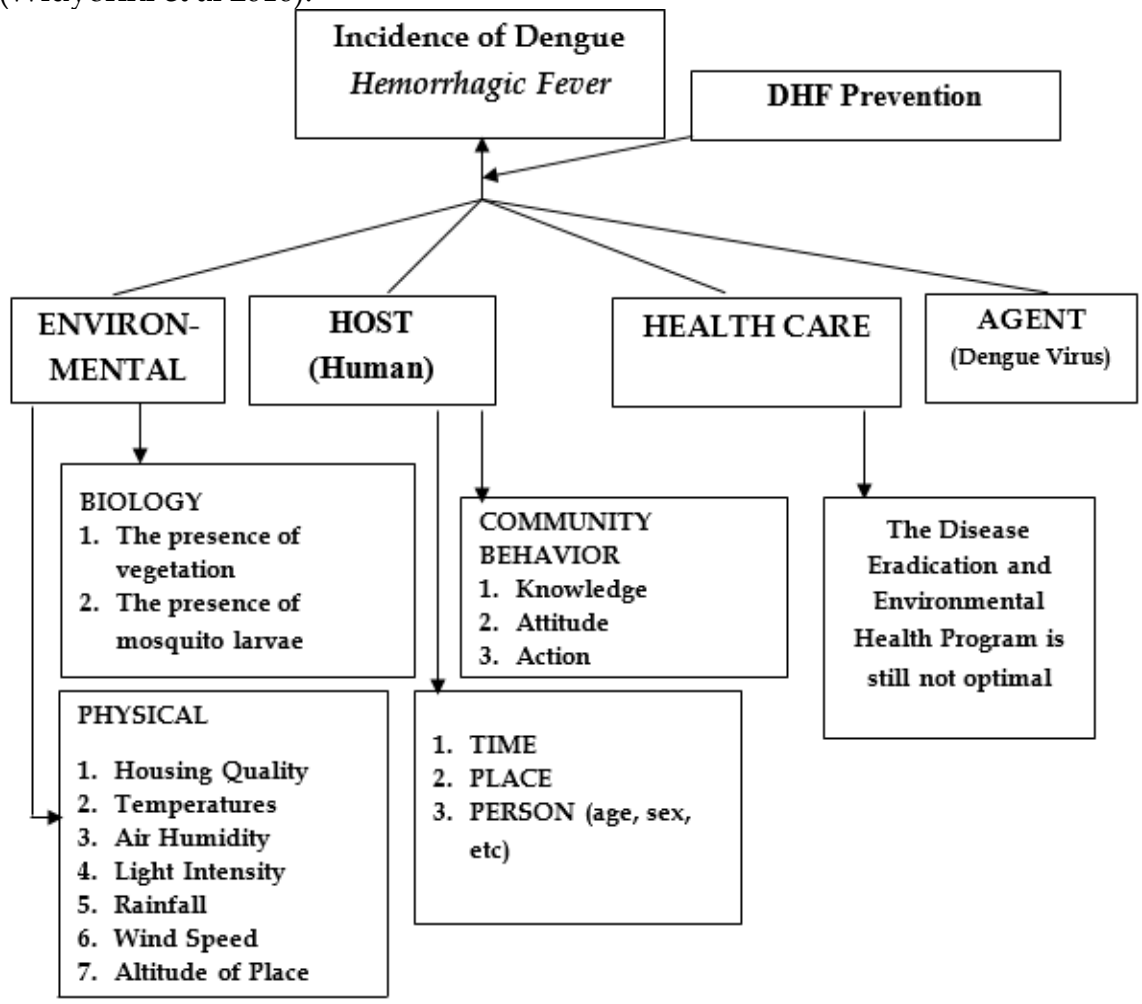
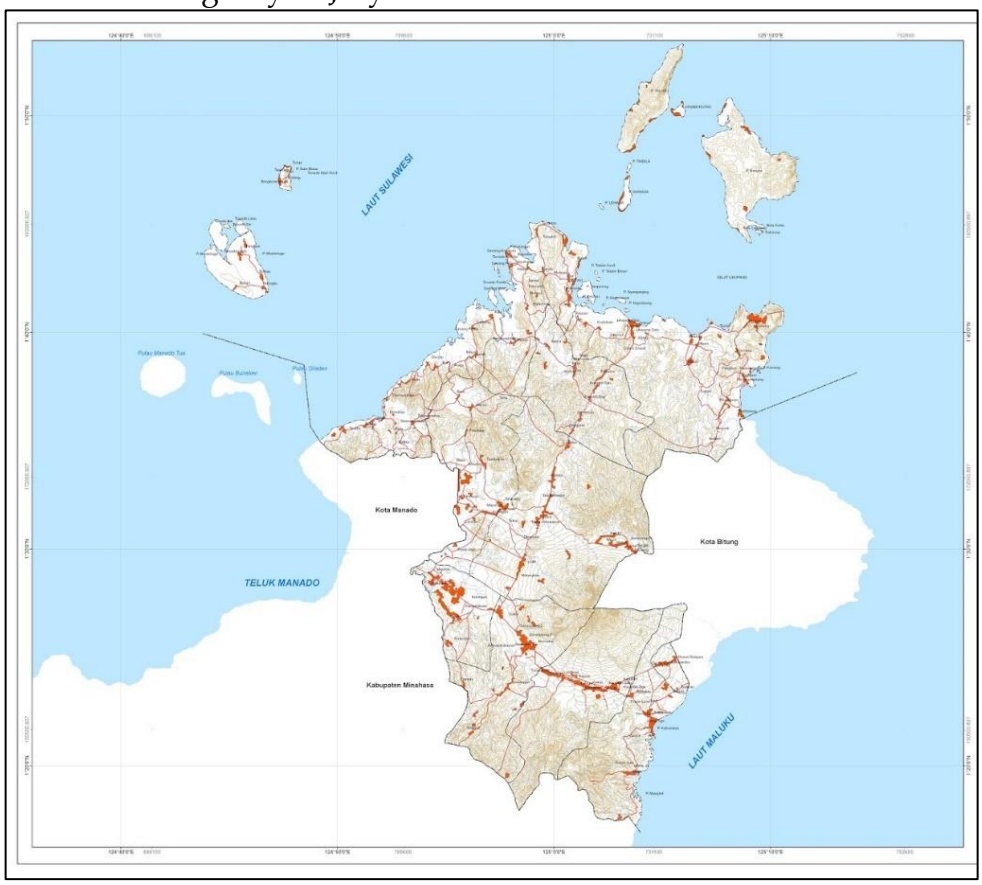


Figure 1. Conceptual Framework

METHODOLOGY

This research is a quantitative research. This research will be carried out in North Minahasa Regency in July-October 2023.



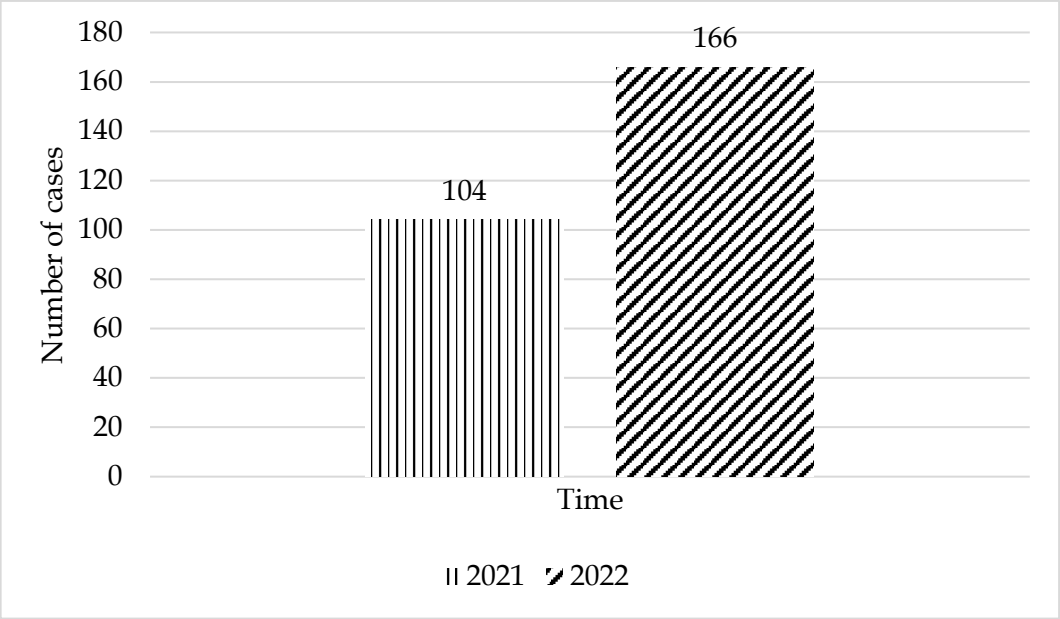
Picture 2. Research Location

This research relies on secondary data from the North Minahasa Regency Health Office. The factors in this study are the prevalence of DHF in North Minahasa Regency by year, Puskesmas work area, gender, and age. The device employed is a fill-in sheet. The DHF prevalence figures ranged from 2021 to 2022. The data analysis used in this study was univariate. The data is presented in the form of graphs.

RESULTS

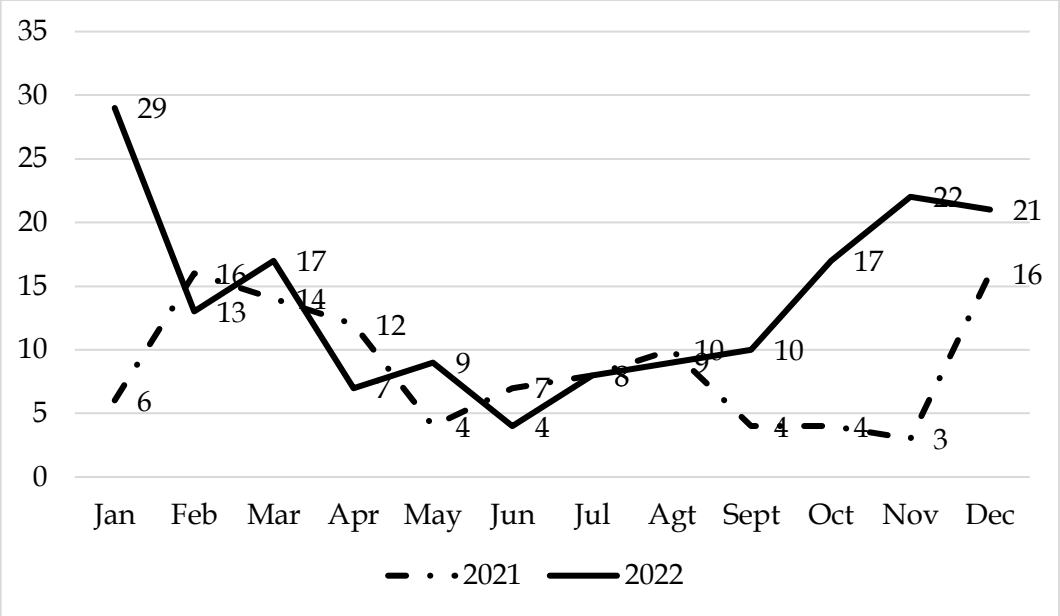
Distribution of DHF Cases in 2021-2022 by Time

The distribution of DHF cases in 2021-2022 based on time (year) can be seen in the following figure.



Picture 3. Distribution of DHF Cases in 2021-2022

The figure above shows that in 2021-2022 DHF cases increased from 104 cases to 166 cases. Furthermore, the distribution of DHF cases in 2021-2022 based on time (months) can be seen in the following figure.

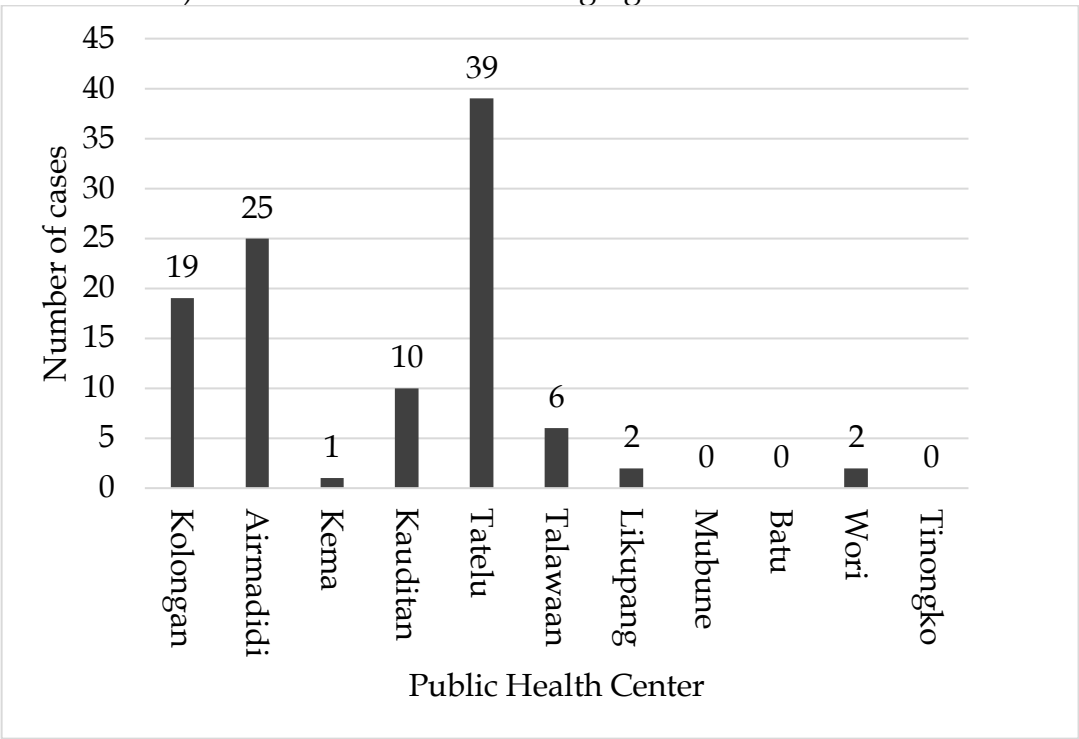


Picture 4. Distribution of DHF Cases by Time (Month)

The figure above shows that in 2021 DHF cases increased in February, August and December. Furthermore, in 2022 there was an increase in cases in March and November.

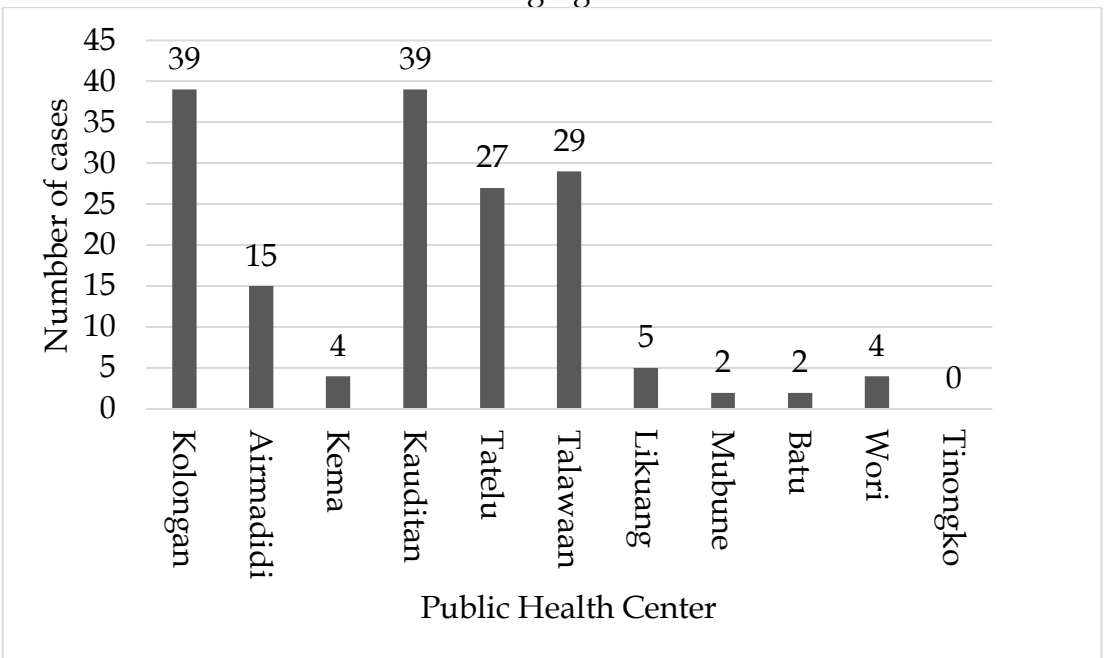
Distribution of DHF Cases in 2021-2022 by Place

The distribution of DHF cases in 2021 based on the place (working area of the Puskesmas) can be seen in the following figure.



Picture 5. Distribution of DHF Cases in 2021 Based on Health Center

The picture above shows that in 2021 the most DHF cases occurred in the Tatelu Health Center work area with 39 cases, followed by Airmadidi Health Center with 25 cases and Kolongan Health Center with 19 cases. Furthermore, the distribution of DHF cases in 2022 based on the working area of the Puskesmas can be seen in the following figure.

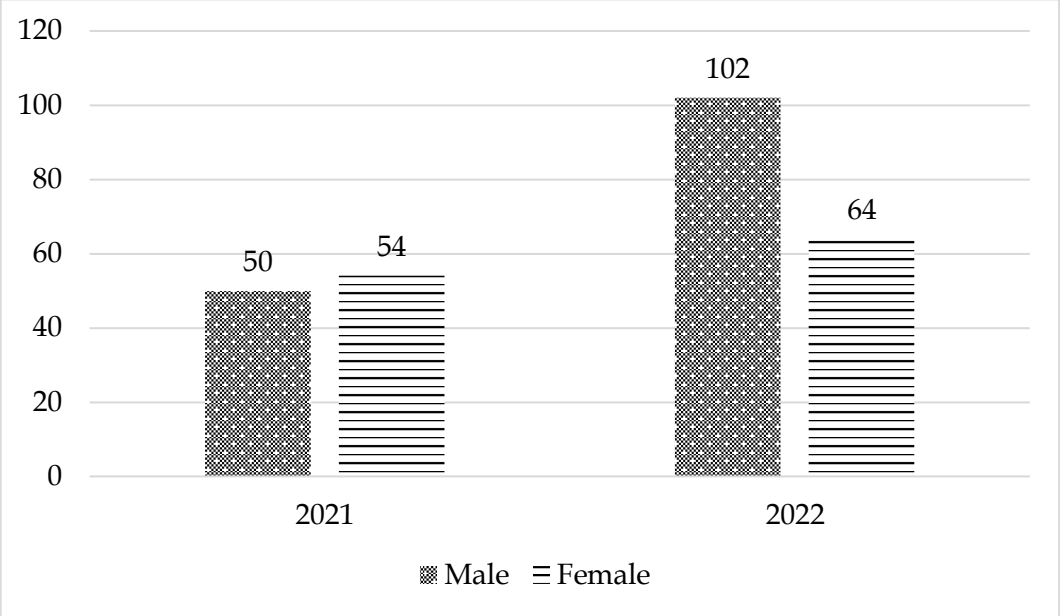


Picture 6. Distribution of DHF Cases in 2022 based on Health Center

The picture above shows that in 2022 the most dengue cases occurred in the working areas of the Kauditan and Kolongan Health Centers with 39 cases each, followed by the Talawaan Health Center with 29 cases.

Distribution of DHF cases in 2021-2022 by person

The distribution of DHF cases in 2021-2022 based on (person) gender can be seen in the following figure.



Picture 7. Distribution of DHF Cases in 2021-2022 by Gender

The figure above shows that in 2021 the most DHF cases occurred in women as many as 54 cases and in 2022 in men as many as 102 cases. The total and average number of cases in 2021-2022 were seen more in men, with a total of 150 cases and an average of 76 cases.

DISCUSSION

Distribution of DHF Cases in 2021-2022 by Time

The results of this study show that in 2021-2022 the DHF cases have increased. Furthermore, the distribution of DHF cases in 2021-2022 based on time (months) can be seen that in 2021 DHF cases increased in February, August and December and in 2022 there was an increase in cases in March and November. The high number of cases this month can be influenced by many factors such as environmental conditions such as climate (temperature and rainfall) and community behavior. Several studies conducted found that there are many factors that cause DHF events. These factors include environmental factors, hosts, causative agents (Dengue virus) and dengue vectors (Sumampouw 2020; Sumampouw 2019).

Biological, physical, and social environmental variables all contribute to the spread of dengue cases. Biological environment, including mosquito larvae and decorative plants in the home and yard. Temperature, humidity, rainfall, occupancy density, water reservoir presence, and other factors all contribute to the physical environment. The social environment includes behavior, population

density and movement, mosquito nest eradication behavior, education level, type of work, income level, culture, and other factors (Zulkarnaini 2019; Dinata and Dhewantara 2012).

Physical environmental factors associated with DHF incidence such as temperature, rainfall and humidity. Some studies show that at temperatures of 28-32^{o}C with high humidity, *Aedes* sp. will remain viable for a long period of time. In Indonesia, because the air temperature is not the same in each place, the time pattern of DHF occurrence is somewhat different for each place (Pinontoan et al 2022; Purwani and Swastika 2018; Marsaulina and Siregar 2018; Indriyani et al 2017; Sunarno et al 2017). Rainfall and air temperature affect the incidence of DHF. Waterlogging caused by rain becomes a breeding ground for *Ae. aegypti* (Lahdji and Son 2017).

Furthermore, global factors like as climate change influence the prevalence of DHF. Climate change raises the average air temperature in a given area. Rising temperatures can promote mosquito breeding, but it eventually slows and ceases. Mosquitoes thrive at temperatures ranging from 25 to 27 degrees Celsius, but may tolerate temperatures as high as 40 degrees Celsius. Above that temperature, mosquito growth stops. Climate change also leads to an increase in rainfall. Rainwater puddles on shrubs and used products (cans and plastic) can form as the rainfall increases. The more standing water, the greater the mosquito breeding location (Rasmanto 2017; Fadly et al 2015).

Distribution of DHF Cases in 2021-2022 by Place

The findings of this study indicate that the majority of DHF cases in 2021 occurred in the working regions of the Tatelu Health Center, Airmadidi Health Center, and Kolongan Health Center. Furthermore, in 2022, the majority of DHF cases occurred in the operating regions of the Kauditan and Kolongan Health Centers. Data from the Central Statistics Agency (BPS) shows that in Dimembe District (working area of Puskesmas Tatelu) population density of 167.21 per km^2, Kauditan District (working area of Puskesmas Kauditan) population density of 267.42 per km^2, Talawaan District (working area of Puskesmas Talawaan) population density of 274.88 per km^2, Airmadidi District (working area of Puskesmas Airmadidi) population density of 359.80 per km^2, and Kalawat District (working area of Puskesm Population density was 849.60 per per km^2. The population density in Kalawat and Airmadidi sub-districts is the highest population density in North Minahasa.

According to Paomey et al. (2019), the distribution of DHF cases is more prevalent in high-density locations, with subdistricts classified as having a population density of more than 6,000 persons per km^2. Density and population are two factors that influence the high and low incidences of DHF. This study also found the average DHF cases per subdistrict in Malalayang subdistrict based on population density, with Bahu subdistrict having 11 cases and a densely populated area due to its area of 0.87 km^2. Malalayang I subdistrict has the highest number of DHF cases, with 16 instances classified as low due to its huge size of 9 km^2 and the highest population of 8,446 people.

According to Tomia et al. (2016), the larger the population in an area, the more people are likely to be exposed to dengue. If a mosquito bites a patient with

viremia, the mosquito will get infected. The dengue virus that enters the mosquito's body multiplies within 8-10 days, and mosquitoes transfer it to others. North Minahasa Regency has considerable population mobility and a huge population.

According to Chandra and Hamid (2019), population density has a weak effect (r= 0.153, or 15.3%) on the incidence of DHF. The coefficient of determination of 0.023 indicates that the regression line equation can explain 2% of the variation in dengue episodes. This study also found a strong association between population density and DHF incidence, with a positive pattern indicating that the higher the population density, the greater the risk of increased dengue incidence. This may cause the population of *Aedes aegypti* to rise. Living in a densely populated environment increases the chance of developing DHF. The number of DHF cases in North Minahasa Regency changed between 2015 and 2020 due to the variable number of cases registered each year. Several variables can contribute to the presence of several endemicity statuses. A region's endemicity status is influenced by factors such as high population movement. The population density factor is also mentioned as one of the elements that influence dengue endemicity. Another component that is thought to play a role in dengue endemicity is the biological environment, namely the density of *Aedes aegypti* larvae. Larval density has a very close relationship with high and low of DHF endemicity (Tomia et al., 2020).

Distribution of DHF Cases in 2021-2022 by Person

The findings of this study indicate that the average prevalence of DHF patients in 2021-2022 is higher in men. Gender is a biological characteristic that distinguishes humans as male or female (World Health Organisation, 2021). Mahendra (2021) discovered a substantial link between sex and DHF. According to Tomia et al. (2020), the distribution of DHF cases in Ternate City from 2009 to 2018 was more male-dominated, with 507 people affected. According to Kasman and Ishak's (2018) research, the distribution of DHF in Banjarmasin is more common in males, with up to 147 persons.

Other research, however, found no significant link between sex and DHF incidence in Wulauan, Minahasa Regency (Baitanu et al. 2022). According to Malaysian research (Azami et al., 2011), gender has no effect on DHF. Data suggest that DHF strikes men up to 53.11% and women up to 46.89% (Ministry of Health RI, 2020). According to research conducted on migrant workers in Singapore, the majority of individuals who were not affected by dengue in this study were women, accounting for up to 40 respondents (72.7%).

According to Halstead in Guha-Sapir and Schimmer (2015), the number of DHF sufferers is higher in men than in women due to immune variables in the body. Women have a stronger immunological response than men. This is because women produce more cytokines than men. This cytokine is a hormone that regulates the intensity and duration of an immune response in the body (Novrita et al., 2017). Furthermore, men have significant mobility and work activities, which allows them to travel to dengue-endemic locations (Rojali and Amalia, 2020).

Risk factors for DHF instances are impacted by both environmental and human factors, such as age and gender. Wita observed a link between sex and the incidence of DHF. Age also has an impact on DHF. Children under the age of five are at a higher risk of contracting dengue. This is related to greater daytime activities taking place at home (Wita 2014; Hakim and Kusnandar 2012). Furthermore, behavioral variables contribute to the prevalence of DHF. Suryani and Sari conducted research on the relationship between 3M behavior and the prevalence of DHF in the Working Area of the West Lingkar Health Center in Bengkulu City. The results of the bivariate analysis showed a significant correlation between 3M behavior and the incidence of DHF in the West Lingkar Health Center Working Area of Bengkulu City (Suryani and Sari 2017).

CONCLUSIONS AND RECOMMENDATIONS

It can be concluded that the highest number of DHF cases in 2021 occurred in February, August, and December. between addition, the number of cases increased between March and November of 2022. DHF cases were most commonly found in Dimembe District (Tatelu Health Center work area), Kauditan District (Kauditan Health Center work area), Talawaan District (Talawaan Health Center work area), Airmadidi District (Airmadidi Health Center work area), and Kalawat District (Kolongan Health Center work area), where the population density in Kalawat and Airmadidi Districts is the highest in North Minahasa Regency. In 2021-2022, the prevalence of DHF cases is higher among men, with a total of 150 cases and an average of 76 cases.

FURTHER STUDY

Dengue Hemorrhagic Fever (DHF) is one of the important communicable diseases in Indonesia, especially North Minahasa regency. Many cases of death are caused due to this disease. One of the efforts that can be done is to examine factors correlated to the DHF incidence so that strategies can be obtained in an effort to decrease the prevalence of DHF.

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REFERENCES

Azami, M. N. A., Salleh, S., Neoh, H. M., Syed Zakaria, S., & Jamal, R. (2011). Dengue epidemic in Malaysia: Not a predominantly urban disease anymore.
BMC Research Notes, 4, 2–5. https://doi.org/10.1186/1756- 0500-4-216

Baitanu, J. Z., Masihin, L., Rustan, L. D., Siregar, D., & Aiba, S. (2022). Hubungan Antara Usia, Jenis Kelamin, Mobilitas, Dan Pengetahuan Dengan Kejadian Demam Berdarah Dengue Di Wulauan, Kabupaten Minahasa. *Malahayati Nursing Journal*, *4*(5), 1230-1241.

Chandra, A. 2010. Demam Berdarah Dengue : Epidemiologi, Patogenesis dan Faktor Risiko Penularan. Aspirator, 2(2): 110–119

Chandra, E., & Hamid, E. (2019). Pengaruh faktor iklim, kepadatan penduduk dan angka bebas jentik (ABJ) terhadap kejadian demam berdarah dengue (DBD) di Kota Jambi. *Jurnal Pembangunan Berkelanjutan*, *2*(1), 1-15.

Fadly, R., Kaunang, W. P. J., & Pandelaki, A. J. (2015). Pemetaan Kasus Demam Berdarah Dengue Di Kabupaten Minahasa Utara. *Jurnal Kedokteran Komunitas Dan Tropik*, *3*(2), 73–81.

Farahiyah, M. 2014. Analisis Spasial Faktor Lingkungan dan Kejadian DBD di Kabupaten Demak. Buletin Peneliti Kesehatan, 42(5): 25– 36.

Guha-Sapir, D., & Schimmer, B. (2015). Dengue fever: new paradigms for a changing epidemiology. *Emerging themes in epidemiology*, *2*(1), 1-10.

Hakim, L., & Kusnandar, A. J. (2012). Hubungan status gizi dan kelompok umur dengan status infeksi virus dengue. *ASPIRATOR-Journal of Vector-borne Disease Studies*, *4*(1).

Health Office of North Sulawesi Province. (2019). Profil Kesehatan Sulawesi Utara. Manado

Indriyani, Z., Rahardjo, M., dan Setiani, O. 2017. Hubungan Faktor Lingkungan Dengan Persebaran Kejadian Demam Berdarah Dengue (DBD) Di Kecamatan Jepara Kabupaten Jepara. *Jurnal Kesehatan Masyarakat (e-Journal)*, *3*(3), 842-850

Ismail, A. R. (2019). *Angka Kejadian Pasien dan Penyebab Penyakit Demam Berdarah Dengue serta Peran Puskesmas dalam Upaya Penyembuhan dan Pencegahan pada Tahun 2018*. https://doi.org/10.31227/osf.io/vcz3e. (Diakses 11 Februari 2023).

Kasman, K., & Ishak, N. I. (2018). Analisis penyebaran penyakit demam berdarah dengue di Kota Banjarmasin tahun 2012-2016. *Media Publikasi Promosi Kesehatan Indonesia (MPPKI)*, *1*(2), 32-39.

Khormi, H. M., & Kumar, L. 2012. Science of the Total Environment The Importance of Appropriate Temporal and Spatial Scales for Dengue Fever Control and Management. Science of the Total Environment, The, 430: 144–149.

Lahdji, A., & Putra, B. B. (2017). Hubungan curah hujan, suhu, kelembaban dengan kasus demam berdarah dengue di Kota Semarang. *MEDIKA*. **8**(1): 46-53

Lestanto, F. 2018. Analisis Spasial Faktor-Faktor yang berhubungan dengan Kejadian Demam Berdarah Dengue di Puskesmas Wilayah Kerja di

Kabupaten Bantul. Jurnal Ilmiah Rekam Medis Dan Informatika Kesehatan, 8(1): 66–78.

Lumingas, E. 2017. Faktor-faktor yang Berhubungan dengan Kejadian Demam Berdarah Dengue di Wilayah Kerja Puskesmas Tanawangko. Media Kesehatan, 9(2): 1–11.

Mahendra, H. I. (2021). Hubungan antara jenis kelamin dan Usia Dengan Kejadian Demem Berdarah Dengue Studi Observasional di Rumah Sakit Islam Sultan Agung Semarang Tahun 2019. *Repository UNISSULA*, 2019–2021. (online) https://repository.unissula.ac.id/id/eprint/21346

Marsaulina, I., & Siregar, F. A. (2018). *Pengaruh Lingkungan Fisik dan Perilaku Masyarakat terhadap Kejadian Demam Berdarah Dengue di Wilayah Kerja Puskesmas Kota Juang Kabupaten Bireuen Provinsi Aceh Tahun 2017* (Doctoral dissertation, Universitas Sumatera Utara).

Ministry of Health of the Republic of Indonesia I. (2020). *Data Kasus Terbaru DBD di Indonesia - Sehat Negeriku*. In Kementrian Kesehatan Republik Indonesia (pp. 6–7).

Ministry of Health of the Republic of Indonesia, 2021. Data Kasus Terbaru DBD di Indonesia**.** https://www.kemkes.go.id/article/view/20120300001/data-kasus-terbaru-dbd-di-indonesia.html (Diakses 4 Februari 2023)

Musfanto, C. P., Sumampouw, O. J., & Pinontoan, O. R. (2019). *SEBARAN KEJADIAN DEMAM BERDARAH DENGUE DI KOTA MANADO*. *8*(6), 263–269.

Mutiara, H. 2016. Analisis Spasial Kepadatan Larva, Maya Index dan Kejadian Demam Berdarah Dengue. Sematic Scholar, 1(1): 1–12

Novrita, B.,Mutahar, R., & Purnamasari, I. (2017). The analysis of incidence of dengue hemorrhagic fever in public health center of Celikah Ogan Komering Ilir Regency. *Jurnal Ilmu Kesehatan Masyarakat*, *8*(1), 58041.

Paomey, V. C., Nelwan, J. E., & Kaunang, W. P. (2019). Sebaran penyakit demam berdarah dengue berdasarkan ketinggian dan kepadatan penduduk di Kecamatan Malalayang Kota Manado tahun 2019. *KESMAS: Jurnal Kesehatan Masyarakat Universitas Sam Ratulangi*, *8*(6).

Pinontoan, O. R., Sumampouw, O. J., Ticoalu, J., Nelwan, J. E., Musa, E. C., & Sekeeon, J. (2022). The variability of temperature, rainfall, humidity and prevalance of dengue fever in Manado City. *Bali Medical Journal*, *11*(1), 81-86.

Purwani, N. P. A. E. N., & Swastika, I. K. (2018). Efektivitas ekstrak ethanol daun kemangi (*Ocimum sanctum*) sebagai insektisida terhadap nyamuk Aedes Aegypti. *E-Jurnal Med Udayana*. **7**(12): 1-4

Rasmanto, M. F. (2017). Model Prediksi Kejadian Demam Berdarah Dengue (DBD) Berdasarkan Unsur Iklim Di Kota Kendari Tahun 2000-2015. *(Jurnal Ilmiah Mahasiswa Kesehatan Masyarakat)*. **1**(3):1-10

Rojali, R., & Amalia, A. P. (2020). Perilaku Masyarakat terhadap Kejadian DBD di Kecamatan Ciracas Jakarta Timur. *Jurnal Kesehatan Manarang*, *6*(1).

Sumampouw, O. J. (2020). Epidemiologi Demam Berdarah Dengue di Kabupaten Minahasa Sulawesi Utara. *Sam Ratulangi Journal of Public Health*, *1*(1), 001. https://doi.org/10.35801/srjoph.v1i1.27272. (Diakses 11 November 2021).

Sumampouw, O.J. (2019). *Perubahan Iklim dan Kesehatan Masyarakat*. CV. Deepublish. Yogyakarta

Sunarno, R. P., Wahyuningsih, N. E., & Budiharjo, A. (2017). Studi Faktor Suhu di dalam Rumah dan Kejadian Demam Berdarah Dengue Di Semarang Tahun 2017. *Jurnal Kesehatan Masyarakat (e-Journal)*.**5**(5): 807-814

Suryani, S., & Sari, D. O. (2017). Hubungan Perilaku 3M Dengan Kejadian Demam Berdarah Dengue di Wilayah Kerja Puskesmas Lingkar Barat Kota Bengkulu. *HIGIENE: Jurnal Kesehatan Lingkungan*, *3*(3), 132-136.

Tomia, S., Hadi, U.K., Soviana, S., & Retnani, E.B. (2020). Epidemiology of Dengue Haemorraghic Fever Cases in Ternate City, North Mollucas. *Jurnal Veteriner*. **21**(4): 637–645. https://doi.org/10.19087/jveteriner.2020.21.4.637

Widyorini, P., Wahyuningsih, N., & Murwani, R. (2016). Faktor Keberadaan Breeding Place Dengan Kejadian Demam Berdarah Dengue Di Semarang. *Jurnal Kesehatan Masyarakat (e-Journal)*, *4*(5), 94–99

Wita, R. (2014). Faktor Risiko Kejadian Demam Berdarah Dengue (DBD) di Kelurahan Pondok Kelapa, Kecamatan Duren Sawit, Jakarta Timur Tahun 2014. *Universitas Indonesia, Depok*.

World Health Organization. (2020). Gender and Health. 2020.

World Health Organization. (2020).*Comprehensive Guidelines for Prevention and Control of Dengue and Dengue Haemorrhagic Fever Revised and expanded edition*. World Health Organization, Regional Office for South East-Asia. (Diakses 11 Februari 2023)

Zulkarnaini, Z., Siregar, Y. I., & Dameria, D. (2019). Hubungan Kondisi Sanitasi Lingkungan Rumah Tangga dengan Keberadaan Jentik Vektor Dengue di Daerah Rawan Demam Berdarah Dengue Kota Dumai tahun 2018. *Jurnal Ilmu Lingkungan*, *3*(2), 115-124.