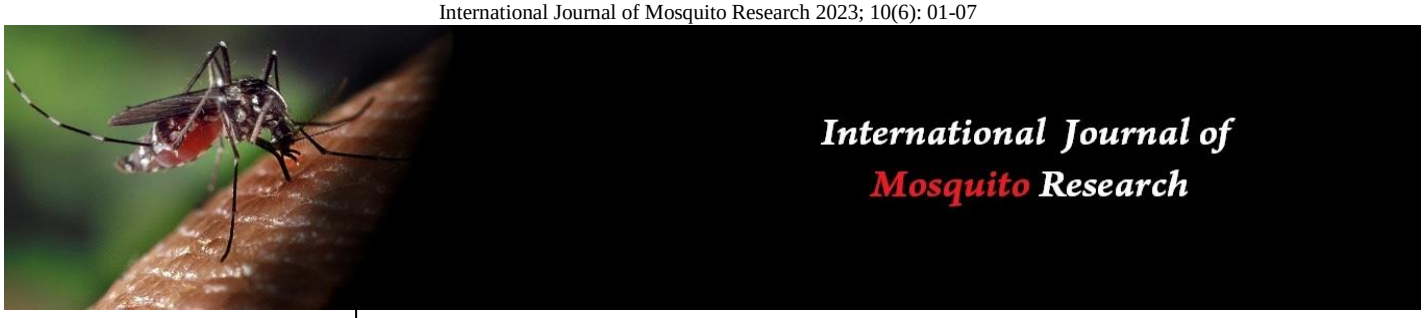

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Aedes aegypti mosquito vector disease susceptibility index, environmental factors in Parvathipuram Manyam District, Andhra Pradesh, India

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Abstract
Dengue Hemorrhagic Fever (DHF) is common in the Parvathipuram Manyam District of Andhra Pradesh, India. According to the Public Health Office in the district headquarters, there has been an increase in dengue cases at Parvathipuram Manyam Community Health Center over the past six months of 2022. The dengue virus, which causes dengue hemorrhagic fever, is transmitted by the *Aedes aegypti* mosquito. If DHF is not treated immediately, it can be fatal. Over the last five years, the Parvathipuram Manyam district of Andhra Pradesh, India, has seen an increase in dengue fever cases. The incidence rate will have an impact on the community health development index and general health status in Parvathipuram Manyam. The goal of this study was to determine how vulnerable the Parvathipuram Manyam district was to dengue fever using the disease vulnerability index. The methodology used to calculate the Village Development Index was investigated. The index of environmental disease vulnerability is divided into seven categories and 23 sub indicators. The district is at an intermediate level of risk, with a DHF vulnerability index score of 2.771. If this condition is not addressed and significant preventative measures are not implemented, it has the potential to become extremely vulnerable in the coming year. Addapuseela was the most vulnerable village, with a value of 3.348, while Parvathipuram was the least vulnerable, with a value of 2.304. According to the findings, every village in the Parvathipuram Manyam district is vulnerable in some way. True and effective efforts on the part of all parties involved, particularly the Community Health Center and the surrounding community, are required to prevent and manage the underlying causes of DHF disease. This is critical if we are to see a decrease in DHF cases and, eventually, its abolition. Using the chi-square test, the statistical analysis produced a p-value of 0.666, indicating that $p > 0.05$. Hence, there exists a correlation between behavioral factors and the incidence of DHF.

Keywords: Dengue hemorrhagic fever, parvathipuram manyam, environmental factors, disease susceptibility index, healing and prevention efforts, statistical analysis

Introduction
Dengue Hemorrhagic Fever (DHF) is a condition that is more severe than Dengue Fever. DHF is a disease transmitted by a vector that carries the dengue virus which can attack all ages, from babies to the elderly [1]. The vectors that carry the dengue virus are most types of mosquitoes from the species *Aedes aegypti* and a small part of *Aedes albopictus* [2].
The cause of dengue fever is one of the four dengue virus serotypes (DENV 1-4). Four dengue virus serotypes belong to the flavivirus genus in the flaviviridae family. Infection from the DENV virus can cause several pathological conditions, ranging from mild and asymptomatic Dengue Fever, Dengue Fever accompanied by flu, to GHF and Dengue Shock Syndrome which can be fatal [3].
Dengue fever has been present in Asia, Africa, and North America since the late 18th century, according to published works dating back to the late 18th century. Dengue fever is estimated to cause 50 million new cases each year. Dengue fever infected approximately 500,000 people, killing approximately 22,000 people, the majority of whom were children. Between 1960 and 2022, the number of dengue fever cases worldwide increased by a factor of 30 [4]. Dengue fever is found in urban and semi-urban areas throughout the tropics and subtropics. India, which has a tropical climate, is very suitable for the growth of mosquitoes such as *Aedes aegypti*.

Dengue virus transmission by *Aedes aegypti* mainly occurs during the rainy season because rainwater reservoirs become mosquito breeding grounds [5].

Even though the number of cases has gone down over the past few years, DHF is still a big public health problem in India. In 2021, there were thousands of cases of dengue fever and 580 deaths per 100,000 people. In 2019–2020, there were only 204,171 cases and 78.85 deaths per 100,000 people [6]. In general, there are three factors that play an important role in the endemicity of dengue fever, namely the host (human), vector (*Aedes aegypti* and *Aedes albopictus*), and the environment. DHF is directly related to society and the environment, thus allowing for widespread transmission. This increase is in line with increased mobility and population density in endemic areas [7]. The *Aedes aegypti mosquito species* is the main vector for the spread of dengue disease in India. This mosquito breeding process occurs in clear and clean puddles such as water reservoirs in bathrooms, barrels, uncovered buckets, flower vases, tree holes, banana fronds and holes contained in rocks are very potential to accommodate puddles. The rapid development of mosquitoes will affect the pattern of spread of the dengue virus which causes dengue disease. *Aedes aegypti mosquitoes* that carry the dengue virus become infective, which means they can transmit the virus to others through their bites. Aedes mosquitoes have a habit of biting during the day. This virus takes time to multiply in the mosquito's body to become infective when it comes out of the mosquito's body. Incubation of the virus occurs intrinsically (human body) and extrinsic incubation (mosquito body). Intrinsic incubation occurs for 3 days to 2 weeks before the onset of symptoms, whereas extrinsic incubation lasts for 8 to 10 days. The presence of viral infections is characterized by high fever for 2 days to 1 week, the appearance of red spots on the skin, thrombocytopenia and plasma leakage caused by increased blood vessel permeability. This plasma leak is an impact that must be avoided because it can cause death in patients with DHF. Fever, toxins, and recovery are the three stages of clinical presentation. The toxic stage, lasting between 24 and 48 hours, is the most dangerous because it causes plasma leakage and circulation problems [8].

The spread of the dengue virus is influenced by several factors, namely environmental factors, biological factors and demographics. The incidence of dengue fever is related to warm weather and high humidity. High temperatures can increase vector breeding and stimulate mosquito biting behaviour. Apart from that, health services are influenced by shifts in age groups, distribution to rural areas, social and biological determinants of race and gender are also causal factors [9].

One of them uses the index method to gauge the size of dengue outbreaks. In many fields, the word "index" is frequently used to refer to a particular number. The Human Development Index (HDI) [10] is one of the measuring methods that can indicate the status of human development, which is one of the causes. The Public Health Development Index, which is a collection of health indicators that can be quickly and directly quantified to explain issues, is compiled by the Health Research and Development Agency of the Ministry of Health, Andhra Pradesh, India. The Election Supervisory Agency uses the index method to calculate the Election Vulnerability Index (EVI) which serves as an instrument to detect the level of vulnerability in each region that wants to hold regional elections [11]. The Village Development Index (IPD) is also the basis for classifying villages into 3 categories, namely independent villages, developing villages and underdeveloped villages. Disease vulnerability index is a value that describes the level of disease vulnerability in a particular area. This disease vulnerability index provides information for health actors in conduct policy interventions. In addition, it is used as a tool to answer questions related to how to fulfill / achieve dimensions and indicators in the context of disease prevention.

This research is limited to knowing the incidence of Dengue Haemorrhagic Fever patients at the Parvathipuram Manyam Health Center in 2022, the factors causing the incidence of Dengue Hemorrhagic Fever patients at the Parvathipuram Manyam Health Center, and the role of the Parvathipuram Manyam Health Center in efforts to cure and prevent Dengue Hemorrhagic Fever at the Parvathipuram Manyam Health Center. By knowing these three things, it is hoped that we can find the right strategy to reduce the development of dengue fever at the Area Hospital Parvathipuram, Andhra Pradesh, India during the time of 2022 period and another purpose of this study was to determine the level of dengue disease vulnerability in Parvathipuram Manyam tribal people based on the disease vulnerability index.

Methodology

The method used in this research is a descriptive qualitative method. Descriptive qualitative research is research with a case study approach. This research focuses on one particular object and studies it as a case. Data in case study research can be obtained from various sources, but is limited to the cases studied. Meanwhile, primary data was conducted through interviews with local Village Heads. The data collection has been carried out in July – December 2022. This data collection includes all factors that affect the incidence of DHF in the work area of each village. The six pillars of the health system used in determining EVI are: (i) health services, (ii) health workers, (iii) health information systems, (iv) access to medical devices/vaccines/technology, (v) health financing, and (vi) health leadership and resources. After compiling the dimensions and indicators, the indicator score is determined based on the standard standards that have been found in the literature study. The amount of score of each indicator is adjusted to the data obtained. The score of this indicator will be input data in the calculation of the overall disease vulnerability index and vulnerability index per dimension. Furthermore, the vulnerability index is calculated based on the VDI calculation formula and Level of Vulnerability Disease [12].

This research was conducted at the Area Hospital Parvathipuram which is located in Parvathipuram Manyam, Andhra Pradesh, India. The Parvathipuram Manyam Health Center oversees 14 villages. Data from this research were taken from interviews with doctors and P2P (Disease Prevention and Eradication) officers on duty at the Area Hospital Parvathipuram and processed data from the Parvathipuram Manyam District Health Service. Data from the Parvathipuram Manyam District Health Service noted that there was an increase in the number of dengue fever sufferers in the last 6 months at the Area Hospital Parvathipuram in 2022. In addition, identification of disease-causing factors was also carried out based on journals related to this research material. Then compiled on dimensional tables, indicators and

indicator scores such as Table 1 which of course are adjusted to the identification of data that has been done.

The environmental factor questionnaire contains 10 question items. This questionnaire uses close ended question with Yes and no answers and the behavioural factor questionnaire contains 10 question items this questionnaire uses close ended question with Yes and No answers. This research was conducted in Parvathipuram Manyam district, selected villages, Parvathipuram Manyam, Area Hospital, Parvathipuram working area, Parvathipuram, data collection process with conduct direct observations on the incidence of Dengue Haemorrhagic Fever and direct interviews with respondents to obtain data on habit hang clothes. The habit of using mosquito repellent, the presence of used items around the house.

Results and Discussion

Based on data from the Parvathipuram Manyam District Health Service, the following results were obtained. Table 1. The incidence of dengue fever sufferers in the Parvathipuram Manyam District Health Centre in the specified of 2022. Based on data from the Parvathipuram Manyam District Health Office, the following results were obtained.

Table 1: The incidence of dengue patients at the Parvathipuram Manyam Health Centre in 2022

No.	Village	Total cases in 2022
1	Addapuseela	21
2	Appandoravalasa	11
3	Chinabondapalle	18
4	Gangamambapuram	17
5	Gopalapuram	11
6	Lakshminarayanapuram	18
7	Parvathipuram Manyam	15
8	Putturu	14
9	Sangamvalasa	12
10	Parvathipuram	4
	Total	141

Based on Table 1, the total number of dengue sufferers at the Parvathipuram Manyam Health Center in 2022 was 141 cases. There has been an increase in the number of dengue sufferers in the last 2 months of 2022, with the highest incidence occurring in Addapuseela Village as many as 21cases. Meanwhile, in Parvathipuram rural area the dengue cases are minimum in 2022.

Table 2: Demographics of respondents by age

Age	F	%
17-25 years	1	2.2
26-35 years	13	26.7
36-45 years	17	33.3
46-55 years	11	21.1
56-65 years	8	16.7
Total	50	100

The cause of dengue fever which occurred frequently in the Area Hospital Parvathipuram in the last 6 months (July-December) in 2022 was due to the rainy season which started to occur. The community does not make enough efforts to prevent the reproduction of the *Aedes aegypti* mosquito, which causes dengue fever, such as by draining, covering and burying water reservoirs. People only rely on fogging which only kills mosquitoes that cause dengue fever, but does not break the chain of reproduction so it is less effective.

Table 3: The relationship of DHF with environmental factors

Environment	F	%
Good	2	4
Bad	48	96
Total	50	100
Behavior	**F**	**%**
Good	38	76
Bad	12	24
Total	50	100
DHF Events	**F**	**%**
DHF does not occur	33	66
DHF occurs	17	34
Total	50	100

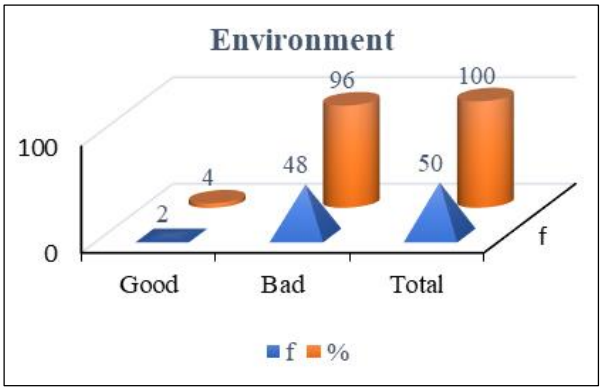

Fig 1: Relationship between dengue fever and Environmental factors

Fig 2: Relationship between dengue fever and Behaviour

Figure 3 Relationship between dengue fever and DHF Events

The table 3 and Figure 1, 2, 3 above shows that of the 50 respondents who had the most environmental conditions were not good as many as 48 (96%) respondents and at least good environmental conditions as many as 2 respondents (4%). The table 3 above shows that from 50 respondents who have the most good behaviour as many as 38 respondents (76.0 %) and no good manners as many as 12 people (24%). DHF Event results shows that of the 50 respondents who did not dengue as many 33 respondents (66%) and dengue fever occurred as many as 17 (34%). The results of research on the relationship between environmental and behavioural factors with dengue fever in Parvathipuram Manyam district, shows that the statistical tests using the chi square test obtained p = 0.666 which means p>0.05. The relationship of behavioural factors with the incidence of DHF and DHF Events shows that the chi

square test obtained p = 0.000 which means p > 0.05. So, there is a relationship between behavioural factors and the incidence of DHF.

Index Value Calculation Results

Based on the research that has been done, the results were obtained in the form of a dengue disease vulnerability index of Gangamambapuram of 2.771. Meanwhile, the other major villages vulnerability index is 2.391; Appandoravalasa village of 2.565; Parvathipuram of 2.304; Chinabondapalle village of 2.696; Addapuseela village of 3.348; Lakshminarayanapuram village at 2.630; Putturu is 3.014 and Sangamvalasa is 3.217. The amount of vulnerability index obtained will be analyzed more deeply to find out what factors play the most role in determining the value of this dengue vulnerability index. While the index in each dimension has varying values, namely the health service dimension index of 2.196; health workforce dimension index of 1.971; environmental health dimension index of 3.095; population dimension index of 2.143, community behavior dimension index of 4.429; The disease control dimension index is 2.214 and the government dimension index is 3.667. Based on the index calculation, a district-level dengue disease vulnerability index of 2.771 and an index in each rural village is obtained as illustrated in Figure 4.

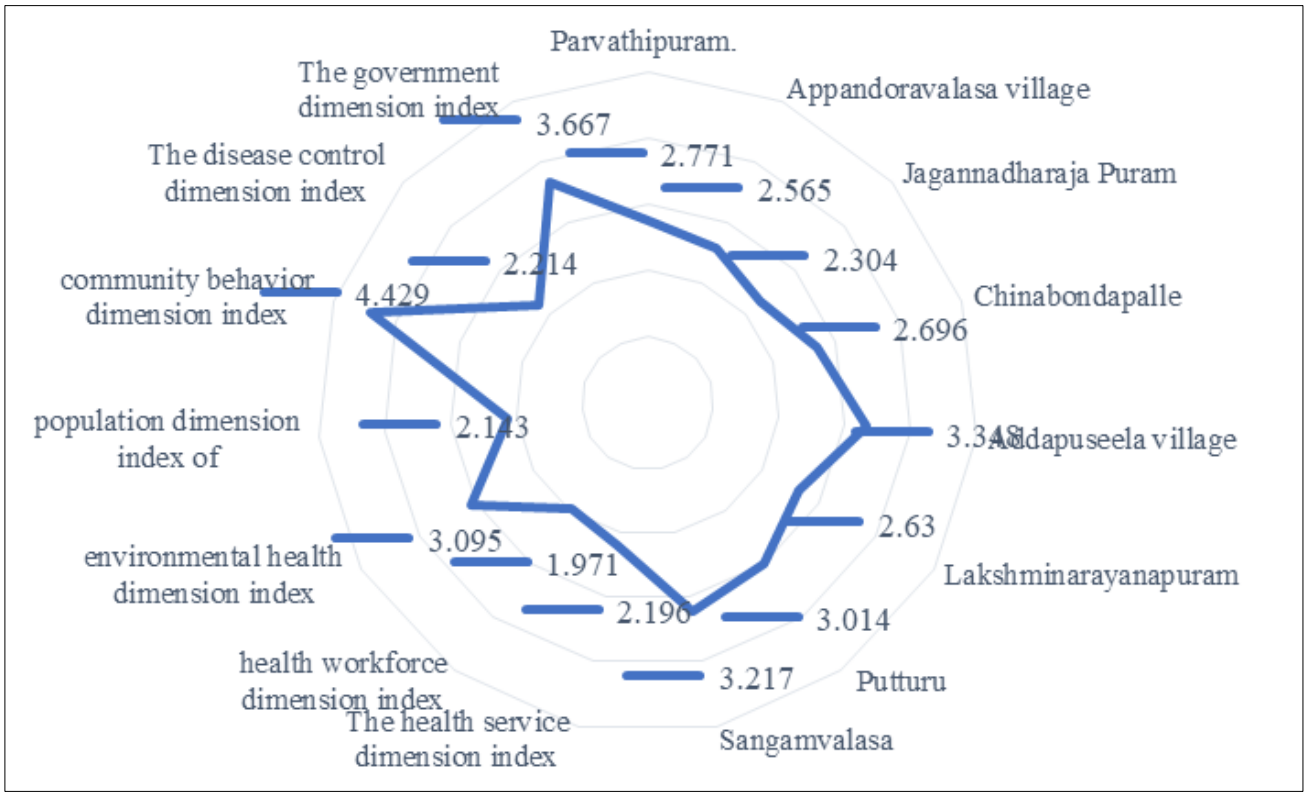

Fig 4: Dengue disease vulnerability index in Parvathipuram Manyam district.

Discussion

Based on the results of the analysis conducted, 7 dimensions and 23 indicators were obtained that affect the dengue disease swampiness index in Gangamambapuram, Parvathipuram Manyam district. The dimensions found will determine the size of the disease vulnerability index, including the dimension of health services, the dimension of health workers, the dimension of environmental health, the dimension of population, the dimension of community behavior, the dimension of disease control and the dimension of government. Health services will affect the dengue vulnerability index in an area consisting of indicators of availability and access to the nearest hospital, availability and access to Villages, availability and access to doctors practices, availability and access to pharmacies. The presence and absence of good health services will determine how much the level of treatment for DHF. Good health services that can be reached by the community will reduce the incidence of diseases, especially infectious diseases and environment-based diseases. Research conducted by Zahir *et al.*, (2016) [13] explained that the improvement of Villages health services for dengue tropical disease management shows that preventive health promotion services through local wisdom delivered by Villages health extension officers are effective in changing the behavior and clean culture of the community for dengue prevention can be optimized Health services must also synergize with other stakeholders to be more effective in Improving health services through preventive efforts to combat tropical infectious diseases.

The next dimension that affects DHF is the dimension of health workers. The availability of doctors, the availability of nurses, the availability of midwives, the availability of pharmacists and the availability of laboratory workers will determine the level of treatment and prevention of dengue disease [14]. Health workers who meet the standards will affect the dengue disease vulnerability index related to the role and function of each health worker. Health workers are said professionals to be health workers who can treat patients well and are able to provide psychological care for patients and have a high social sense in providing healing efforts to patients. This dimension is also used in calculating EVI where the indicators included in this dimension are the availability of

doctors, the availability of nurses, the availability of midwives, the availability of pharmacists and the availability of laboratory workers will determine the level of handling and prevention of environment-based diseases.

The environmental health dimension of dengue disease consists of indicators of landfill availability, mosquito nest eradication schedules and waste collection schedules. These three indicators will affect the dengue disease vulnerability index, especially the eradication of Ae mosquito nests [15]. *Aegypti* which is a vector that spreads the dengue virus that causes dengue fever. If the eradication of mosquito nests is routinely carried out more in the rainy season, it will break the chain of transmission of the virus that causes dengue fever. These three indicators will affect the dengue disease vulnerability index, especially the eradication of Ae mosquito nests. Aegypti which is a vector that spreads the dengue virus that causes dengue fever. If the eradication of mosquito nests is routinely carried out more in the rainy season, it will break the chain of transmission of the virus that causes dengue fever [14-15].

The population dimension also affects the dengue disease vulnerability index. This dimension consists of percentage indicators of education level and population income will affect health behavior patterns and population density levels will affect mosquito breeding and dengue virus spread patterns.

The indicators of residents' propensity to close water reservoirs, their use of medicine when their fever is severe, and their propensity to cultivate plants that repel mosquitoes make up the dimensions of community behavior in dengue sickness. The prevalence of DHF is influenced by these three parameters. The community's failure to seal water reservoirs will have an impact on the prevalence of dengue since it may alter the growth patterns of the dengue-causing mosquitoes. According to WHO that one of the symptoms of DHF is high fever, if people know the symptoms of DHF then healing actions will be quickly carried out. Community behavior related to planting mosquito repellent plants will have a positive impact on inhibiting the breeding of mosquitoes that cause dengue fever [16].

The dimension of disease control is related to the incidence of DHF and the cure rate of DHF. These two indicators will affect the size of the dengue disease vulnerability index. This dimension consists of 2 indicators, namely the incidence rate of disease and the success rate of treatment. These two types of data were obtained in the Villages report in 2020 on all Villages in Parvathipuram Manyam district. The high and low incidence of disease will determine the value of the vulnerability index. Standard indicator scores are prepared based on the Ministry of Health's Strategic Plan 2015-2020[17]. The last dimension is the government dimension related to the budget and percentage of infectious disease counseling, especially dengue. The indicators in this dimension are the percentage of budget for health, the ratio of special budgets for disease prevention and eradication or policies in areas that specialize in disease control. These three indicators are closely related to environment-based disease prevention. Adequate budgeting will help programs related to disease prevention and other aspects of environmental health so as to reduce the incidence of environment-based diseases. General health counseling programs and infectious disease-specific counseling will affect people's health-related behaviors and habits. People will understand the importance of health and try to avoid diseases that come from the environment. So that it will reduce the incidence rate and at the same time the environment-based disease vulnerability index.

Figure 4 is included in the category of potential vulnerable. If this condition is not fully conditioned to survive, then in the future this vulnerability index is likely to become vulnerable. For this reason, breakthroughs are needed from local governments regarding efforts to prevent dengue disease. For example, by increasing the budget for counseling to the community. The status of dengue fever in Parvathipuram Manyam district is in the vulnerable potential zone with a district-level index of 2,771. The high density of dengue fever is closely related to and the pattern of behavior of the community which is still low regarding a clean and healthy lifestyle. As explained by Murray (2013) that community behavior in terms of eradicating mosquito larvae that cause dengue fever is the most influential on the incidence of dengue in a certain area and at a certain time span.

In general, all rural villages in Parvathipuram Manyam district are still in the category of potential dengue disease prone despite the difference in index figures in each rural village. The lowest vulnerability index occurred in Parvathipuram. Although the population density in Parvathipuram Manyam district is the highest, it does not affect the vulnerability index. This is contrary to Cahyorini (2019) [19]who stated that the density of houses has a significant effect on DHF. This is because the vulnerability index is a composite number of various dimensions. The vulnerability index figure arises from combining indicator scores from 7 existing dimensions. So the population density indicator will be covered by the indicator score on the other dimension.

The disease vulnerability index in Parvathipuram is the lowest compared to other rural villages. This is influenced by the location of Parvathipuram in the district capital, all health service facilities are available in this rural village and access to reach these health service facilities is easy. The dimension that most affects the value of the dengue vulnerability index in Parvathipuram Manyam district is the community behavior dimension with a dimension index of 4.429 in accordance with that community behavior, especially related to the closure of water reservoirs to prevent the entry of mosquitoes to lay eggs in puddles, has a significant influence on the incidence of dengue fever. Community behavior to raise larvae-eating fish and plant mosquito repellent plants is an important behavior in preventing dengue. Both of these behaviors include 3M plus suggested by the Ministry of Health. This is in accordance with Kurniawati's statement (2018) [20], that the implementation of 3M plus is an influential activity in eradicating and preventing dengue transmission. The complete form of 3M's activities is draining water reservoirs, closing water reservoirs and recycling used materials that can hold water in the environment. While the pluses in question include activities to raise larvae-eating fish, using mosquito repellent, installing window wires, mutual assistance in cleaning the environment, checking larvae in water reservoirs regularly, using larvicide to kill mosquito larvae, repairing clogged drains and waste and planting mosquito repellent plants.

The incidence of dengue fever continues to increase due to accelerating human mobility, uncontrolled urbanization, fewer public services and good hygiene practices, household waste that is not handled properly, industrialization of single-use

items that continue to increase will exacerbate inorganic waste in the environment. The number of events continues to increase due to the lack of optimal community participation in the prevention and control of DHF. It is necessary to make integrated efforts in preventing disease. As some studies have mentioned that the community-based dengue prevention model has a significant influence on control and prevention, although there is still a lot of improvement on the effectiveness of the role of the community at various levels

Through a circular letter from the Simultaneous Movement for the Prevention of Control and Early Awareness of DHF in Parvathipuram Manyam, the Parvathipuram Manyam Government has appealed to the Area Hospital Parvathipuram to make efforts to prevent control and early vigilance for DHF by doing the following.

Readiness of health service facilities, by providing treatment and care for dengue fever sufferers of degrees 1 and 2 being treated at community health centres/clinics that have adequate laboratories, while sufferers of dengue fever degrees 3 and 4 are immediately referred to hospital.

Eradication of vectors/mosquito larvae

- Mosquito Nest Eradication Movement (PSN) in all educational institutions, starting from schools, High Schools, and universities, both private/state.
- Carry out a simultaneous movement to prevent and control dengue fever through activities to eradicate mosquito nests with 3M+ (PLUS).
- Drain water storage places such as bathtubs/WCs, jars, drums, etc., at least once a week
- Close the water reservoir tightly after collecting the water, so that mosquitoes cannot enter and breed.
- Bury or get rid of used items that can collect rainwater such as used plastic, cans and so on.
- Mobilizing the community to be involved in socializing the prevention of dengue fever.

Conclusion

From the results of interviews and data analysis from the Parvathipuram Manyam District Health Service, it can be concluded that there has been an increase in the number of dengue fever sufferers in the last 6 months (July-December) in 2022 which is due to ineffectiveness in preventing and controlling dengue fever at the Area Hospital Parvathipuram. The Parvathipuram Manyam Government has now taken steps by calling on the Area Hospital Parvathipuram to carry out a series of actions and activities to prevent and control dengue fever through direct community involvement in all aspects of age and social status. Based on the results of research that has been conducted, it can be concluded that the dengue vulnerability index in Parvathipuram Manyam district is 2.771 which is included in the category of potential vulnerable. The highest vulnerability index in Seberang Musi rural village is 3.348, this is related to the geographical location of Addapuseela village is far from the capital of Parvathipuram so that health facilities and infrastructure are inadequate and the contours of remote areas make it difficult to access health facilities. In addition, the low public knowledge about health accompanied by the lack of availability of doctors affects the high dengue vulnerability index in this district. The lowest dengue vulnerability index is in Parvathipuram of 2.304 which is related to the location of Parvathipuram in the district capital so that all health service facilities are available in Parvathipuram and access to reach these health service facilities is easy. Based on the index per dimension, it can be explained that the dimension that most affects the dengue vulnerability index in Parvathipuram Manyam district is the community behavior dimension with an index of 4.429 and the lowest dimension index is the health worker dimension of 1.971. Community behavior, especially related to the closure of water reservoirs to prevent the entry of mosquitoes to lay eggs in puddles, has a significant influence on the incidence of dengue fever.

Recommendations

The community has a very important role in efforts to prevent and control dengue fever. Through small things that can be done by the whole community, they can have a big influence on the effectiveness of disease prevention and control efforts. The public should be more aware of making effective and real efforts to stop the spread of dengue fever in order to reduce the incidence of dengue fever or even prevent it from happening again.

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