Volume 2, No. 10 October 2023 - (1102-1118)
p-ISSN 2980-4868 | e-ISSN 2980-4841
https://ajesh.ph/index.php/gp

ENVIRONMENTAL ANALYSIS AND DISTRIBUTION PATTERNS OF Aedes Aegypti MOSQUITO TO PREDICT DHF ENDEMICITY AREA IN KARO DISTRICT

[1*]Jernita Sinaga,[2]Risnawati Tanjung, [3]Helfi Nolia
[123]Politeknik Kesehatan Kemenkes Medan
Email: jernitas74@gmail.com

ABSTRACT:
In 2018 there were 81 cases, IR: 19.77 per 100,000 population based on the initial survey at the health office there were 131 cases, the highest was at Kabanjahe Health Center: 46, the lowest was at Kuta Buluh Health Center: 2 and Lau Baleng Health Center 2 cases. The purpose of this study was to analyze environmental factors and distribution patterns to predict areas prone to dengue fever in Karo Regency. The analysis is divided into 3 categories, namely the District Level using time series data analysis, forecasting (Arima) which aims for Early Warning Sign, the Kelurahan/Village level using GIS data processing describing the sub-districts as very vulnerable, vulnerable and not vulnerable. Individual level using case control design, chi square test analysis and mapping with GIS aims to describe the distribution of areas with dengue fever and exposure behavior that affects the incidence of dengue and see the most dominant factor using multiple logistic regression analysis. The density of larvae is the most influential factor with the density of Aedes Aegypti in Karo Regency with Exp B 4,102 (p-value ,000, 95% CI ,333 – 18,012), Community behavior (knowledge, actions and attitudes) has no relationship with Aedes Aegypti density in Karo Regency. Population density based on distribution pattern has no relationship with Aedes Aegypti density in Karo Regency, Occupancy density has no relationship with Aedes Aegypti density in Karo Regency, House index (HI) in Karo Regency is at Density Figure (4) at medium density, Container index (CI) and Breteau index (BI) are in the Density Figure (9) in high density and the larva-free rate at 72.54% is below the national standard of 95%, There are clusters of cases that have a risk of 2.69 times affected by DHF for patients who are in the cluster compared to patients who are outside the cluster, the cluster radius is 2.76 km.

Keywords: Environment, Information Systems (GIS), DHF

INTRODUCTION

This type of vector-based health problem (DHF) occurs in tropical areas. WHO designated dengue fever as one of 10 diseases that have the potential to threaten in 2019 and the latest outbreaks in many countries prove this observation. Dengue fever epidemics tend to have a seasonal motif, where most infections occur during/after the rainy season (WHO, 2020)

In 2019, dengue fever cases in Prov. North Sumatra: 7,584, 37 deaths, 2018: 5,786 with 26 deaths. and in 2017: 5,454, 28 people died. in 2016 the number of cases was 8,715 and in 2015 5,695 cases. CFR in 2019 was 0.5%.

2017 dengue fever cases in Kab. Karo had 38 cases, morbidity rate/IR: 9.4/100,000 population, mortality rate/CFR: 5.3%. (Profile of Karo District Health Office, 2017). In 2018 there were 81 cases, IR: 19.77 per 100,000 population (Karo District Health Office Profile, 2018). There were 244 cases, the highest at Kabanjahe Health Center: 46, the lowest at Kuta Buluh Health Center: 2, Lau Baleng Health Center: 2 (Health Office Profile Karo District, 2019).

Research on mosquito identification and distribution of Aedes sp mosquitoes with the incidence of dengue fever in the district. Kabanjahe District. Karo in 2019, the results of capture and identification were: 106 Aegipty mosquitoes: 6.77% and Albopictus: 5.09%. Many found: Aegipty: 59 individuals and Albopictus: 47 individuals. At an altitude of 1208.15 m above sea level, 8 Aedes sp mosquitoes were found, Aegipty: 3 and Albopictus: 5. The most Aedes sp mosquitoes were found at an altitude of 913 – 1100 m above sea level, Aedes sp mosquitoes: 32, Aegipty: 16 and Albopictus: 16 (Jernita & Likas, 2019).

The results of research in 2019 in Kec. Kabanjahe (Tongging village) obtained the most Aedes sp mosquitoes at temperatures of 25^{o}C - 30^{o}C Aedes sp mosquitoes: 61, Aegipty: 36 and Albopictus: 25. The most numerous Aedes sp mosquito species at humidity 60 – 80^{o}F: 65 Aedes sp mosquitoes, Aegipty: 37 and Albopictus 28 (Jernita & Likas, 2019).

It is possible to carry out regional-based surveillance efforts to identify the chain of dengue transmission and identify the location of the sufferer to the individual's address, so as to obtain information about the distribution of cases in each region using the Geographic Information System (GIS). DHF cases in Kab. Karo (2017-2019) there has been an increase, it is necessary to carry out environmental analysis, knowing the density distribution pattern of Aedes sp mosquitoes in order to predict dengue endemic areas in the district. Karo so that prevention efforts can be carried out in the form of the Karo Community Movement for Ovitrap (GERMAVIT).

RESEARCH METHODS

This research was conducted for 10 months, January - December 2022 in Kab. Karo. This research uses a sample of the entire population (*total sampling*) dengue fever sufferers in the Karo Regency area

based on the results of laboratory examinations and recorded in the DKK DHF surveillance/W2 report. Karo in 2020 numbered 244 people. This research uses data on the incidence of dengue fever, HI, CI, BI and larvae-free rates obtained from DKK Karo. Population density data: BPS Kab. Karo, these data are divided into 2, namely primary data using questionnaire data collection techniques and direct researcher observation of respondents: residential density and PSN habits as well as secondary data obtained from Karo DKK, Community Health Centers, Districts, Kel/village communities, studies electronic-based libraries and data. The analysis is divided into 3 categories, namely the sub-district level using time series data analysis, forecasting (Arima) which aims for Early Warning Signs, sub-district/village level using GIS data processing to describe sub-districts as very vulnerable, vulnerable and not vulnerable. Individual level using a case control design, chi square test analysis and mapping with GIS aims to describe the regional distribution of dengue fever sufferers and exposure behavior that influences the incidence of dengue fever as well as looking at the most dominant factors using multiple logistic regression analysis.

RESULTS AND DISCUSSION

Research Results Overview

1.1 General description of the research location

Geographically, Karo Regency is located at around 97º55' - 98º38' East Longitude and 2º50'- 3º19' North Latitude. Karo Regency is located in the Bukit Barisan Plateau and most of its area is highland. Two active mountains are located in this area, making it prone to volcanic earthquakes and volcanic eruptions. The Karo Regency area is at an altitude of 120-1400 meters above sea level.

Administratively, Karo Regency is divided into 17 sub-districts consisting of 259 villages and 10 sub-districts, as in table 1.1 below:

Table 1
Name of District, District Capital and Number of Villages/Subdistricts in Karo Regency

No	Nama Kecamat	IbuKota Kecama	Jumlah Desa	Jumlah Kelurahan
1.	Mardingding	Mardingding	12	0
2.	Laubaleng	Laubaleng	15	0
3.	Tigabinaga	Tigabinanga	19	1
4.	Juhar	Juhar	25	0
5.	Munte	Munte	22	0
6.	Kuta Buluh	Kuta Buluh	16	0
7.	Payung	Payung	8	0
8.	Tiganderket	Tiganderket	17	0
9.	Simpang Empa	Simpang Empat	17	0
10.	Naman Teran	Naman	14	0
11.	Merdeka	Merdeka	9	0
12.	Kabanjahe	Kabanjahe	8	5
13.	Berastagi	Berastagi	6	4
14.	Tigapanah	Tigapanah	26	0

Sumber: Kabupaten Karo,2021

2.1. Characteristics of Research Subjects

Table 2
Frequency distribution of research subjects by age group in Karo Regency

No	Age	Number (n)	Percentage (%)
1	0-5 Years	2	0.8
2	6-17 Years	33	13.5
3	18-45 Years	174	71.3
4	45-55 Years	24	9.8
5	>=56 Years	11	4.5
Total		244	100.0

The dominant respondents aged 18-45 years were 174 (71.3%) respondents, aged 0-5 (0.8%), aged ≥ 56 years (4.5%) and 45-55 (9.8%) respondents. The characteristics of research subjects based on work can be seen in the table below:

Table 3
Frequency distribution of research subjects based on occupation in Karo Regency

No	Work	Number (n)	Percentage (%)
1	Doesn't work	25	10.2
2	Farmer	93	38.1
3	PNS/ABRI	5	2.0
4	Self-employed	47	19.3
5	Private Officer	3	1.2
6	Housewife	23	9.4
7	Student	48	19.7
Total		244	100.0

The most dominant group of case subjects who experienced dengue fever were farmers, 93 (38.1%) of the

respondents, while those in the private sector were 3 (1.2%).

1.2 Study of Dengue Fever Risk Factors*Dengue* (DBD)

1.2.1. Map of the Distribution of Dengua Hemorrhagic Fever (DHF) Events

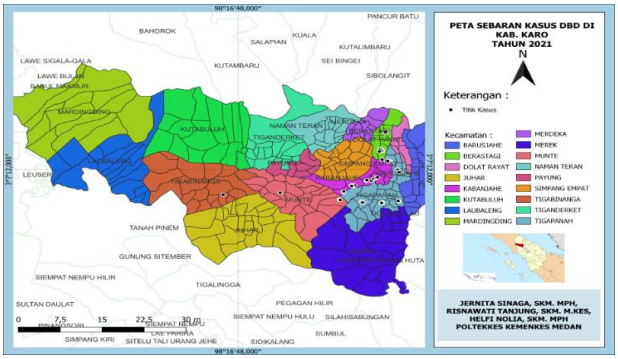

Figure 1. Map of the Distribution of Dengue Fever Incidences in Karo Regency

The distribution of dengue fever cases is not spread across all sub-districts, but only in a few sub-districts. Based on the research results, the most cases were in Tigapanah District with a total of 66 cases, including Kuta Kepar Village with a total of 40 cases, Aji Jahe Village with a total of 12 cases, Aji Mbelang Village and Kubu Simbelang Village with a total of 6 cases, Suka Dame Village with a total of 2 cases. Meanwhile, Tiga Binanga is the area with the lowest cases with a total of 1 case.

The distribution of cases was analyzed using the nearest neighbor analysis method, the indicator used was the nearest neighbor index number taking into account the average distance from each case coordinate point. Based on the results of analysis using Satscan, there are 2 clusters with the Most Likely cluster. There are 66 cases,*p* – value <0.01; RR: 14.87; radius: 4.07 km, which means there is a grouping of cases (clusters) that are most at risk, having a risk level of 14.87 times of getting dengue fever for sufferers who are inside the cluster compared to sufferers who are outside the cluster with a cluster radius of 4, 07 km.

The second cluster has 18 cases,*p* – value <0.01; RR: 2.69; radius; 2.76 km, which means that a grouping of cases (cluster) has a 2.69 times risk of contracting dengue fever for sufferers who are inside the cluster compared to sufferers who are outside the cluster, the cluster radius is 2.76 km. Like the picture below:

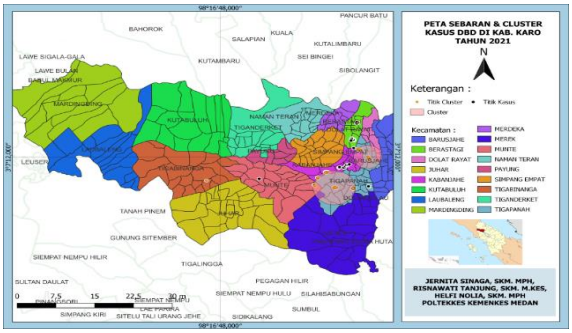

Figure 2. Nearest neighbor analysis and distribution of dengue fever cases in Karo district in 2021

Next, we can see the distribution of cases based on population density in Karo Regency:

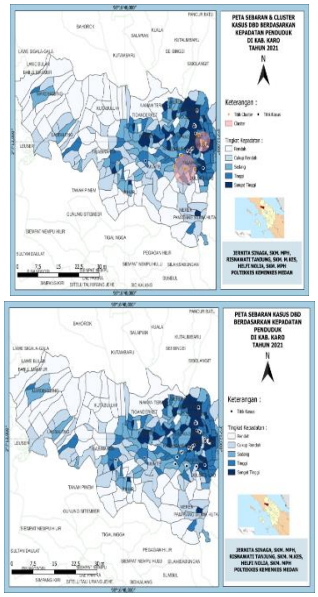

Figure 3. Map of Case Distribution Based on Population Density in Karo Regency in 2021

Population density criteria based on:

Low : <75 people/km2

Pretty low : 75 – 155 people/km2

Currently : 155 – 284 people/km2

Height : 284 – 510 people/km2

Very high : >510 people/km2

Based on the results of regression analysis with GeoDa software, no relationship was found between population density and the incidence of dengue fever in the district. Kabanjahe (*p value*: 0,44).

1.3. Univariate Analysis Results

Univariate analysis namely,*figure density*, mosquito nest eradication behavior (PSN) which consists of PSN knowledge, PSN attitudes and PSN actions, and residential density.

1.3.1. Larvae Presence Variable

Of the 244 houses examined, 67 houses were found to have larvae. So that*House index* earned: 27.45 this shows in*density figures* at medium density (4). From this table it can also be obtained that the larvae free rate (ABJ) is 72.5%.

$$House\ index(HI) = \frac{Number\ of\ Houses +}{Number\ of\ Houses\ Inspected} X\ 100\%$$

$$House\ index(HI) = \frac{67}{244} X\ 100\%$$

House Index (HI) = 27,54

Table 4
Frequency distribution of research subjects based on the presence of larvae at home in Karo Regency

No	The existence of larvae	Amount (n)	Percentage (%)
1	There is	67	27.5
2	No	177	72.5
Total		244	100.0

$$Flick\ Free\ Numbers(ABJ) = \frac{Number\ of\ Larvae\ Free\ Homes}{Number\ of\ Homes\ Inspected} X\ 100\%$$

$$Flick\ Free\ Numbers(ABJ) = \frac{177}{244} X\ 100\%$$

Larval Free Rate (ABJ) = 72.54 %

Table 5

Results of Univariate Analysis of Risk Factors for DHF Incidents (Presence of Larvae) Based on Cases and Controls in Karo Regency

No	Keberadaan Jentik	Kejadian DBD				Total	
		Mengalami		Tidak Mengalami			
		n	%	n	%	n	%
1	Ada	51	41,8	16	13,1	67	27,5
2	Tidak Ada	71	58,2	106	86,9	177	72,5
Total		122	100	122	100	244	100

The group that experienced dengue fever with larvae was 51 (41.8%) respondents and subjects in the no larvae category were 71 (58.2%) respondents. In the group who did not experience dengue fever, the presence of larvae was 16 (13.1%) respondents, whereas there were no larvae in 106 (86.9%) respondents.

Table 6

Frequency Distribution of Research Subjects Based on The presence of larvae in containers in Karo Regency

No	Water reservoirs	The presence of TOTAL larvae					
		There is		No			
		N	%	N	%	N	%
1	Human	238	97,5	6	2,5	244	100
2	Drinking places	33	13,5	211	86,5	244	100
3	Used Goods	212	86,9	32	13,1	244	100
4	Village Bunga	79	32,4	165	67,6	244	100
5	Refrigerator Storage	96	39,3	148	60,7	244	100
6	Waterways	134	54,9	110	45,1	244	100
7	Dispenser Container	166	68,0	78	32,0	244	100
8	Bathtub	208	58,2	36	14,8	244	100

Of the 244 houses inspected, 1,706 containers were obtained. There are 956 containers containing larvae. So*Container index* earned: 57.93 this shows in*density figures* at high density (9).

$$Container\ Index(THERE) = \frac{Number\ of\ Positive\ Flick\ Containers}{Number\ of\ Containers\ Inspected} X\ 100\%$$

$$Container\ Index(THERE) = \frac{956}{1706} X\ 100\%$$

Container Index (HI) = 57,93 %

Table 7
Frequency distribution of research subjects based on the presence of larvae in case home containers in Karo Regency

No	Water reservoirs	The existence of larvae				TOTAL	
		There is		No			
		n	%	n	%	n	%
1	Human	43	35,2	79	64,8	122	100
2	Drinking places	16	13,1	106	86,9	122	100
3	Used Goods	64	52,5	58	47,5	122	100
4	Village Bunga	32	26,2	90	73,8	122	100
5	Refrigerator Storage	31	25,4	91	74,6	122	100
6	Waterways	46	37,7	76	62,3	122	100
7	Dispenser Container	46	37,7	76	62,3	122	100
8	Bathtub	59	48,8	63	51,6	122	100

Of the 122 case homes examined, 377 containers contained larvae. So it is obtained*Breteu Index* amounted to 276 in*density figures* at high density (9).

1.3.2. PSN Behavioral Variables

Behavioral variables (Knowledge, Attitudes and PSN Actions) are as follows

Table 8
Frequency Distribution of Research Subjects Based on Mosquito Nest Eradication Behavior (PSN) in Karo Regency

No	Variabel	Kejadian DBD				Total	
		Kasus		Kontrol			
		n	%	n	%	n	%
1	Pengetahuan						
	Rendah	28	23,0	13	10,7	41	16,8
	Tinggi	94	77,0	109	89,3	203	83,3
	Total	122	100	122	100	244	100
2	Sikap						
	Kurang Baik	118	96,7	122	100	240	98,4
	Baik	4	3,3	0	0	4	6
	Total	122	100	122	100	244	100
3	Tindakan						
	Kurang	77	63,1	104	82,5	181	74,2
	Baik	45	36,9	18	14,8	63	25,8
Total		122	100	122	100	244	100
4	Padatan Hunian						
	Tidak Memenuhi Syarat	93	76,2	76	62,3	169	69,3
	Memenuhi Syarat	29	23,8	46	37,7	75	30,7
Total		122	100	122	100	244	100

There were 28 (23%) respondents who experienced dengue fever who had low knowledge, 77 (63.1%) had inadequate action and 45 (36.9%) respondents took good action. In the group who did not experience dengue fever, 104 (85.2%) had poor attitudes, and 18 (14.8%) respondents had poor attitudes. For residential density that experienced dengue fever, there were 93 (76.2%) respondents who did not meet the requirements and 29 (23.8%) respondents who met the requirements. In the group who did not experience dengue fever, the residential density that did not meet the requirements was 76 (62.3%) respondents with the residential density meeting the requirements being 46 (37.7%) respondents.

1.4. Bivariate Analysis Results

The results of the bivariate analysis between the risk factors studied and the incidence of dengue fever in Karo Regency can be seen in the table below:

Table 9

Bivariate Analysis of Risk Factors for Dengue Fever*Dengue* in Karo Regency

No	Variabel	Kejadian DBD				Total	
		Kasus		Kontrol			
		n	%	n	%	n	%
	Pengetahuan						
1	Rendah	28	23,0	13	10,7	41	16,8
	Tinggi	94	77,0	109	89,3	203	83,3
	Total	122	100	122	100	244	100
	Sikap						
2	Kurang Baik	118	96,7	122	100	240	98,4
	Baik	4	3,3	0	0	4	6
	Total	122	100	122	100	244	100
	Tindakan						
3	Kurang	77	63,1	104	82,5	181	74,2
	Baik	45	36,9	18	14,8	63	25,8
Total		122	100	122	100	244	100
	Padatan Hunian Tidak						
4	Memenuhi	93	76,2	76	62,3	169	69,3
	Syarat	29	23,8	46	37,7	75	30,7
	Memenuhi Syarat						
Total		122	100	122	100	244	100

1.4.1. The Effect of the Presence of Larvae on the Occurrence of DHF

There were 51 (41.8%) houses that had larvae present and 71 (58.2%) had no larvae in houses that had dengue fever. There were 122 respondents who did not experience dengue fever cases. There were 67 (27.5%) houses where larvae were present, and those without larvae were 177 (72.5%) houses of respondents who did not experience cases of dengue fever. Based on the statistical test results, the analysis results show value*p value* = 0.000 or*p value* <0.005, thus it can be concluded that there is a significant relationship between the presence of larvae and cases of dengue fever.

1.4.2. Influence of Knowledge with DB Events

Respondents who experienced dengue cases had low knowledge as many as 28 (23.0%) and those who had high knowledge as many as 94 (77.0%) and respondents who did not experience dengue cases had low knowledge as many as 13 (10.7%) and those with high knowledge as many as 109 (89.3%). Based on the statistical test results, the analysis results show a value = 0.010 or*p value* <0.005, thus it can be concluded that there is a significant relationship between knowledge and the incidence of dengue fever.

1.4.3. The Influence of Attitude on the Occurrence of DHF

Respondents who experienced dengue cases had an unfavorable attitude as many as 118 (96.7%) and those who had a good attitude were 4 (3.3%) and respondents who did not experience dengue cases had an unfavorable attitude as many as 122 (100.0%) and those who had a good attitude were as many as 0 (0.0 %). Based on the statistical test results, the analysis results show a value = 0.130 or*p value* >0.005, thus it can be concluded that there is no significant relationship between attitude and the incidence of dengue fever.

1.4.4. Effect of Actions on DHF Incidents

Respondents who experienced dengue cases had unfavorable actions as many as 77 (63.1%) and those who had good actions were 44 (36.9%) and respondents who did not experience dengue cases had unfavorable actions as many as 104 (85.2%) and those who had good actions were as many as 18 (14.8 %). Based on the statistical test results, the analysis results show a value = 0.000 or*p value* <0.005, thus it can be concluded that there is a significant relationship between actions and cases of dengue fever.

1.4.5. Effect of Residential Density on DHF Incidence

The density of housing that met the requirements for dengue fever sufferers was 29 (23.8%) and those that did not meet the requirements were 93 (76.2%) respondents. Meanwhile, there were 46 (37.7%) respondents who did not suffer from dengue fever and 76 (62.3%) respondents who did not meet the requirements. Based on the statistical test results, the analysis results show a value = 0.026 or*p value* <0.005, thus it can be concluded that there is a significant relationship between residential density and cases of dengue fever.

1.5. Multivariate Analysis Results

The results of the multivariate analysis of risk factors for dengue fever in Karo Regency can be seen in the following table:

Table 10

Logistic Regression Final Model

Variabel	B	Sig.	Exp(B)	95% C.I.for EXP(B)
Keberadaan Jentik	1,411	,000	4,102	,333-18,012
Tindakan	-1,006	,002	,366	,332 – 9.197
Constant	-2,215	,000	,109	

From the results of multivariate analysis using logistic regression, it was found that 2 variables influenced the incidence of Dengue Hemorrhagic Fever (DHF), namely the presence of larvae variable and the action variable. The most dominant factor influencing the incidence of dengue fever is the presence of larvae with Exp B 4.102 (*p-value* ,000, 95 % CI ,333-18,012).

DISCUSSION

1. Relationship between the presence of larvae and the incidence of dengue fever

Statistical analysis results using tests*chi-square* The variable for the presence of larvae shows a significant relationship with the incidence of dengue fever, where the value of p = 0.000 is obtained. The percentage of respondents'

homes that contained larvae from both dengue fever sufferers and non-sufferers was 67 (27.5%) out of 244 respondents and those that did not contain larvae from both dengue fever sufferers and non-sufferers were 177 (72.5%) respondents. With an OR value = 4,759, it shows that the presence of larvae has a risk of 4,759 times causing dengue fever.

The results of this research are supported by previous research (Syarifah, 2017), the results of research regarding the incidence of dengue fever with the presence of larvae. The results obtained were p value = 0.028.*p value* <0.05 then it can be concluded that Ho and Ha are accepted. So there is a significant relationship between the presence of larvae and the incidence of dengue fever in West Medan District, Medan City, North Sumatra Province

The place that dengue mosquitoes like is a landfill with clear or clean water. Dengue mosquitoes like to land in damp places. Dengue mosquitoes cannot live in water that is in direct contact with the ground. Of all landfills, bathtubs are the favorite place for dengue mosquitoes. To avoid the breeding of dengue mosquitoes, people must drain water reservoirs at least twice a week.

2. Relationship between knowledge and the incidence of dengue fever

Based on statistical analysis using the Chi square test, it is known that p = 0.010 and OR = 2.498, which means that knowledge influences the incidence of dengue fever and knowledge that is not low carries a 1,941 risk of being exposed to dengue fever.

This research is strengthened by previous research from (Farhandika et al., 2018) regarding knowledge of the incidence of dengue fever, the results obtained were p value = 0.000 p value < 0.05. So it can be interpreted that there is a significant relationship between knowledge and prevention of dengue hemorrhagic fever.

Lack of knowledge can influence a person's behavior in the health sector, so it can be the cause of the high rate of spread of diseases, including dengue hemorrhagic fever (DHF), which has a fairly high risk of transmission and spread. DHF, which is an environment-based disease, is also influenced by the state of personal hygiene and environmental cleanliness, good sanitation that meets health requirements and is supported by good personal hygiene will be able to reduce the risk of the emergence of a disease, including dengue fever. Good personal hygiene and sanitation of the housing environment can be realized if it is supported by good community behavior or behavior that supports the dengue disease eradication program (Dewi et al., 2019).

3. Relationship between attitude and dengue fever incidence

The results of statistical analysis using the chi-square test on the attitude variable showed that there was no significant relationship with the incidence of dengue fever, p = 0.130. This research is in contrast to previous research by (M. Nur et al., 2020) who had a negative attitude in preventing dengue fever. 13 respondents (52.0%), while 12

respondents (48.0%) had a positive attitude. Apart from that the results*p value* = 0.05<0.003, meaning that there is a significant relationship between attitude and dengue prevention in the Tanjung Basung area of the Pasar Usang health center. These results indicate that the negative attitude of respondents regarding dengue prevention is one of the factors in the occurrence of dengue fever.

Attitude is a tendency to respond to a particular problem and situation and attitude is formed from individual social interactions which will form a certain pattern of attitude towards the object they are facing. The attitude of the sufferer's family here is said to be a response to the sufferer in prevention and treatment, because with a response positive attitude from the family in supervising or as a motivator for sufferers in their treatment so as to prevent drug resistance and reduce the risk of transmission to other people (Nurkhasanah et al., 2021).

4. Relationship between actions and dengue fever incidents

Based on statistical analysis using tests*Chi square* It is known that p = 0.000 and OR = 0.296, which means that actions have an influence on the incidence of dengue fever and actions that do not meet the requirements carry a risk of 0.296 times exposure to dengue fever.

This research is in line with previous research (M. Nur et al., 2020) which had 14 respondents (56.0%) who had bad actions, while 11 respondents (44.0%) had good actions, which resulted in*p value* = 0.05<0.010, meaning there is a significant relationship between action and dengue prevention in Tanjung Basung, Pasar Usang Community Health Center area.

Action is an internal response after thoughts, responses, inner attitudes and insight. Someone who has a high level of formal education has a better and broader level of knowledge and insight and has a more mature personality and attitude. Wider insight and thinking in the health sector will influence individual behavior in responding to a problem. Good education can motivate, set an example and encourage family members to prevent dengue fever (M. Nur et al., 2020)

5. Relationship between residential density and dengue fever incidence

Based on statistical analysis using tests*Chi square* It is known that p = 0.026 and OR = 1.941, which means that residential density influences the incidence of dengue fever and residential density that does not meet the requirements is at risk of being exposed to dengue fever 1,941 times.

This research is in line with previous research (Kaeng et al., 2020) regarding residential density, p value = 0.031 p value < 0.05. This value means there is a relationship between residential density and the incidence of dengue fever in the Tompaso Minahasa Health Center working area.

This research is inversely proportional to research (Nolia, 2013) where residential density and the incidence of dengue fever in Gading Cempaka District, Bengkulu City showed an insignificant relationship (OR = 1.034: 95% CI = 0.602 – 1.775: p value = 0.897). Residential density does not statistically have a significant relationship with the incidence of dengue fever because*p value* > 0.05, this condition is because residential density is not a causative factor but is only a risk factor that can cause dengue transmission.

Population density can influence the number of dengue cases. A large number of individuals in a particular area will facilitate the spread of dengue fever, because it will facilitate and speed up the transmission of the virus*dengue* from vectors (Sumampouw, 2017; Sumampouw, 2018). The denser the population, the more residential density it will cause. Occupancy density is the ratio of the number of occupants to the area of the house, where based on health standards it is 10 m2 per occupant, the wider the floor area of the house, the higher the habitability of a house.

6. Relationship between Mosquito Larva Density*Temples of the Egyptians*

The research results show that the variables whose bivariate analysis test results have a p value <0.25 are the presence of larvae, knowledge, actions and residential density. Next, all independent variables are included in multivariate modeling. The results show that there are 2 variables that influence the incidence of Dengue Fever*Dengue* (DHF) in Karo Regency, namely the larva presence variable and the action variable. The high risk factor for the incidence of Dengue Hemorrhagic Fever (DHF) in Karo Regency is the variable presence of larvae with Exp B4,102 (*p-value* .000, 95 % CI .333 – 18.012). This research is in line with research conducted by Syarifah in 2017 with the titlerelationship between density of mosquito larvae*temples of the Egyptians* with the incidence of dengue fever in West Medan District*with*The results of research regarding the incidence of dengue fever with the presence of larvae showed that the p value = 0.028, the p value <0.05. So there is a significant relationship between the presence of larvae and the incidence of dengue fever in West Medan District, Medan City, North Sumatra Province.

CONCLUSION

The analysis is divided into 3 categories, namely the District Level using time series data analysis, forecasting (Arima) which aims for Early Warning Sign, the Kelurahan/Village level using GIS data processing describing the sub-districts as very vulnerable, vulnerable and not vulnerable. Individual level using case control design, chi square test analysis and mapping with GIS aims to describe the distribution of areas with dengue fever and exposure behavior that affects the incidence of dengue and see the most dominant factor using multiple logistic regression analysis. The density of larvae is the most influential factor with the density of Aedes Aegypti in

Karo Regency with Exp B 4,102 (p-value ,000, 95% CI ,333 – 18,012), Community behavior (knowledge, actions and attitudes) has no relationship with Aedes Aegypti density in Karo Regency. Population density based on distribution pattern has no relationship with Aedes Aegypti density in Karo Regency, Occupancy density has no relationship with Aedes Aegypti density in Karo Regency, House index (HI) in Karo Regency is at Density Figure (4) at medium density, Container index (CI) and Breteau index (BI) are in the Density Figure (9) in high density and the larva-free rate at 72.54% is below the national standard of 95%, There are clusters of cases that have a risk of 2.69 times affected by DHF for patients who are in the cluster compared to patients who are outside the cluster, the cluster radius is 2.76 km.

BIBLIOGRAPHY

Dewi, T. F., Wiyono, J., & Ahmad, Z. S. (2019). Hubungan pengetahuan orang tua tentang penyakit DBD dengan perilaku pencegahan DBD di Kelurahan Tlogomas Kota Malang. *Nursing News: Jurnal Ilmiah Keperawatan*, *4*(1), 348–358.

Farhandika, M., Wardani, D. W. S. R., & Setiawan, G. (2018). Hubungan Pengetahuan dan Status Sosial Ekonomi Terhadap Upaya Pencegahan Demam Berdarah Dengue (DBD) di Desa Pajaresuk Kecamatan Pringsewu Kabupaten Pringsewu Relationship of Knowledge and Socio-Economic Status Against the Prevention of Dengue Hemorrhag. *Jurnal Majority*, *7*(3), 68–72.

Jernita & Likas. (2019). Identifikasi dan distribusi nyamuk Aedes SP. Sebagai Prevalensi Penyakit Demam Berdarah Dengue Di Kabupaten Karo. *Penelitian*, 54–78.

Kaeng, L. W., Warouw, F., & Sumampouw, O. J. (2020). Perilaku Pencegahan dan Kepadatan Hunian dengan Kejadian Demam Berdarah Dengue. *Indonesian Journal of Public Health and Community Medicine*, *1*(3), 01–06.

M. Nur, Y., Eliza, E., & Haria, W. E. (2020). Faktor-Faktor Predisposisi yang berhubungan dengan Pencegahan DBD di Tanjung Basung Wilayah Kerja Puskesmas Pasar Usang. *Jurnal Akademika Baiturrahim Jambi*, *9*(1), 131. https://doi.org/10.36565/jab.v9i1.198

Nolia, H. (2013). *Faktor Lingkungan Dan Kejadian Demam Berdarah Dengue (Dbd) Daerah Endemis Kecamatan Gading Cempaka Kota Bengkulu Tahun 2012*.

Nurkhasanah, D. A., Sitorus, R. J., & Listiono, H. (2021). Faktor-Faktor yang Berhubungan dengan Pencegahan Demam Berdarah Dengue (DBD). *Jurnal Ilmiah Universitas Batanghari Jambi*, *21*(1), 277. https://doi.org/10.33087/jiubj.v21i1.1164

Syarifah, Z. (2017). *Hubungan kepadatan larva nyamuk aedes aegypti dengan*

kejadian penyakit dbd di kecamatan medan barat skripsi.

WHO. (2020). Dengue in the WHO European Region. *Dengue in the WHO Eoropean Region*.

Klein, J. (2002, June 12). How the solidarity dream turned sour. *The Guardian*, 8-9Dewi, T. F., Wiyono, J., & Ahmad, Z. S. (2019). Hubungan pengetahuan orang tua tentang penyakit DBD dengan perilaku pencegahan DBD di Kelurahan Tlogomas Kota Malang. *Nursing News: Jurnal Ilmiah Keperawatan*, *4*(1), 348–358.

Farhandika, M., Wardani, D. W. S. R., & Setiawan, G. (2018). Hubungan Pengetahuan dan Status Sosial Ekonomi Terhadap Upaya Pencegahan Demam Berdarah Dengue (DBD) di Desa Pajaresuk Kecamatan Pringsewu Kabupaten Pringsewu Relationship of Knowledge and Socio-Economic Status Against the Prevention of Dengue Hemorrhag. *Jurnal Majority*, *7*(3), 68–72.

Jernita & Likas. (2019). Identifikasi dan distribusi nyamuk Aedes SP. Sebagai Prevalensi Penyakit Demam Berdarah Dengue Di Kabupaten Karo. *Penelitian*, 54–78.

Kaeng, L. W., Warouw, F., & Sumampouw, O. J. (2020). Perilaku Pencegahan dan Kepadatan Hunian dengan Kejadian Demam Berdarah Dengue. *Indonesian Journal of Public Health and Community Medicine*, *1*(3), 01–06.

M. Nur, Y., Eliza, E., & Haria, W. E. (2020). Faktor-Faktor Predisposisi yang berhubungan dengan Pencegahan DBD di Tanjung Basung Wilayah Kerja Puskesmas Pasar Usang. *Jurnal Akademika Baiturrahim Jambi*, *9*(1), 131. https://doi.org/10.36565/jab.v9i1.198

Nolia, H. (2013). *Faktor Lingkungan Dan Kejadian Demam Berdarah Dengue (Dbd) Daerah Endemis Kecamatan Gading Cempaka Kota Bengkulu Tahun 2012*.

Nurkhasanah, D. A., Sitorus, R. J., & Listiono, H. (2021). Faktor-Faktor yang Berhubungan dengan Pencegahan Demam Berdarah Dengue (DBD). *Jurnal Ilmiah Universitas Batanghari Jambi*, *21*(1), 277. https://doi.org/10.33087/jiubj.v21i1.1164

Syarifah, Z. (2017). *Hubungan kepadatan larva nyamuk aedes aegypti dengan kejadian penyakit dbd di kecamatan medan barat skripsi*.

WHO. (2020). Dengue in the WHO European Region. *Dengue in the WHO Eoropean Region*.