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Environmental Factor Determination on Aedes Aegypti Egg Density in Endemic Areas in South Sulawesi Province

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Abstract – Dengue Hemorrhagic Fever (DHF) is an infection caused by the dengue virus. The dengue virus is found in tropical and sub-tropical areas, mostly in urban and suburban areas of the world. Dengue is a disease virus transmitted from the Aedes aegypti mosquito. The purpose of this study was to determine the relationship between the determinants of environmental factors and the density of Aedes aegypti mosquito eggs in dengue-endemic areas in South Sulawesi Province. This type of research is analytic observational using a cross-sectional study design. The population in this study, households in the Paccerakang and Bontoa, as well as Jenetallasa Villages, with a total sample size of 100 each. The results showed that temperature and humidity had a relationship to the density of Aedes aegypti mosquito eggs in three villages with a p-value <0.005 (p = value 0.001; 0.001; 0.001) and humidity p-value <0.005 (p-value = 0.016; 0.010; 0.001).). Then the occupancy rate on the density of Aedes aegypti mosquito eggs in Bontoa and Jenetallasa villages, there is a relationship with a p-value <0.005 (p-value = 0.001; 0.0037) which indicates there is a relationship while in Jenetallasa Village there is no relationship because of the value. p value> 0.005 (p-value = 0.0422). Furthermore, the use of screen wire in three sub-district was not found to be connected. It is hoped that related agencies in an effort to break the chain of Aedes aegypti mosquitoes will conduct a survey using the ovitrap method.

Keywords – Aedes Aegypti Eggs, Density, Environmental Factors.

I. Introduction

Dengue Hemorrhagic Fever (DHF) is an infection caused by the dengue virus. Dengue is a disease virus transmitted from the Aedes aegypti mosquito, the fastest growing mosquito in the world, which causes nearly 390 million people to be infected every year. Dengue virus is found in tropical and sub-tropical areas, mostly in urban and suburban areas in the world. (Ministry of Health of the Republic of Indonesia, 2018). According to the World Health Organization (WHO), it is estimated that 50 to 100 million dengue infections occur each year. From these cases, 500,000 cases develop into dengue which causes 22,000 deaths, mostly children (Sanyaolu, 2017).

In Indonesia in 2017, the number of DHF cases reported was 68,407 with 493 deaths and IR 26.12 per 100,000 population compared to 2016 with 204,171 cases and IR 78.85 per 100,000 population, then there was a decrease in cases in 2017. (Ministry of Health of the Republic of Indonesia, 2018). South Sulawesi Provincial Health Office 2016 to 2017, DHF cases in South Sulawesi province have decreased, from the number of cases in 2016 of 7,568 cases (IR 87, 93 per 100,000 population) with 48 deaths (CFR 0.63%), then in 2017, there were 1,895 cases (IR 19.90 per 100,000 population) with 17 deaths (CFR 0.90%). In 2018, there were an increase of 2,122 cases (IR 24 per 100,000 population) with 19 deaths (CFR 0.9%). These cases are spread across 24 districts/cities in Sulawesi - South Province

Changes in temperature affect disease transmission and reproduction rates, biting rates, the extrinsic incubation period for pathogens, as changes in geographic range and rainfall increase the availability of breeding grounds for mosquitoes (Promprou, et al, 2005). This is in line with research conducted by Rahayu, et al,(2010), who said that temperature is a characteristic that affects the development, growth, adaptation, and geographic distribution of mosquitoes where mosquitoes will breed normally at temperatures (25 ° C-27 ° C). Further research by (Liu-Helmersson, et al, 2014), said that the potential for a dengue epidemic is very dependent on temperature, where the potential for a dengue epidemic will peak at a temperature of 29 ° C, but will decrease above that temperature

High humidity makes mosquito Ae. aegypti lasts a long time, so it is possible that the time pattern of the disease will vary from one place to another depending on the climate and humidity (MOH, 2013). From this phenomenon the mosquito Ae. aegypti often live in areas or areas with low humidity conditions, for example in people's homes. The pattern of increasing cases of dengue infection is epidemiologically related to the rainy season because rainwater reservoirs will become breeding grounds for mosquitoes (Karyanti & Hadinegoro, 2016)

The density of occupancy has a close relationship with density, population density, so it plays an important role in the spread of DHF. This is confirmed by the research of Fakhriadi, R., et al. (2015), who explained that occupancy density is a risk factor for incidence, which shows that respondents with high occupancy density have a risk of contracting dengue disease 6,682 times compared to respondents with low occupancy density. Then the house with ventilation conditions is not installed with gauze, making it easier for mosquitoes to enter and bite humans inside, while the ventilation of the house is fitted with cloth/gauze, which can prevent mosquitoes from entering the house and reduce the possibility of being bitten by mosquitoes. This is in line with research Wahyuningsih, et. al (2017). and, Wijirahayu, et, al (2019) where there is a relationship between the installation of gauze on the house ventilation with the incidence of dengue hemorrhagic fever. The aim of this study was to determine the relationship between the determinants of environmental factors and the egg density of Aedes aegypti mosquitoes in DHF endemic areas in South Sulawesi Province.

II. METHODS

A. Research Type and Design

This type of research is an analytic observational study using a cross-sectional study design. The cross-sectional study is an epidemiological study design that studies the relationship between environmental factors (independent variables) and the egg density of Aedes aegypti mosquitoes (dependent variable) by taking instantaneous measurements.

B. Location and Time of Research

This research study was conducted in Paccerakang Village, Makassar City, and Bontoa Village, Maros Regency, and Jenetallasa Village, Gowa Regency. Then the research time is in June-July 2020.

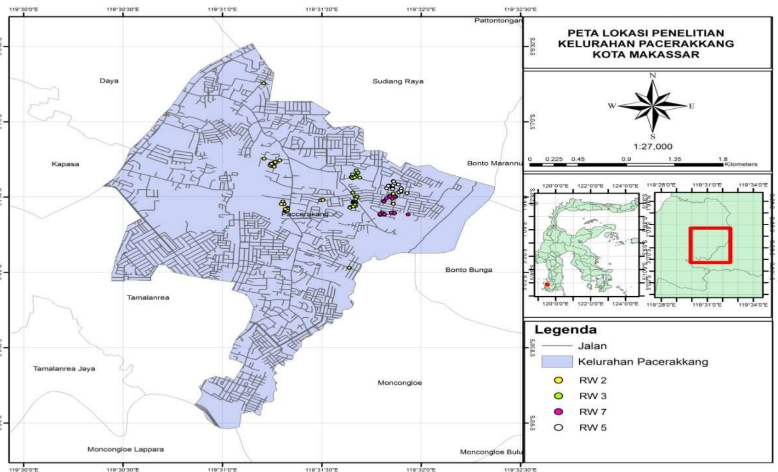

Figure 1. Map of Research Location in Paccerakang Village, Makassar City

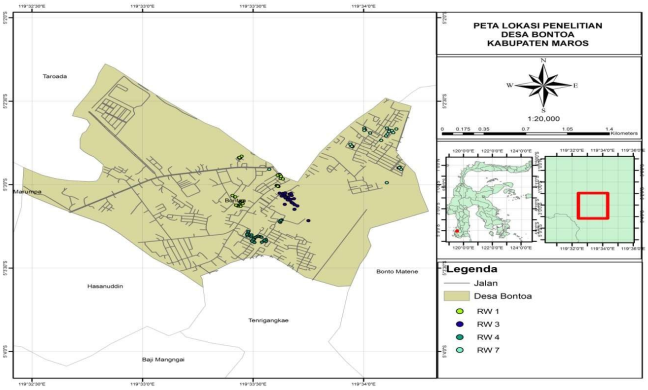

Figure 2. Map of Research Locations in Bontoa Village, Maros Regency

C. Jenetallasa Village, Gowa Regency

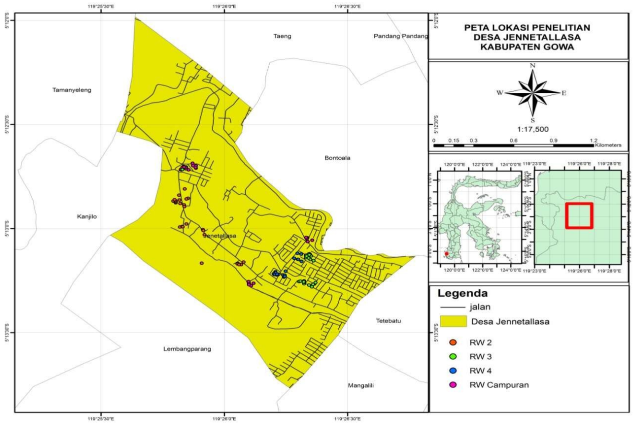

Figure 3. Map of Research Locations in Jennetallasa Village, Gowa Regency

D. Population and Sample

The population in this study were households in Paccerakkang Village, Biringkanaya District, Jenetallasa Village, Pallanga District, and Bontoa Village, Mandai District. Then the sample in this study is the household in the neighborhood unit (RW) that has been selected by procedure, with a total sample of 100 households each.

III. Results And Discussion

A. The egg density of Aedes aegypti mosquitoes

The density of Aedes aegypti mosquito eggs was measured by placing an ovitrap in each respondent's house with the number of ovitraps for each respondent of two ovitraps. Then the ovitrap was kept in the respondent's house for one week (6 days), then observations were made of the ovitrap that was positive for eggs in each research location and the results can be seen in table 2.

Table 1. Density Distribution of Ae. agypti Every house in Paccerakkang, Bontoa and Jenetallasa Villages in 2020

Ae. Aegypti Mosquito Egg Density		Amount (n)	Percentage (%)
Paccerakkang	Positive	38	38,0
	Negative	62	62,0
Bontoa	Positive	35	35,0

	Negative	65	65,0
Jenetallasa	Positive	23	23,0
	Negative	77	77,0

Table 1 shows that the Pacerakang sub-district has the highest number of positive ovitraps, namely 38 ovitraps, or 38.0%, of the 100 ovitraps installed, while the lowest number of positive ovitraps is in Jenetallasa Village, namely 23 ovitraps or 23.0% positive of the 100 ovitrap attached. The results of the density calculation of Aedes agypti eggs with the Ovitrap index (OI) show that Paccerakang and Bontoa are in the medium category, with a density> 30%, while Jenetallas is in the low category, with a density category level of <30%. Density with low category 0 - 30%, moderate> 30 -70%, high ≥ 70% Burroni, et al, (2013).

B. Temperature and Density of Aedes aegypti Eggs

Physical environmental factors such as temperature are one of the environmental factors that affect the development of Aedes aegypti mosquitoes to lay their eggs. The following table shows the relationship between temperature measurements and the density of Aedes aegypti mosquitoes in Paccerakang, Bontoa and Jenetallasa Villages, which can be seen in the table. 2

Table 2. Relationship between Air Temperature and Density of Mosquito Eggs in Paccerakkang, Bontoa, and Jenetallasa Villages in 2020

Air temperature	Mosquito Egg Density				Total		p-value
	Positive		Negative				
Paccerakkang Sub-district	n	%	n	%	n	%	
Potential	23	60,5	7	11,2	30	100	0,001
Not Potential	15	39,5	55	88,8	70	100	
Bontoa Sub-district							
Potential	28	80,0	12	18,5	40	100	0,001
Not Potential	7	20,0	53	81,5	60	100	
Jenetallasa Sub-district							
Potential	19	82,6	15	19,5	34	100	0,001
Not Potential	4	17,4	62	80,5	66	100	

Based on the table showing the results of the Chi-Square test, it can be seen that air temperature has a significant relationship with the density of Aedes aegypti mosquito eggs in three villages, namely Paccerakang, Bontoa and Jenetallasa Villages with a p-value of 0.001 <0.005, and the strongest correlation is Bontoa Sub-districtis 0.514. And the Paccerakang and Jenetallasa villages show a moderate relationship. This condition is related to the average temperature in Paccerakang and Bontoa Villages, which are still categorized as optimal for the development of Aedes Agypti mosquitoes, namely 30.50C and 30.60C, while in Jenetallasa Village an average temperature of 31.80C is not included in the optimal temperature category. Mosquitoes generally lay their eggs at a temperature of 20-30 ° C and the optimum temperature for the growth and development of mosquitoes is 25-27 ° C. Temperature is an important factor in the development of the mosquito life cycle. Wahono, (2019). In measuring the density of Aedes agypti eggs with the Ovitrap index (OI), it was found that Paccerakang and Bontoa Villages were in the medium category and Jenetallas was in the low category.

The results showed that there was a relationship between Aedes agypti egg density and air temperature. The temperature and humidity factors are greatly influenced by the rainy season or summer. When the research was conducted to coincide with the dry season in July and August in three urban villages, this condition greatly affects the density of mosquito eggs caught on the ovitrap. This research is in line with the research conducted by Barreto E, et al (2020) regarding the evaluation of ovitraps to monitor Aedes spp. in Dili, the capital of East Timor. The researchers explained that the density of Aedes aegypti eggs had a positive and significant correlation with air temperature. Therefore, ovitrap is a tool that can integrate the density of Aedes spp eggs as a monitoring and control program in Timor-Leste.

Then another study that is in line with this research is research by Lakoro (2015) which explains that the air temperature inside 29oC to 31oC is very optimum for the growth of Aedes egypti eggs. And research by Zapletal, et al (2018), shows that larval density and daily temperature can influence the development of Aedes aegypti.

C. Humidity with Aedes aegypti Egg Density

Humidity in an area is closely related to the life cycle of mosquitoes. Humidity greatly affects the habits of mosquitoes to lay their eggs somewhere. Air humidity is defined as the content of water vapor in the air which is usually in percent (%) with the measuring instrument used is the hygrometer. Measurement of air humidity was carried out in the respondent's house, using a Thermo Hygrometer. The following is a table of the results of humidity measurement in Paccerakkang, Bontoa and Jenetallasa Villages, which can be seen in the following table.

Table 3.The Relationship between Air Humidity and Density of Mosquito Eggs in Paccerakkang, Bontoa, and Jenetallasa Villages in 2020

Humidity	Mosquito Egg Density				Total		p-value
	Positive		Negative				
Paccerakkang Sub-district	n	%	n	%	n	%	
Potential	26	68,4	27	43,5	53	100	0,016
Not Potential	12	31,6	35	56,5	47	100	
Bontoa Sub-district							
Potential	27	77,1	33	50,7	60	100	0,010
Not Potential	8	22,9	32	49,3	40	100	
Jenetallasa Sub-district							
Potential	17	73,9	5	6,5	22	100	0,001
Not Potential	6	26,1	72	93,5	78	100	

The results of the research on humidity show that the average humidity there are two villages that have optimal humidity, namely Bontoa Village, namely 60.8% and Paccerakang 59.9%, so that physical environmental factors such as temperature and humidity greatly affect the presence of Aedes agypti mosquitoes for lay eggs. This condition is related to the number of houses whose ovitrap is positive for eggs in the table.

Based on the results of the Chi-Square test, it shows that air humidity has a significant relationship with the density of Aedes aegypti mosquito eggs in three Paccerakang, Bontoa, and Jenetallasa villages. Based on the Kepmenkes RI No. 035 of 2012 concerning Guidelines for the Identification of Health Risk Factors Due to Climate Change, it is stated that humidity of more than 60% is optimal for the breeding of Aedes aegypti larvae.

The results of the measurement of the average air humidity in the three villages, namely Paccerakkang Village, the average humidity is 59.9%. Bontoa Sub-district has an average humidity of 60.8%. In the Jenetallasa Sub-district, the average humidity is 54.4%. Humidity is an environmental factor that greatly affects the density of the Aedes agypti mosquito to lay eggs as measured by the ovitrap index (OI). In measuring the density of Aedes agypti eggs with the Ovitrap index (OI), it was found that Paccerakang and Bontoa Villages were in the medium category and Jenetallas was in the low category.

This research is in line with research conducted by Farida Heriyani (2019) from the results of the analysis, showing the presence of Aedes agypti mosquito larvae with room humidity in the Banjar Baru Utara primary school. Then the same was done by Susanti et al, (2017) which explains that statistically there is a relationship between air humidity and the presence of Aedes aegypti mosquitoes in the working area of the Halmahera Public Health Center, Semarang City. Further research (Novitasari, et al, 2015) which explained that there was a relationship between humidity and the presence of larvae (p = 0.0001), then research (A Arsunan Arsin, kk(2014) Then the results showed that there was a relationship between humidity and Aedes aegypti larvae (p- value: 0.027).

D. Use of Gauze Wire with Aedes aegypti Mosquito Density

Using gauze at home, the goal is to cover vents and windows, limiting the movement of mosquitoes that are free to enter and exit the house. Wire gauze is also widely used to coat the door in the house to prevent mosquitoes from entering and leaving the house freely when the door is opened. The amount of use of gauze in the house in the villages of Paccerakkang, Bontoa, and Jenetallasa can be seen in table 4.

Table 4 The Relationship between Using Gauze Wire and Mosquito Egg Density in Paccerakkang, Bontoa, and Jenetallasa Villages in 2020

Kawat Kasa	Mosquito Egg Density				Total		p-value
	Positive		Negative				
Paccerakkang Sub-district	n	%	n	%	N	%	
There is	7	18,4	18	29,1	25	100	0,234
There is no	31	81,6	44	70,9	75	100	
Bontoa Sub-district							
There is	11	31,4	18	27,7	29	100	0,695
There is no	24	68,6	47	72,3	71	100	
Jenetallasa Sub-district							
There is	4	17,4	18	23,4	22	100	0,543
There is no	19	82,6	59	76,6	78	100	

This condition indicates that the house with ventilation conditions is not installed with gauze, which will make it easier for mosquitoes to transmit diseases and rest. The condition of the house ventilation that is not covered with screen wire will cause mosquitoes to enter the house from morning to evening. The results showed that the highest number of houses found using gauze was in Bontoa village, namely 29 houses or 29.0%. Meanwhile, respondents with the number of houses found the lowest use of wire netting in Jenetallasa Village, namely 22 houses or 22%. From these data, it illustrates that in general, the respondents do not understand the benefits of using wire netting as a preventive effort to minimize the presence of mosquitoes in the house. This condition is closely related to the presence of a positive egg house in the ovitrap. In measuring the density of Aedes agypti eggs with the Ovitrap index (OI), it was found that Paccerakang and Bontoa Villages were in the medium category and Jenetallas was in the low category.

However, based on the results of the Chi-Square test, it shows that there is no significant relationship between the use of gauze wire and the density of Aedes agypti mosquito eggs in three villages. Where the Paccerakkang Village with a p-value = 0.234> 0.05, the Bontoa Village with a p-value = 0.695> 0.05 and the Jenetallasa Village obtained a p-value = 0.543> 0.05. This research is in line with research by Tusy Triwahyuni1, et al, (2020) which indicates that there is no significant relationship between the presence of wire netting in the home environment and the presence of Ae.aegypti larvae in Way Kandis Village, Bandar Lampung (p-value of 0.565. OR = 0.789). The P-value obtained was 0.565, which is not significant because the P value> 0.05

E. Occupancy Density with Aedes aegypti Egg Density

A large number of individuals in a certain area will facilitate the spread of DHF, because it will simplify and accelerate the transmission of dengue virus from vectors. The following is the table of the results of measuring the density of the occupants of the houses in Paccerakkang, Bontoa and Jenetallasa Villages can be seen in table 5.

Table 5.The relationship between occupancy density and mosquito egg density in Paccerakkang, Bontoa, and Jenetallasa Villages in 2020

Occupancy Density	Mosquito Egg Density				Total		p-value
	Positive		Negative				
Paccerakkang Sub-district	n	%	n	%	N	%	
Densely	4	10.5	3	4,8	7	100	0,422
Not densely	34	89,5	59	95,2	93	100	
Bontoa Sub-district							
Densely	16	45,7	4	6,2	20	100	0,001

Not densely	19	54,3	61	93,8	80	100	
Jenetallasa Sub-district							
Densely	3	13,0	1	1,3	4	100	0,037
Not densely	20	87,0	76	98,7	96	100	

From the research results, it shows that the sub-district that has the number of houses with the highest density category is Bontoa Village, namely 20 houses or 20.0%. Meanwhile, the sub-district that has the number of houses with the lowest density category is Jenetallasa, which is 4 houses or 4.0%. From these data, it shows that on average 80% of the respondents' houses are categorized as not dense or feasible in accordance with the requirements of the Indonesian Minister of Health No. 829 /Menkes/SK/ VII / 1999, namely 8 m2 per occupant. In theory, the occupancy density is more to an increase in DHF cases in an area, but it does not directly affect the mosquito density, but the results of research in Bontoa Village found that there is a relationship, this condition is due to the high humidity factor, the results of the study show the high density of occupancy in Bontoa Village.

Based on the results of the Chi-Square test, there are two sub-districts that show no significant relationship between residential density and density of Aedes aegypti mosquitoes, namely in Paccerakang with p-value = 0.606> 0.05 with and Jenetallasa Village with p-value = 0.178. > 0.05. Meanwhile, Bontoa Village with p-value = 0.001 <0.05 indicates a significant relationship with a correlation strength of 0.498 indicating a moderate relationship. From the results of research in Bontoa Sub-district and Jenetallasa Sub-district in line with the research, by Sahrir, et al (2016) explained that the factor that most influenced the density of the Aedes aegypti mosquito, namely the density of the inhabitants of the house with a value of p = 0.044 (p <0.05).

Then the results of research in Paccerakang and Bontoa Villages, in line with research by Obin Sarwita et al. (2018) explain that there is no correlation between occupancy density and the number of Aedes aegypti mosquitoes. Furthermore, researchers Masruroh, et al (2016) show that there is no relationship between residential density in the house and mosquito density which results in the occurrence of DHF. Then the research results Rahayu, et al (2010) show that there is no relationship between occupancy density and the incidence of DHF.

IV. Conclusion

Based on the results of research on the determinants of environmental factors on the density of Aedes aegypti mosquitoes in DHF endemic areas in South Sulawesi Province, it can be concluded that the temperature and humidity in the house have a relationship to the density of Aedes aegypti eggs in three districts/cities in South Sulawesi Province. Then for the occupancy in Maros Regency and Gowa Regency, there is a relationship to the density of Aedes aegypti mosquito eggs because the p-value is <0.05, while in Makassar City there is no relationship because the p-value => 0.005. Furthermore, there is no relationship between the use of wire netting to the density of Aedes mosquito eggs in three districts/cities in South Sulawesi Province. It is hoped that the relevant agencies will conduct an initial survey through the installation of ovitrap in each house as one of the programs that must be developed at the health center level if they break the chain of Aedes aegypti mosquito breeding and eradicate the nest of Aedes aegypti Mosquito in three districts/cities in South Sulawesi Province.

References

[1] A Arsunan Arsin, & Ibrahim, E. (2014). Analysis Relationship and Mapping of The Environmental Factors with The Existence of Mosquito Larva Aedes aegypti in The Endemic Area of Dengue Fever, Makassar, Indonesia. International Journal of Current Research and Academic Review, 2(11), 1–9.

[2] Burroni, N., Loetti, V., Prunella, P., & Schweigmann, N. (2013). Ovitraps placed in dwellings and on public paved areas for Aedes aegypti (Diptera: Culicidae) monitoring. Revista Colombiana de Entomologia, 39(1), 56–60.

[3] Erna Sari, Nur Endah Wahyuningsih, R. M. (2017). Hubungan Lingkungan Fisik Rumah Dengan Kejadian Demam Berdara Dengue Di Semarang. Jurnal Kesehatan Masyarakat (E-Journal), 5(5), 609–617.

[4] Karyanti, M. R., & Hadinegoro, S. R. (2016). Perubahan Epidemiologi Demam Berdarah Dengue Di Indonesia. Sari Pediatri, 10(6), 424. https://doi.org/10.14238/sp10.6.2009.424-32

[5] Ministry of Health of the Republic of Indonesia. (2018). InfoDatin Situas Demam Berdarah Dengue. Journal of Vector Ecology. https://doi.org/10.3376/1081-1710(2006)31[71:aomtva]2.0.co;2

[6] Liu-Helmersson, J., Stenlund, H., Wilder-Smith, A., & Rocklöv, J. (2014). Vectorial capacity of Aedes aegypti: Effects of temperature and implications for global

dengue epidemic potential. PLoS ONE, 9(3). https://doi.org/10.1371/journal.pone.0089783

[7] Masruroh, L., Wahyuningsih, N., & Dina, R. (2016). Hubungan Faktor Lingkungan Dan Praktik Pemberantasan Sarang Nyamuk (Psn) Dengan Kejadian Demam Berdarah Dengue (Dbd) Di Kecamatan Ngawi. Jurnal Kesehatan Masyarakat (E-Journal), 4(4), 992–1001.

[8] Novitasari, I., & Sugiyanto, Z. (2015). Hubungan Suhu, Kelembaban Rumah Dan Perilaku Masyarakat Tentang Psn Dan Larvasidasi Dengan Keberadaan Jentik Nyamuk Penular Demam Berdarah Dengue Di Rw 01 Kelurahan Sendangguwo Semarang. Kesehatan Masyarakat.

[9] Promprou, S., Jaroensutasinee, M., & Jaroensutasinee, K. (2005). Climatic factors affecting dengue haemorrhagic fever incidence in Southern Thailand. Dengue Bulletin, 29, 41–48. https://doi.org/10.2004/wjst.v2i1.175

[10] Rahayu, M., Baskoro, T., & Wahyudi, B. (2010). Studi Kohort Kejadian Penyakit Demam Berdarah Dengue. Berita Kedokteran Masyarakat, 26(4), 163–170.

[11] Sahrir, N., Ishak, H., & Maidin, A. (2016). Pemetaan Karakteristik Lingkungan Dan Densitas Nyamuk Aedes aegypti Berdasarkan Status Endemisitas DBD Di Kecamatan Kolaka. JST Kesehatan, 6(1), 70–75.

[12] Sanyaolu, A. (2017). Global Epidemiology of Dengue Hemorrhagic Fever: An Update. Journal of Human Virology & Retrovirology, 5(6). https://doi.org/10.15406/jhvrv.2017.05.00179

[13] Susanti, S., & Suharyo, S. (2017). Hubungan Lingkungan Fisik Dengan Keberadaan Jentik Aedes Pada Area Bervegetasi Pohon Pisang. Unnes Journal of Public Health, 6(4), 271–276. https://doi.org/10.15294/ujph.v6i4.15236

[14] Triwahyuni, T . , Husna, I , . Putri, D.F. M. M. (2020). Hubungan Kondisi Lingkungan Rumah dengan Keberadaan Pendahuluan, 11(1), 365–371. https://doi.org/10.35816/jiskh.v10i2.291

[15] Wijirahayu, S., & Sukesi, T. W. (2019). Hubungan Kondisi Lingkungan Fisik dengan Kejadian Demam Berdarah Dengue di Wilayah Kerja Puskesmas Kalasan Kabupaten Sleman. Jurnal Kesehatan Lingkungan Indonesia, 18(1), 19. https://doi.org/10.14710/jkli.18.1.19-24