CORRELATION OF FREE LARVAE INDEX AND POPULATION DENSITY WITH DENGUE FEVER INCIDENCE RATE

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ABSTRACK

Introduction: Dengue Hemorrhagic Fever (DHF) is a disease caused by the dengue virus that infects the body. Dengue is a common viral infection in warm tropical climates. The infection is caused by one of four closely related dengue viruses. The disease now plagues many countries and even more than 100 countries within the WHO, including Africa, the Americas, the Eastern Mediterranean, Southeast Asia, and the Western Pacific. The Americas, Southeast Asia, and the Western Pacific are the most severely affected regions, with Asia representing 70% of the global disease burden. The high incidence rate of DHF in various regions of Indonesia is the background by several factors, one of which is the density of the seaters. The aim of this study was to analyze the correlation between population density and larvae free index and Incidence Rate (IR) Dengue Hemorrhagic Fever (DHF) in Blitar Regency in 2013-2017. **Methods:** The data were analyzed quantitatively using Spearman correlation tests to analyze relationships between variables. **Result:** The results of the analysis found there was no correlation between dengue fever incidence rate and larvae free index (p = 0.603 r = -0.117), and there was a correlation between the incidence rate of dengue fever and population density (p = 0.002 r = 0.619). **Conclusion:** High population density is a risk factor for DHF events in Blitar Regency, so there needs to be an anticipation of preventive measures such as the implementation of 3M and counseling of the impact of high population density.

Keywords: Incidence rate DHF, free larvae index, Population density

INTRODUCTION

Dengue Hemorrhagic Fever (DHF) is known as a disease that infects the body with the dengue virus as the cause (Nisa, 2015). Dengue is a common viral infection in warm tropical climates. The cause of infection is one of four dengue viruses that are closely related or known as serotypes and this can cause a broad spectrum of symptoms, including some that are very mild (invisible) to those that may require medical intervention and hospitalization. In severe cases, death can occur (WHO, 2020). In the past, the epidemic of severe dengue fever only occurred in nine countries before 1970. The disease now plagues many countries and even 100 more countries within the WHO now include Africa, the Americas, the Eastern Mediterranean, Southeast Asia, and the Western Pacific. The Americas, Southeast Asia, and the Western Pacific are the worst affected regions, with Asia representing 70% of the world's disease burden (WHO, 2020).

Indonesia is a tropical country in Asia, this condition is suitable for Aedes Aegypti mosquitoes to grow and breed, especially when the rainy season comes and many puddles or rainwater shelters become breeding grounds (Hasan et al., 2016). Currently, DHF disease is one of the public health problems in Indonesia, Indonesia's health profile in 2018 reported 65,602 cases of dengue fever, which indicates a decrease in the incidence rate compared to the previous year which reached 68,407 occurrences although the decrease is not so

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significant (Kemenkes RI, 2018). Regions in Indonesia have very different disease patterns (Pongsilurang et al., 2015). Based on incidence rate (IR) data recorded in 2014 reached 39.80 per 100,000 inhabitants; this figure includes data from 34 provinces in Indonesia, and in the following year reached 50.75 per 100,000 inhabitants, while in 2016 the IR figure continued to increase to reach 78.85 per 100,000 inhabitants. When looking at the national target, the IR figure is still above the target of 49 per 100,000 residents (Directorate General of Disease Control and Environmental Health, 2011). According to the East Java Provincial Health Office, the number of cases of DHF incidents in 2018 in East Java reached 9,452, an increase in cases from the previous year which reached 7,866 cases. Also, the DHF pain rate in East Java in 2018 reached 1.2%; this indicates the DHF pain rate still does not meet the target of <1% (Indonesian Ministry of Health 2018). In East Java, one of the areas with the highest DHF cases was Blitar Regency, the last data researchers obtained were the incidence rate (IR) cases of dengue fever in 2016 of 26.8 per 100 thousand residents with a Case Fatality Rate (CFR) of 2.3% (Indonesian Ministry of Health, 2017).

The higher incidence of DHF in various regions of Indonesia is driven by several factors such as population density, the higher number of humans than the higher human chance of being bitten by the Aedes Aegypti mosquito. This is one of the background causes of DHF (Pongsilurang et al., 2015). According to Masrizal and Sari (2016), DHF has a significant relationship with population density. Chandra (2019) found one of the factors that can influence the incidence of DHF is population density. It is also explained that the high population density is directly proportional to the incidence of DHF in the area (Chandra, 2019). The increasing population and spread of dengue fever in Indonesia are also due to the high mobility of the population, the development of urban areas, changing climate, increasing population, and changes in population distribution (Haryanto, 2018).

The high case of dengue fever undeniably occurs due to the presence of Aedes Aegypti mosquito. Aedes mosquitoes themselves have a life cycle that is from the form of eggs, larvae, pupae, to adult mosquitoes. This mosquito lays eggs or chooses a place in clean, clear, and calm water usually found in water shelters inside or outside the house with its open conditions (Ridha et al., 2013). Alternatives to control are needed, especially in areas with high and persistent transmission, namely city or district areas that have a high incidence rate (IR), this is related to controlling the prevalence of DHF cases because it requires the observant and fast treatment of diseases (Qi et al., 2015).

The purpose of this study was to analyze the correlation between free larvae index and population density with incidence rate (IR) and dengue fever (DHF) in Blitar Regency in 2013-2017.

METHOD

This research is quantitative research by conducting secondary data processing from year to year or called time-series sourced from the Blitar District Health Office covering all sub-districts in the Blitar Regency, which consisted of 22 sub-districts in 2013-2017. Incidence rate (IR) and free larvae index data are obtained from the Blitar District Health Office while population data are obtained from the Central Bureau of Statistics. Data collection was conducted after obtaining a research license from the National Unity and Political Agency of East Java Province and Blitar Regency as well as the use of secondary data by related agencies.

The data obtained are then categorized incidence rate of DHF cases which is the number of cases/number of at-risk population per 100,000 residents in the district of IR <20 per 100,000 inhabitants and IR > 20 per 100,000, then the population density with Medium 500-1249 people/km^2 criteria rarely <500 people/km^2, solid 1250-2499 people/km^2, very dense 2500-3999 people/km2, free larvae index categorized as free larvae index (= ≥ 95%) and not free larvae index (= < 95%). Map creation in this study uses the QGIS application. The test used in analyzing the relationship between free variables is incidence DHF rate and bound variables, namely free larvae index and population density, were conducted with Spearman correlation test and 95% trust level. This research has been licensed by the ethics committee of the Faculty of Public Health Airlangga University with the number 571/EA/KEPK/2018.

RESULT

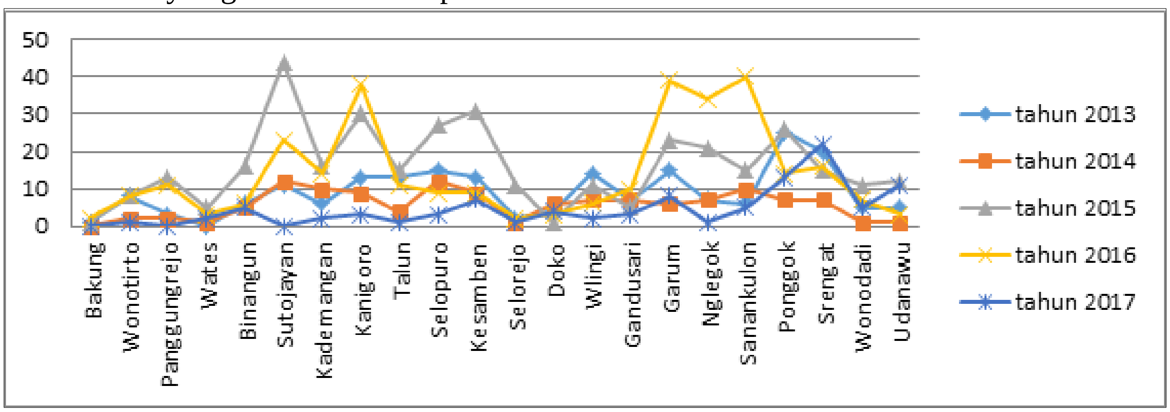

Figure 1. Graph of Dengue Dengue Fever Incidence per District in Blitar Regency in 2013-2017

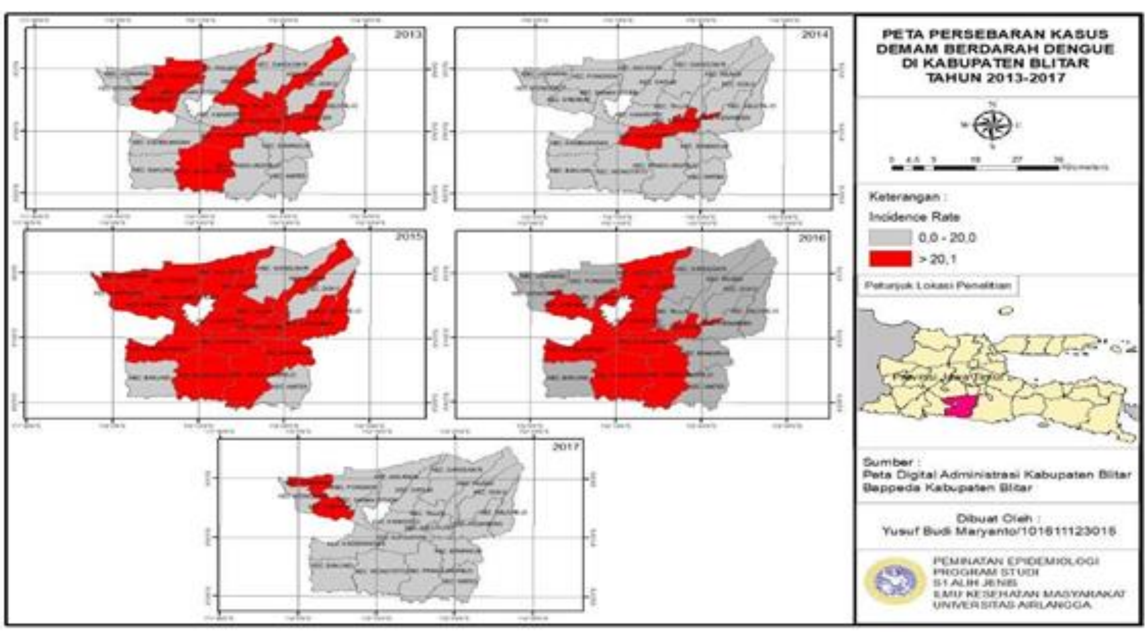

Figure 2. Map of the Incidence Rate Distribution of Dengue Hemorrhagic Fever Cases in Blitar Regency, 2013-2017

Distribution of Incidence Rate of Dengue Dengue Fever Cases in Blitar Regency

Blitar Regency is one of the endemic areas of dengue fever cases in East Java. This can be known with the high incidence of dengue fever every year. In the data of dengue fever cases in 2013-2017, although every year the trend of DHF incidence shows a decrease, Blitar Regency is still one of the regions that have cases in the high category.The number of dengue fever cases in Blitar Regency in 2013-2017 is likely to increase and decrease (Figure 1). Based on the data shown in Figure 1, 2015 became the year with the highest dengue fever cases which was 357 cases and in 2016 with 308 cases, then, in 2017, it tended to decrease from the previous year. The highest number of cases in the last five years is found in three sub-districts, namely Kanigoro sub-district with 93 cases (8.5%), Garum sub-district with 91 cases (8.4%), and Sutojayan Sub-District with 90 cases (8.3%). Dengue fever cases can be known by incidence rate which is the frequency of infectious diseases in the community in a region and at any given time compared to the number of at-risk populations. Based on the map of dengue fever cases in Blitar Regency in Figure 2, the average case of dengue fever during 2013-2017 with a value of more than 20 per 100,000 inhabitants is in eight sub-districts, namely, Sutojayan Sub-district 37.7 per 100,000; Selopuro sub-district 31.1 per 100,000 residents; Kesamben sub-district 28.3 per 100,000; Garum sub-district 28.2 per 100,000; Sanankulon sub-district 27.3 per 100,000 inhabitants; Srengat sub-district 24.7 per 100,000 inhabitants; Kanigoro Sub-district 24.3 per 100,000 inhabitants; and Nglegok Sub-district 20.1 per 100,000 inhabitants. The incidence rate of DHF cases is lowest in Bakung sub-district with 3.1 per 100,000 inhabitants.

Table 1. Average IR Figure per Year

Year	Average IR (per 100.000 population)
2013	17,5
2014	11,1
2015	31,2
2016	26,8
2017	19

Source : Blitar District Level Health Office

According to Table 1, dengue fever cases in the past five years decreased in 2014 and 2017. The peak case of DHF disease occurred in 2015; almost all districts have an IR value of more than 20 per 100,000 inhabitants. In 2016, there were cases of dengue fever on a high scale even though the number was not as large as in 2015. This is likely due to the 5-year cycle of dengue fever cases that also occur in several regions in Indonesia with different year sizes.

Distribution of Free Larvae Index in Blitar Regency

Based on the data of the Blitar District Health Office in Table 2, it is found that free larvae index in Blitar Regency every year changes both down and up. Here is the average free larvae index data in Blitar Regency every year

Table 2. Average Number of Free Larvae Index per Year

Year	Average Free Larvae Index
2013	80.5
2014	81.5
2015	79.9
2016	76.5
2017	78.9

Source : Blitar District Level Health Office

Figure 3 shows the map of the distribution of free larvae index figures in Blitar Regency, which illustrates that, overall, only a small number of districts in Blitar Regency that have a value of free larvae index > 95% and an average of five years shows the figure <95%. It is observed a decrease in free larvae index figures, which indicate a positive trend;, this is indicated by the council in 2013 to 2015 which has five sub-districts that reached the target, in 2016 increased by only two sub-districts and, in 2017, there were no sub-districts with free larvae index > 95%.

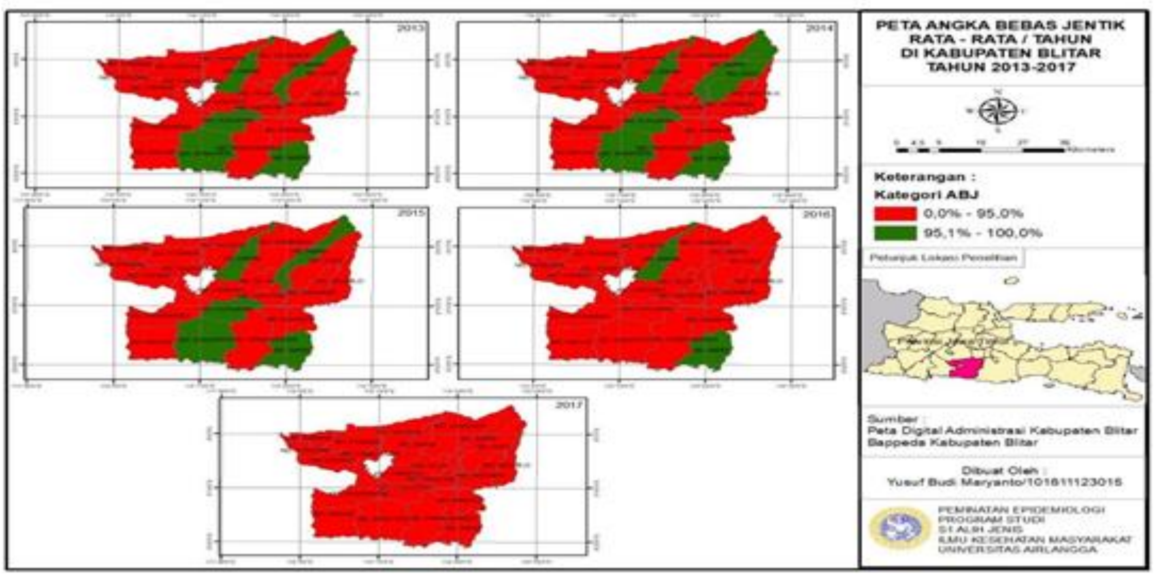

Figure 3. Map of Free Larvae Index Distribution in Blitar Regency 2013-2017

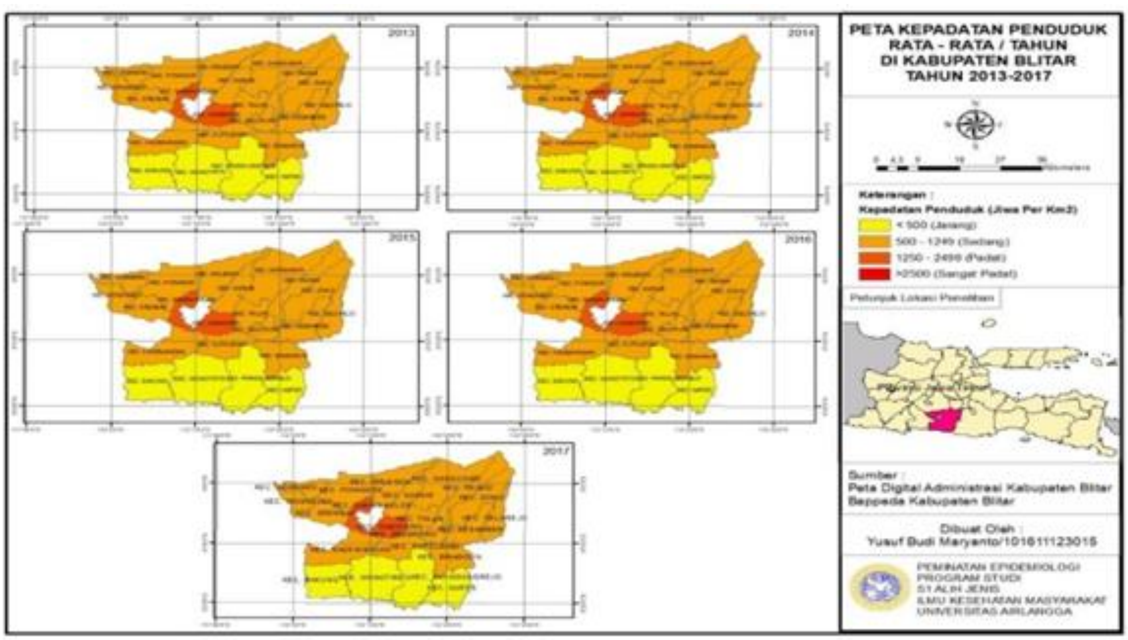

Figure 2. Map of the Incidence Rate Distribution of Dengue Hemorrhagic Fever Cases in Blitar Regency, 2013-2017

Population Density in Blitar Regency

The Office of the Central Bureau of Statistics of Blitar Regency noted that the population over a period of five years, namely 2013 to 2017, increased. It can be seen in Table 3 that the average increase occurred from 2013 to 2017 and reached 12.8

million people. The increase or increase in the population occurs each year with various causative factors, one of which is the large number of people who migrate (displacement of residents) from other districts/cities to Blitar Regency.

Table 3. Average Population Density per Year

Year	Average Population Density (People/ km^2)
2013	837.6
2014	841
2015	844.6
2016	847.5
2017	850.4

Source : Central Bureau of Statistics Blitar District

Figure 4 shows a map of the distribution of population density in the Blitar Regency which tends to have similarities from 2013 to 2017. The Kanigoro and Sanankulon sub-districts are densely populated areas and there are four sub-districts in the southern Blitar region with sparse population density. The district with the highest average population density is 1,665 people/km^2, the lowest population density is in the Wonotirto sub-district of 217 people/km^2. Overall data over a period of five years show the average population density in the Blitar Regency is 844 people/km^2. Several other factors that are the reason for the increase in population in the Blitar Regency include economic, social, cultural, natural resources, and good geographical conditions, as well as the number of natural and artificial tourist attractions found in Blitar Regency.

Bivariable Analysis

The test results obtained based on the data of each variable found that the incidence rate DHF variable with a population density of p = 0.002; this indicates that $p < \alpha$, which means there is a relationship between the two variables; then obtained r (correlation value) of 0.619 with positive value shows a moderate relationship between incidence rate and population density. Furthermore, analysis of the relationship between variable incidence rate DHF and free larvae index found p = 0.603, this indicates $p > \alpha$ which explains that the result of the analysis of the relationship of the two variables is that there is no significant relationship (Table 4).

Table 4. Bivariate Analysis

Variable	p-Value	R	Desc.
Free Larvae Index	0.603	-0.117	There was no correlation
Population Density	0.002	0.619	There was a correlation

DISCUSSION

Incidence Rate Relationship with Free Larvae Index

An indicator of the presence of the Aides Aegypti mosquito population in an area is the presence of Aaides Aegypti larvae in the area. The percentage of the number of houses not found having larvae in them against the total number of houses inspected is the definition of free larvae index (Directorate General of Disease Control and Environmental Health, 2011). The density of DHF disease vectors can be seen using several sizes, one of which is a free larvae index based on the house index, but this figure is neither environmental sanitation nor containers that are likely to be the breeding ground for dengue fever vectors, so it cannot describe how large is the vector breeding place for dengue fever. Based on the data, there are several sub-districts with high IR values and high free larvae index values: Garum, Sutojayan, and Kesamben sub-districts. This is a note, in theory, that the value of free larvae index high incidence rate of dengue fever cases should tend to be low because this variable will be the opposite, as is the case with research in Jember Regency which states that free larvae index is inversely proportional to dengue fever cases (Kurniawati et al., 2015). This phenomenon can occur due to some technical errors during the reporting process, or because of the implementation of larvae monitoring that has not been running to the maximum.

Results obtained from a Spearman correlation analysis showed no meaningful relationship between DHF incidence rate and free larvae index in Blitar Regency with p-value = 0.603. This result is in line with Murdani et al.'s (2017) research which suggests that there is no relationship between free larvae index and DHF Event. Chandra’s (2019) research conducted in Jambi City also found that free larvae index's achievement does not affect DHF events and also explained that it can occur because DHF transmission can occur due to other factors. TPrasetyowati and Kushartanti (2019) also explained in their research in Semarang that the amount of free larvae index descriptively does not affect DHF events when viewed in a scriptive way. According to the explanation, this phenomenon can be caused in part because house sampling has not been done regularly. Contrary to previous findings, research in Magetan Regency found that free larvae index variables influenced DHF events in the various sub-districts studied (Ghafarul, 2015). According to Kinansi et al. (2017). the condition of an area whose free larvae index has not reached or is less than 95% has a risk in the increased incidence of DHF. According to Kurniawati and Yudhastuti (2016)there is a link between free larvae index and DHF event, although the analysis results show a weak relationship, according to the study this occurs because not all larvae of Aedes mosquitoes can survive until becoming adult mosquitoes . The low reach of free larvae index shows that there are still many larvae found in each house, and, according to research conducted by Anggraini (2018), there is a meaningful link between the presence of Aedes larvae and the incidence of DHF .

No cure or vaccine for the DHF virus has been found, making preventive efforts one of the most effective DHF disease control strategies (Directorate General of Disease Control and Environmental Health, 2007). The dengue fever eradication strategy is currently focused on dengue fever vectors. Another thing that is noticed is that the size of the larvae index before and after the control can be used to study the results of the vector control. Mosquito Nest Eradication Program is one of the options in DHF control measures, an activity that has been carried out in Indonesial its implementation can be carried out by various levels of age and from all levels of education. Free larvae index is the benchmark for the success of the PSN program with free larvae index = 95% expected cases of events and transmission can be prevented (Kemenkes RI, 2016). However, free larvae index in Blitar Regency in 2013-2017 experienced a bad trend that did not reachthe target = 95%. Many things can background the phenomenon that occurs in Blitar Regency, one of them can be due to larvae monitor implementers who have not met the national standards that have been set (Suryani, 2018). In this case, the movement of one house one larvae monitor (Jumantik) was launched by the government for continuous enrichment of PSN with 3M plus as the core message carried out by the community (Kemenkes RI, 2016).

Relationship between Incidence Rate and Population Density

Population density can be interpreted as a condition in which the human julmlah at a certain space boundary continues to increase compared to the area it occupies thus creating dense space conditions. From a descriptive description of the average incidence rate (IR) of dengue fever cases associated with population density, it can be known that a high population density of >1000 people/km2 will be comparable to the high number of dengue fever cases. Density and population are among the factors affecting the high incidence rate of DHF(Paomey et al., 2019). This is related to the flying distance of DBD disease vectors, namely Aedes mosquitoes that have a flying distance of < 50 meters per day (Directorate General of Disease Control and Environmental Health, 2007). A report by the CDC says that the flying range of Aedes mosquitoes can reach ≤ 200 meters (CDC, 2010). If it is associated with a condition of high population density, then it can be a risk factor for the transmission of dengue fever.

Based on the results of the analysis, it obtained a value of $p = 0.002$ which when compared ($p < 0.05$) indicates that there is a meaningful relationship between dengue fever cases with population density and from r (correlation value) obtained $r = 0.619$, which means a moderate relationship between the two variables . The results are in line with research in Karang Malang sub-district conducted by Setyaningsih and Setyawan (2014) who explained the relationship between DBD case distribution and population density. Other similar research explains that population density has a moderate and positive pattern with dengue fever cases (Rahmi and Sari, 2017). This is in line with research outside Java Island area in Palopo City which found a link between DBD incidence and population density (Ashlihah et al., 2016). The spatial picture of dengue fever sufferers in Bitung City based on population density shows that there is a link between population density and cases of dengue fever spatially, in this case that the population density is directly proportional to the number of cases of DBD (Paruntu et al., 2018). Similarly, Masrizal and Sari's (2016) research explains the link between DBD events and population density in Tanah Datar Regency of West Sumatra Province.

Several other studies have different results related to this, namely in a study in the working area of Umbulharjo Health Center Yogyakarta, Setiawan et al. (2017) explained that there is no relationship of dengue fever incidence with population density . In A study conducted in Jakarta, it was also suggested that, spatially, the distribution of the population did not Affect the distribution of existing DHF cases (Nandini and Susilowati, 2017). Handayani et al. (2017) also explained the same in THEIR research in Padang city, that there is no link between population density and DBD event.

The condition of high population density resulting in the distance between houses of the population is increasing the risk of DBD disease spreading higher, because the flying distance of dengue fever mosquito vectors will be shorter; in addition, the risk of exposure to DBD will also increase when members of

one residence are exposed to DBD because it creates conditions that support to transmit dengue fever disease (Ratri et al., 2017). This condition is also supported by the rapid mobilization of the population to and from various regions with modern means of transportation (Chandra, 2019). High density conditions can be caused by various factors that occur in various regions. either in the city or in the suburbs (Handayani et al., 2017). This is supported by many studies that find high population density in various areas. It is undeniable that humans are carriers of dengue virus, which means that the higher the human population, the higher the risk of transmission. All of these things can occur if the prevention of the development of A. Aegypti mosquitoes is not included in the handling of the problem (Chandra, 2019).

Preventive measures in the transmission of DBD by suppressing the rate of development of Aedes Aegypti mosquitoes are absolute of course, but, in addition, building public awareness by counseling about the impact of population density becomes another important point (Handayani et al., 2017).

The advantage of this study is that the data used are over a period of five years, which is expected to present existing conditions and, based on the data, a map was created using QGIS to make more clearly visible the distribution area. However, there are some flaws in this study, namely the last year of the data used is from 2017.

CONCLUSION

Public health problems are still found in Blitar Regency today, one of which is dengue fever, which makes it one of the areas with the highest DHF incidence rated in East Java. The distribution of incidence rate of DHF disease cases in Blitar Regency in 2013-2017 mostly reached >20 per 100,000 residents, with the free larvae index having an average value of < 95% and the population density is increasing year on year. But, in the five years, the population density in Blitar Regency belongs to the moderate category with the highest average figure reaching 850.4 million inhabitants in 2017. The results of Spearman's correlation analysis found no significant link between the incident rate of DHF disease and the free larvae index, while the relationship between the incident rate of DHF disease and population density found a significant relationship with a positive pattern. Prevention measures are very important in reducing the incidence of DHF and the implementation of government programs in suppressing the spread of DHF should be done appropriately, as well as building awareness of the community in preventing the development of Aedes Aegypti mosquitoes, one of which is to do 3M. In addition, the government is considered necessary to counsel the impact of high population density and the equalization of the population so that there is no population density resulting in an increased risk of dengue fever events in the region.

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