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The Influence of Environmental Factors on the Incidence of Malaria on the Coast of Malacca Regency

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Environmental conditions that support malaria transmission include the physical environment such as temperature, air humidity, rainfall, wind speed, altitude of a place or location and sunlight. The biological environment which is the environment of flora and fauna such as: mangroves, mosses and algae can affect the life of mosquito larvae. The presence of plants can protect larvae from sunlight and attacks from other living things. The mosquito population in an area is also determined by the presence of various types of larva-eating fish such as tin head fish, tilapia and tilapia. The presence of large livestock such as cows and buffaloes can reduce the number of mosquito bites in humans if the cage is located close to the house. The purpose of this study is to determine and analyze the Influence of Environmental Factors on the Incidence of Malaria on the Coast of Malacca Regency. The type of research used is quantitative research with Case Control design. The population in the study was all people living in coastal areas covering the working areas of the Weoe and Lamea health centers who carried out microscopic and RDT thick drops blood preparation examinations based on malaria register data at the Puskesmas in 2020. The case sampling technique in this study was to use a total sampling technique saturated with a total of 73 local positive malaria cases (indigenus) recorded in 2020 at the Weoe and Alkani health centers, while the control sample was set at a ratio of 1: 1, so that a large sample of 73 people was obtained. So the total sample number is 146 people. The data was then analyzed using a simple logistic regression test. The results showed that there was an influence of mosquito breeding sites, mosquito breeding sites on the incidence of malaria on the coast of Malacca Regency with a p.value value<α (0.05). While the variables Temperature, Humidity, Large livestock ownership had no influence on the incidence of Malaria (p > 0.05).

1. Introduction

Malaria is still a burden and global disease trend In 2016, 91 countries reported 216 million cases of malaria, an increase of 5 million cases compared to 211 million cases in 2015. Most malaria cases are in Africa (90%) followed by Southeast Asia (7%) and the Eastern Mediterranean region (2%). Global malaria deaths in 2016 reached 445,000 deaths compared to 446,000 in 2015. The largest contributor to death from the African region (90%) followed by the Asian region (6%) (WHO, 2017).

In Indonesia, malaria is still one of the public health problems that can cause death, especially in high-risk groups, namely infants, children under five, pregnant women, besides that malaria directly causes anemia and can reduce work productivity. Although the Annual Parasite Incidence (API) which is an indicator of the success of malaria control efforts tends to decrease in the time bracket of 1990-2015 from 4.69 per 1000 population to 0.85 per 1000 population, there is still a disparity in malaria incidence in 5 (five) Provinces of Eastern Indonesia namely Papua, West Papua, East Nusa Tenggra, Maluku and North Maluku (Ministry of Health RI, 2018). As a result, it can reduce productivity and cause economic losses and contribute greatly to infant, child and adult mortality. Malaria infection during pregnancy can cause abortion and Low Birth Weight (BBLR) (WHO, 1997 in Sutarto, 2017)

Malaria cases in NTT Province in 2018 were 18,053 cases with an Annual Parasite Rate (API) of 3.34 per 1000 population and in 2019 as many as 12,723 cases with an API of 2.16 per 1000 population. While Malacca Regency malaria cases in 2018 were 357 with API 2/1000 population increased to 658 cases in 2019 with API 3.51/1000 population (Dinkes Malacca, 2019).

Malacca Regency consists of 12 sub-districts and 1 (one) sub-district of which is located in the coastal area, namely Wewiku sub-district with 2 (two) puskesmas working areas, namely Weoe and Alkani Health Centers. Wewiku District is the district that contributes the most malaria cases in Malacca Regency every year. Profile data of the Malacca District Health Office for 3 (three) consecutive years from 2017-2019 shows that the highest malaria cases are in Wewiku District with the following details: in 2017 there were 213 cases from a total of 355 people, in 2018 there were 206 cases from a total of 357 people and in 2019 there were 571 cases from a total of 658 people. Meanwhile, in 2020 there were 73 cases out of a total of 93 people.

Environmental factors have a major influence on the incidence of malaria in an area, because if environmental conditions are in accordance with the breeding place, mosquitoes will

multiply rapidly (Setya, Faulah, et al, 1997 in Sutarto, 2017). Environmental conditions that support malaria transmission include the physical environment such as temperature, air humidity, rainfall, wind speed, altitude of place or location and sunlight (Sutarto, 2018, Hanida, 2018, Efraim et al, 2019). The biological environment which is the environment of flora and fauna such as: mangroves, mosses and algae can affect the life of mosquito larvae. The presence of plants can protect larvae from sunlight and attacks from other living things. The mosquito population in an area is also determined by the presence of various types of larva-eating fish such as tin head fish, tilapia and tilapia. The presence of large livestock such as cows and buffaloes can reduce the number of mosquito bites in humans if the cage is located close to the high house (Ministry of Health, 1999 in Sutarto, 2017, Febriani, Devita, 2011 in Gilang YP, 2015) and the chemical environment consisting of acidity, salinity and dissolved oxygen (Gilang YP, 2015)

Environmental factors and malaria control efforts that are not yet local to the extent are thought to have a role in the increase in malaria cases on the coast. This is a challenge for the Malacca District Government to achieve malaria elimination by 2030. By looking at these problems, researchers are motivated to examine the Influence of Environmental Factors on the Incidence of Malaria on the Coast of Malacca Regency.

2. Research Method

This type of research is quantitative research with case control design. This research was carried out at the Weoe and Alkani health centers in January-April 2021. The population in the study was all people living on the coast in the working area of the Weoe and Lamea health centers who carried out microscopic and RDT blood preparation examinations based on malaria register data at the Puskesmas in 2020. The case population was 73 people, while the control population was 1,652 people. Case samples in this study were malaria patients with positive malaria blood preparation test results, while control samples were non-malaria patients with negative malaria blood preparation test results. The case sampling technique in this study was to use a saturated total sampling / sampling technique, namely all local malaria cases (indigenus) recorded in 2020 at the Weoe and Alkani health centers as many as 73 people, while the control sample was set with a ratio of 1: 1, so that a large sample of 73 people was obtained. So the total sample number is 146 people.

Data collection techniques using questionnaires, the factors studied include air temperature, air humidity, mosquito breeding sites, mosquito resting places, large livestock ownership of malaria incidence on the coast of Malacca Regency. Data analysis included univariate, bivariate

with simple logistic regression tests.

3. Result and Discussion

Table 1. The influence of environmental factors on the incidence of malaria

Variable	Incidence of Malaria				p.value
	Positive		Negative		
	N	%	n	%	
Temperature					
Qualify	40	54,8	47	64,4	
Not eligible	33	45,2	26	35,6	0,235
Total	**73**	**100**	**73**	**100**	
Moisture					
Qualify	68	93,2	70	95,9	
Not eligible	5	6,8	3	4,1	0,472
Total	**73**	**100**	**73**	**100**	
Mosquito Breeding Place					
Available	47	64,4	26	35,6	
Not available	26	35,6	47	64,4	0,001
Total	**73**	**100**	**73**	**100**	
Mosquito rest area					
Available	47	64,4	28	38,4	
Not available	26	35,6	45	61,6	0,002
Total	**73**	**100**	**73**	**100**	
Large Livestock Ownership					
Available	36	49,3	27	37,0	
Not available	37	50,7	46	63,0	0,134
Total	**73**	**100**	**73**	**100**	

Based on table 1 above, the results of statistical tests of bivariate analysis (simple logistic regression) between air temperature variables and malaria incidence obtained a value of p.value = 0.235 which means there is no significant influence between air temperature on malaria incidence. The results of statistical tests of bivariate analysis (simple logistic regression) between air humidity variables and malaria incidence obtained a p.value = 0.472 which means there is no significant influence between air humidity on malaria incidence. The results of statistical tests of bivariate analysis (simple logistic regression) between the variables of mosquito breeding sites and malaria incidence obtained a value of p.value = 0.001 which means that there is a significant influence between mosquito breeding sites on malaria incidence. The results of statistical tests of bivariate analysis (simple logistic regression) between mosquito resting places and malaria incidence obtained a value of p.value = 0.002

which means that there is a significant influence between mosquito resting places on malaria incidence. The results of statistical tests of bivariate analysis (simple logistic regression) between large livestock ownership and malaria incidence obtained p.value = 0.134 which means that there is no significant effect between large livestock ownership on malaria incidence.

Discussion

The effect of temperature on the incidence of malaria on the coast of Malacca Regency

Air temperature greatly affects the short length of the sprogony cycle or extrinsic incubation period. The optimum temperature ranges from 20-300C. The higher the temperature (to some extent) the shorter the extrinsic incubation period and vice versa, the lower the temperature, the longer the extrinsic incubation period. The effect of temperature is different for each species, at 26.70C the extrinsic incubation period is 10-12 for P. falciparum and 8-11 days for P. vivax, 14-15 days for P. malariae and P. ovale

The results of the analysis showed a p value of 0.239 (p < 0.05) which means there is no significant influence between temperature on the incidence of malaria on the coast of Malacca Regency and OR of 0.671 which means respondents who have a qualified environmental temperature have a 0.67 times chance of malaria.

There is no influence of temperature on the incidence of malaria in the study area because the temperature of coastal areas is relatively ranging from 23 ° C - 30 ° C which is the optimal temperature for the sporogony cycle, which is the time when mosquitoes are more active in biting. The Weoe and Alkani health centers are located along the coast and there is no noticeable temperature difference between the case and control environments. There were 87 respondents in both cases and controls at temperatures eligible for mosquito growth.

This study is in line with research conducted by research conducted by (Mirontoneng et al., 2014) which states there is no relationship between temperature and the incidence of malaria in children in the PKM Tona Working Area, Tahuna District, Sangihe Regency. Strengthened by research conducted by (Hermanto Putra, 2020) which states there is no relationship between temperature and malaria incidence at the Leuser health center, Southeast Aceh Regency, Aceh Province.

This study is not in line with research conducted by (Watofa et al., 2018) which states there is a significant relationship between temperature and malaria incidence in the Lake Sentani area,

Jayapura Regency, Papua Province. Strengthened by research conducted by (Resiany Nababan &; Sitti Rahmah Umniyati, 2018) which states there is a relationship between temperature and the incidence of malaria in the highest endemic areas in Central Java. Research conducted by (Efraim Watmanlusy, 2019) also states that there is a relationship between temperature and the incidence of malaria in Seram District, Maluku.

The effect of air humidity on the incidence of malaria on the coast of Malacca Regency
Air humidity affects the vulnerable age of mosquitoes, a humidity level of 60% is the lowest number to allow mosquitoes to live. Low air humidity shortens the life of mosquitoes and reduces the chance of malaria parasites completing their extrinsic incubation period, humidity also affects the speed of breeding, biting and resting habits, at higher humidity more active and more frequent biting, thus increasing malaria transmission.

The results of the analysis conducted showed a p value of 0.472 ($p < 0.05$) which means there is no significant influence between air humidity on the incidence of malaria on the coast of Malacca Regency with an OR of 0.583 which means respondents who have qualified environmental humidity have a 0.58 times chance of malaria.

The absence of the influence of air humidity on the incidence of malaria in the study area which is a coastal area with humidity ranging from 60-90% is the optimal humidity level for mosquitoes to be more active and bite more often which is at risk of contracting malaria by infective anopheles mosquitoes. The humidity level in the study area between case respondents and controls there were 138 people who were at optimum humidity (70-80%), this showed that there was no difference in air humidity levels between the environment of case respondents and controls.

This research is in line with research conducted by research conducted by (Mirontoneng et al., 2014) which states there is no relationship between humidity and the incidence of malaria in children in the PKM Tona Working Area, Tahuna District, Sangihe Regency. Strengthened by research conducted by (Efraim Watmanlusy, 2019) which states there is no relationship between humidity and the incidence of malaria in Seram District, Maluku.

This study is not in line with research conducted by (Watofa et al., 2018) which states there is a significant relationship between humidity and malaria incidence in the Lake Sentani area, Jayapura Regency, Papua Province. Strengthened by research conducted by (Resiany Nababan &; Sitti Rahmah Umniyati, 2018) which states there is a relationship between humidity and

the incidence of malaria in the highest endemic areas in Central Java.

The influence of mosquito breeding sites on the incidence of malaria on the coast of Malacca Regency

The physical environment associated with the breeding place of malaria-transmitting mosquitoes (Anopheles) is in puddles, either fresh water or brackish water depending on the type of mosquito (Ministry of Health RI, 1999). In coastal areas, most mosquito breeding sites occur in ponds that are not managed properly, the presence of illegal logging of mangroves is a potential habitat for mosquito breeding. Sundaicus and many rivers covered with sand (lagun) which is the breeding ground of An mosquitoes. Sundaicus.

The results of the analysis showed a p value of 0.001 (p < 0.05) which means that there is a significant influence between mosquito breeding sites on the incidence of malaria on the coast of Malacca Regency with an OR of 3.268 which means respondents who have mosquito breeding sites have a 3.26 times chance of getting malaria.

The influence of mosquito breeding sites on the incidence of malaria at the study site because in the study location many mosquito breeding sites are in accordance with the characteristics of coastal areas such as "swamps, lagoons, ponds, rice fields, sewers or waterways with a distance of ≤ 500 m. from the respondent's house.

This research is in line with research conducted by (Resiany Nababan &; Sitti Rahmah Umniyati, 2018) which states that there is a relationship between the place of brood and the incidence of malaria in the highest endemic area in Central Java. Strengthened by research conducted by (Harmendo, 2008) which states there is a relationship between the place of brooding and the incidence of malaria in the working area of the Kenanga health center, Sungailiat District, Bangka Regency. Research conducted by Pratiwi, et al (2016) stated that there is a relationship between the existence of breeding places and the incidence of malaria at the Koka II health center, Kulon Progo. Research conducted by (Efraim Watmanlusy, 2019) also states that there is a relationship between the place of brooding and the incidence of malaria in Seram District, Maluku

This research is not in line with research conducted by (Hasan Husin, 2007) which states there is no relationship between the place of brood and the incidence of malaria at the Sukamerindu health center, Sungai Serut District, Bengkulu City. Reinforced by research conducted by (Wardah, Nurjazuli, Hanan Lanang Dangiran, 2017) which stated there was no relationship

between the place of brood and the incidence of malaria at the Salaman 1 health center, Magelang Regency.

The effect of mosquito resting places on the incidence of malaria on the coast of Malacca Regency

The biological environment is one of the determinants that provide a vehicle for mosquitoes to develop, various good plants on land such as large plants and form a plantation or forest area will function to block the entry of sunlight to the soil surface, thus the lighting will be low, low temperature and high humidity. Conditions like this are very favored by mosquitoes to rest after sucking host blood while picking up the maturation process of their eggs, for example the mosquito Anopheles balabacensis, very happy to live in humid and low-lighting areas, such as corn gardens, bananas, bushes, forests and shrubs.

The results of the analysis conducted showed a p value of 0.002 (p < 0.05) which means that there is a significant influence between mosquito resting places on the incidence of malaria on the coast of Malacca Regency with an OR of 2.905 which means respondents who have mosquito resting places have a 2.90 times chance of getting malaria. The results of interviews based on questionnaires showed that respondents' houses in the study area had many mosquito resting places ≤ 500 m away such as banana gardens, corn gardens, shrubs, forests, unmaintained yards.

This research is in line with research conducted by (Resiany Nababan &; Sitti Rahmah Umniyati, 2018) which states there is a relationship between mosquito resting places and the incidence of malaria in the highest endemic areas in Central Java. Strengthened by research conducted by (Hasan Husin, 2007) which states there is a relationship between mosquito resting places and the incidence of malaria at the Sukamerindu health center, Sungai Serut District, Bengkulu City. Research conducted by (Efraim Watmanlusy, 2019) also states that there is a relationship between mosquito resting places and the incidence of malaria in Seram District, Maluku.

This research is not in line with research conducted by (Wardah, Nurjazuli, Hanan Lanang Dangiran, 2017) which states there is no relationship between mosquito resting places and the incidence of malaria at the Salaman 1 health center, Magelang Regency. Strengthened by research conducted by (Harmendo, 2008) which states there is no relationship between mosquito resting places and the incidence of malaria in the working area of the Kenanga health center, Sungailiat District, Bangka Regency.

The effect of large livestock ownership on the incidence of malaria on the coast of Malacca Regency

The presence of large livestock such as cows and buffaloes can reduce the number of mosquito bites in humans, if the animal cage is placed outside the house (Ministry of Health RI.2003). The results of the analysis showed a p value of 0.134 (p < 0.05) which means there is no significant influence between livestock ownership on the incidence of malaria on the coast of Malacca Regency with an OR of 1.658 which means respondents who have large livestock pets in the home environment have a 1.65 times chance of getting malaria.

The interview results showed that respondents who had fewer large livestock so that zoophilic mosquitoes instead of biting animals but more often biting humans because there were no large livestock around the house that acted as a barrier. In addition, in the study it was also found that respondents who owned livestock were not caged near the house but they tied them in the garden.

This research is in line with research conducted by (Ali Sukamto, R. Budi Haryanto, 2014) which states there is no relationship between the presence of livestock and malaria in the working area of the Kokap 2 health center, Kokap District, Kulon Progo Regency. This research is reinforced by research conducted by (Resiany Nababan &; Sitti Rahmah Umniyati, 2018) which states there is no relationship between the presence of livestock and the incidence of malaria in the highest endemic areas in Central Java. Research conducted by (Wardah, Nurjazuli, Hanan Lanang Dangiran, 2017) also stated that there was no relationship between the presence of livestock and the incidence of malaria at the Salaman 1 health center, Magelang Regency.

This research is not in line with research conducted by (Babba, 2007) which states there is a relationship between the presence of livestock with case groups and controls in the Hamadi Health Center area. Reinforced by research conducted by (Susanna &; Eryando, 2010) which states there is a relationship between the presence of large livestock and the incidence of Malaria in rural areas.

4. Conclusion

There is a significant influence between mosquito breeding sites, mosquito resting places on

the incidence of malaria on the coast of Malacca Regency. Suggestions for Weoe and Alkani Health Centers need to conduct counseling related to the dangers of malaria, SBM activities, distribution of mosquito nets to the community and tighten supervision of their use, spraying in people's homes and inviting the community to clean the environment.

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