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# SPATIAL ANALYSIS OF MALARIA ENDEMICITY BASED ON RISK FACTOR MODELS OF VECTOR BEHAVIOR, VECTOR TREATMENT, AND SURVEILLANCE SYSTEM WITH THE POTENTIAL OF MALARIA EVENTS IN MANGGARAI DISTRICT IN 2019

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## ABSTRACT

**Background:** Malaria cases in NTT province continue to decline but until now it is still an endemic area and accounts for around 21% of Malaria cases in Indonesia (NTT Health Office, 2017). In endemic areas, Malaria affects the burden on the health sector both in hospitals and health centers, Malaria also causes economic losses including losses from the tourism sector due to the threat of this disease to tourists. Malaria can also reduce labor productivity and increase the absenteeism of school students where 8% of student absences are due to Malaria (Unicef Kupang, 2016). In the last 5 years, API (Annual Parasite Incidence) in Manggarai district decreased, in 2014 it was 0.22, in 2015 it was 0.16, in 2016 it was 0.19, in 2017 it was 0.09 and in 2018 it was 0.09. And the main requirement for a Malaria-free area is the Annual Parasite Incident (API), or annual parasitic incidents, under one per 1,000 population and there is no case of Malaria in the local population for three consecutive years (NTT Provincial Health Office, 2018). **Objective:** to analyze spatially, individual characteristics, behavior of Anopheles sp. Mosquitoes, breeding places for Anopheles sp. Mosquitoes, surveillance systems that are related to the potential incidence of malaria in Manggarai district. **Method**: This research is quantitative research with analytic observation approach, and case-control design. Case-control is a study conducted by comparing two groups, namely the case group and the control group (Notoatmodjo, 2010). Case-control studies are carried out by identifying case groups and control groups, then retrospectively investigating risk factors that might explain whether cases and controls may be exposed to exposure or not. in this study, data on the potential for Malaria events were identified at this time and then associated with risk factors namely the behavior of vectors (Anopheles sp), vector breeding places (Anopheles sp. mosquitoes), individual characteristics, and surveillance systems. **Results**: bivariate analysis, the variables that had influence were age, sex, occupation, population mobility, presence, type, distance, presence, type, paddy field distance, existence, type, buffalo puddle distance, existence, type, distance like fish, existence, type, gutter distance, existence, type,the distance of buffalo footprints, presence, type, the distance of puddles with p-value <0.25, Anopheles sp. the final model of two variables simultaneously influencing the potential for Malaria events in Manggarai Regency is> 35 years of age having an opportunity of 0.378 times and population mobility, 8,750 times. **Conclusion:** there is a relationship between vector behavior, vector breeding place, population mobility and age of population> 35 years to the potential for malaria in Manggarai district.

**KEYWORDS:** Risk factor model, individual characteristics, vector behavior, vector breeding, and surveillance systems.

## Preliminary

Malaria is an infectious disease caused by Plasmodium protozoan parasites and transmitted through Anopheles mosquito bites. Malaria is the most widespread disease in the world and is endemic, especially in the tropics and subtropics. there were 212 million cases of Malaria occurring globally and as many as 429,000 people died in 2015, most of them children under 5 years old. There are around 91 countries that are still endemic to Malaria in the world in early 2016. The regions with the highest cases of Malaria are in parts of Africa, America, the Middle East, and Asia. the risk of the population being attacked by Malaria in Asia is 1.4 billion. A total of 14.4 million cases of Malaria occurred in the Asian region in 2015. Nine countries that were at high risk of developing Malaria in the Asian region were India, Myanmar, Indonesia, Bangladesh, Bhutan, South Korea, Nepal, Thailand, and Timor Leste. The highest proportion was

achieved by India, 89%, Myanmar 2%, and Indonesia 7% (WHO, 2016).

Global Malaria morbidity rate in 2013-2017 tends to fluctuate, namely 207 million Malaria cases in 2013 to 198 million Malaria cases in 2014. And 200 million Malaria cases in 2015 to 216 million Malaria cases in 2016 and 219 million Malaria cases in 2017). globally, Malaria cases are declining. World Malaria Report 2018 Report has decreased the incidence of Malaria in the world by 8% from 2010 to 2017. As many as 239 million cases of Malaria in 2010. Meanwhile, in 2017 it dropped to 219 cases of Malaria in the world. Data were taken from 91 countries (WHO, 2018).
Indonesia is one of the endemic countries of Malaria in the world. The case of Malaria in Indonesia has actually decreased from year to year, but the figure is still considered high. The results of Riskesdas in 2013 mentioned a decrease in the incidence of Malaria in Indonesia, from 2.9% in 2007 to 1.9%. Although there has been a decrease in the Annual Parasite Incidence (API) nationally, some regions with high Malaria cases still have very high API numbers exceeding the national figures, whereas in areas with low positive Malaria cases often occur Extraordinary Events (KLB) as a result of the case of imported Malaria. Malaria morbidity rate Nationally, from 2013-2018 it tends to decrease, from 1.38 per 1,000 population in 2013 to 0.99 per 1,000 population in 2014. And 0.85 per 1,000 population in 2015 to 0.88 per 1,000 population in 2016 as well as 0.99 per 1,000 population in 2017 to 0.68 per 1,000 population in 2018 (Ministry of Health Republic of Indonesia, 2018).

Even though Malaria cases in NTT province continue to decline but until now it is still an endemic area and accounts for around 21% of malaria cases in Indonesia (NTT Health Office, 2017). In endemic areas, Malaria affects the burden on the health sector both in hospitals and health centers, Malaria also causes economic losses including losses from the tourism sector due to the threat of this disease to tourists. Malaria can also reduce labor productivity and increase the absenteeism of school students where 8% of student absences are due to Malaria (Unicef Kupang, 2016).

In the last 5 years, API (Annual Parasite Incidence) in Manggarai district decreased, in 2014 it was 0.22, in 2015 it was 0.16, in 2016 it was 0.19, in 2017 it was 0.09 and in 2018 it was 0.09. the main requirement for a Malaria-free area is the Annual Parasite Incident (API), or annual parasitic incidents, under one per 1,000 population and there have been no cases of Malaria in the local population for three consecutive years (NTT Provincial Health Office, 2018).

## Method

### Study Design

This type of research is quantitative research with analytic observation approach, and case-control design. Case population in this study were all household heads who lived in potential areas of Malaria (endemic). while the control population in this study are all household heads who live in receptive areas.,

### Sample

The total sample is 204 heads of households. The sampling technique in this study is to use the technique of total sampling/sampling saturation which is the technique of determining the sample if all members of the population are used as samples.

### Instrument

The study used a questionnaire in the form of sheets and also in the form of KoBo Collect and KoBoToolbox. applications on Android phones and Laptops that had previously been studied were included. research steps are determining endemic and receptive areas, filling out questionnaire sheets and attributes (Variables studied) in KoBoCollect and KoBoToolbox on Android and Laptops cell phones in the form of (surveillance officer identity, vector behavior, and vector breed sites), Behavioral survey and breeding places Malaria vector, this activity uses a behavioral survey form, a breeding place for Malaria vector transmitters and interviews of surveillance officers in receptive and endemic areas. These are included in th KoBoCollect and KoBoToolbox applications on Android and Laptops phones. Adult Anopheles Mosquito Survey, Anopheles Mosquito Larvae / Survey, determine and identify the type and characteristics of breeding sites (TP). TP type can be in the form of permanent ponds, ponds, tidal pools, swamps, rice fields, irrigation channels, springs, ponds, and others. while the characteristics of TP, are determined by physical conditions (light, flow, depth, turbidity, etc.), chemistry (salinity, pH), and biology (the presence of animal and plant species). taking the coordinates at the positive place of larvae / mosquitoes, preparing larvae / mosquitoes survey officers, preparing materials and equipment including dipper (dipper), identification

### Data analysis

Data were analyzed statistically by univariate, bivariate, multivariate analysis and risk factor modeling

### Ethical considerations

Research permission was obtained from the Faculty of Medicine, University of Nusa Cendana, Kupang Indonesia. written consent and information were received from all household heads who were respondents. researchers maintain the confidentiality of the respondent's identity, other identifying information.

**Table 1: Characteristics of samples in endemic and receptive areas.**

| Characteristics Respondents | endemic | | reseptifve | | of Total | |
|---|---|---|---|---|---|---|
| | f | (%) | f | (%) | f | (%) |
| **Age** | | | | | | |
| < 35 years old | 25 | 24,5 | 35 | 19,6 | 45 | 22,05 |
| >35 years | 77 | 75,49 | 67 | 80,3 | 159 | 77,9 |
| | 102 | 100 | 102 | 100 | 204 | 100 |
| Gender | | | | | | |
| Men | 86 | 84,3 | 96 | 94,11 | 182 | 89.2 |
| Women | 16 | 15,6 | 6 | 5,8 | 22 | 10.8 |
| | 102 | 100 | 102 | 100 | 204 | 100 |
| **Profession** | | | | | | |
| Farmers | 89 | 87,2 | 78 | 76,4 | 167 | 81.9 |
| Government employees | 9 | 8,8 | 14 | 13,7 | 23 | 11.3 |
| Private | 4 | 3,9 | 10 | 9,8 | 14 | 7.8 |
| | 102 | 100 | 102 | 100 | 204 | 100 |
| **Education** | | | | | | |
| Low (elementary, junior high, high school) | 91 | 89.2 | 88 | 86.3 | 179 | 87.7 |
| Height (PT) | 11 | 10.8 | 14 | 13.7 | 25 | 12.3 |
| | 102 | 100 | 102 | 100 | 204 | 100 |
| **Population Mobility** | 80 | 100 | 58 | 100 | 138 | 100 |

## RESULTS

Table 1. shows that the proportion of potential cases of Malaria by age in the endemic areas was > 77 years or 77% and the smallest potential cases of Malaria at <35 years were 25 people or 24.5%. while the potential of Malaria cases based on age in the most receptive areas at age> 35 years was 82 people or 80.3% and the potential for the smallest cases of Malaria at age <35 years was 20 people or 19.6%

The potential proportion of male Malaria in receptive areas is 96 people or 94.11% higher than the endemic areas of 86 people or 84.3%. the high potential for cases of Malaria in receptive areas is a record for the prevention and eradication program of Malaria in Manggarai regency to be more specific in looking at risk factors in receptive areas and not only in endemic areas so that they can become program considerations in efforts to prevent and eradicate Malaria.

The proportion with low education level in endemic areas was 91 people or 89.2% higher than the level of low education in receptive areas as many as 88 people or 86.3%. the proportion of farmer work in endemic areas is 89 people or 87.2% higher compared to receptive areas in 78 people or 76.4%. while the proportion of potential Malaria to population mobility there is no difference between Malaria and receptive endemic areas.

## DISCUSSION

Based on the results of the Bivariable analysis, it is known that the factors that influence the potential for malaria in Manggarai Regency are as follows:

Age Relationship to Potential Occurrence of Malaria in Endemic and Receptive Areas in Manggarai Regency in 2019.

According to Hendrik L. Blum, health status is influenced by four interrelated and interplaying factors. These four factors are environmental, behavioral, health service, and hereditary factors. Health development is an effort to fulfill one of the basic rights of the people, namely the right to gain access to health services. Health service performance is one of the important factors in efforts to improve the quality of population health. Health care is a direct factor related to the incidence of infectious diseases (morbidity). Individual risk factors that are thought to play a role in malaria infection are age, sex, genetics. Every human being can be infected by a biological agent, Plasmodium. One intrinsic factor that affects human vulnerability is age.

Based on the results of the Chi-square test it can be concluded that people aged> 35 years have a risk of 0.622 times greater for the potential to suffer from Malaria (protective) compared to people aged <35 years, and statistically the age factor influences the potential for Malaria.

This study is different from Sukiswo (2014) there is no difference in the age factor of immunity to malaria infection where with age the immunity increases. This study is in line with the study of Atameha (2018) There is no relationship between age and the incidence of malaria. this study is also different from the research by Notobroto (2016) which shows that there is no meaningful relationship between age and malaria incidence where in this study it is said that age is a confounding factor of malaria incidence, basically anyone can get malaria. In contrast to the study of

Munizar, et al (2015), which states that there is a relationship between age and the physical vulnerability of the community to malaria in the working area of the Lamteuba Community Health Center in Seulimum District, Aceh Besar District.

The high risk of potentially being infected with Malaria in those aged> 35 years in endemic and receptive areas is influenced by decreased immunity, and if frequent contact with Anopheles sp. Mosquitoes, parasite plasmodium easily infects the body of people aged> 35 years.

Relationship of Population Mobility to Potential Malaria Occurrence in Endemic and Receptive Areas in Manggarai Regency in 2019.

Mobility and migration of people from villages to cities allow transmission of Malaria, this is possible because new residents bring the disease from their regions or vice versa. Areas, where the population does not have immunity to the disease, will contract the disease under the migrants or vice versa. Migrants from new areas or the area of origin and bring the original disease in the area of origin that does not have the disease, for example transmigrants, bias also people who move from low endemic areas to high malaria endemic areas. This will endanger his health if not protected.

The Chi-square test results concluded that the Population Mobility Group who had left the area had a risk of 2,871 times greater for potentially suffering from Malaria compared to people who had never left the area. Statistically, the factor of Population Mobility influences the potential for Malaria.

This research is in line with Prastiawan (2019). There is an influence between the frequency of mobility on the incidence of imported malaria in Watulimo District, Trenggalek Regency. People with high mobility frequency (≥ 3 times) have a risk of 16,670 times greater exposure to imported malaria compared to people who have low mobility frequency (1-2 times). This study is in line with Sibala (2013) showing that there is an influence between the frequency of mobility and the incidence of malaria. According to Santi, et al. (2011) that the high intensity of mobility towards malaria-endemic areas will indirectly increase the chance of contracting malaria in endemic areas. However, it is different from Anggraini's research (2014) which shows that there is no influence between the frequency of mobility on the incidence of imported malaria. The results of the study of Santi, et al. (2011) shows that the longer stay in endemic areas, will indirectly increase the chances of contracting malaria in endemic areas. The duration of stay is short or long in malaria- endemic areas if you work and live in a forest far from residential areas. This is what causes the higher intensity of contact with Anopheles mosquitoes. Most of the respondents in this study were laborers with a piece system who worked and were bound by contracts with forest land development companies. Migrant workers choose to live or settle in the area where they work with a place to live in a hut or camp (a place to live in tents/tarp). The Settlement of Malaria transmission in some regions is likely due to one of them being imported from outside the region. Determinants of malaria transmission in the Epidemiological zone, one of which is the importation of malaria parasites through population migration and nonimmune population migration. Population movement is an important factor in increasing Malaria cases, increasing travel to Endemic areas has led to Import cases. Communities in the Endemic Malaria region usually has natural immunity so it has natural immunity and is more resistant to being infected with Malaria ((Depkes RI, 2010).

Mobility or population movement is an important factor in the potential occurrence of cases of Malaria, increased travel to endemic areas resulting in cases of imports. the longer stay in endemic area, will indirectly increase the chances of contracting malaria in endemic areas. duration of stay is short or long in malaria-endemic area, if working and living in forests far from residential areas. this causes a higher intensity of contact with the Anopheles Mosquito. migrant workers choose to live or settle in the area where they work with a hut or camp (a tented / tarpaulin residence). The Settlement of Malaria transmission in some regions is likely due to one of them being imported from outside the region. the determinants of malaria transmission in epidemiological zones, one of which is the importation of Malaria parasites through population migration and migration of non-immune populations.

## CONCLUSION

Risk factors for potential Malaria events in endemic and receptive areas in Manggarai Regency, namely: age, sex, occupation, population mobility, presence, type, lagging distance, presence, type, paddy field distance, existence, type, buffalo puddle distance, presence, type, distance like a fish, the existence, type, distance of the trench, the existence, type, distance of gutters, the existence, type, distance of buffalo footprints, the presence, type, distance of puddles, the behavior of Anopheles sp.