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*by* Elne Vieke Rambi

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# Spatial Study of Malaria Events and the Effect of Plasmodium SP Density. Against Anemia, Thrombocytopnia and SGPT/ SGOT in Malaria Patientsin Southeast Minahasa District 2017

**Elne Vieke Rambi[1], Joy V.I. Sambuaga[1], Linda Augustien Makalew[1,2]**

*[1]Lecturer of Health Analyst, Polytechnic of Health, Manado, [2]Doctoral Student, Department of Health Promotion and Behavior Science, Faculty of Public Health, Airlangga University, Surabaya, Indonesia*

## Abstract

Malaria affects almost all blood components. One of the most common haematological disorders is thrombocytopenia. Plasmodium infection can cause abnormalities in platelet structure and function. This study aims to spatial/map the spread of malaria incidence, location and physical environmental conditions and chemical breeding places of malaria vectors and analyze the effect of the density of Plasmodium sp on Anemia, Thrombocytopenia and SGPT/SGOT on malaria patients in Minahasa District in 2017. Samples were malaria sufferers April-August came to check up at the existing Puskesmas in Southeast Minahasa Regency, then the data of the coordinates of the house of malaria patients and Anopheles sp habitat and the physical and chemical environmental conditions of the Anopheles sp habitat surveyed using Global Positioning System (GPS). To analyze the effect of plasmodium sp density on anemia, thrombocytopenia and SGPT/SGOT using Chi square test statistics. The results of the study Dissemination of malaria incidence and the distance of Anopheles sp habitat to the homes of malaria sufferers. Physical and chemical environmental conditions in Anopheles sp habitat. in residential areas of malaria sufferers are temperatures 25.1-27.9 0c, humidity 72%-86%, pH 6.2-6.7 and salinity 0 ‰. Plasmodium sp density in 37 malaria patients consisted of 18 + cases, 12 ++ cases, 5 +++ cases and 2 ++++ cases. Statistical test results showed no relationship between Plasmodium sp density and anemia, and there was a relationship between the density of Plasmodium sp to Thrombocytopenia and SGPT/SGOT.

***Keywords:*** *Spatial, Malaria, Anemia, Thrombocytopenia, SGPT/SGOT.*

## Introduction

About 96% of the population at risk of contracting malaria in the Southeast Asian region lives in Bangladesh, India, Indonesia, Myanmar and Thailand and causes 95% of malaria cases (both sick and dead) in the area[(1)]. Indonesia is one of the countries where malaria transmission still occurs (at risk of malaria or risk of malaria), where in 2014 there were 252,027 positive cases of malaria[(2)]. North Sulawesi Province is ranked ninth out of 34 provinces in Indonesia with malaria morbidity rate (API) 0.94 per 1000 at-risk population[(3)]. Southeast Minahasa Regency is one of the Regencies in North Sulawesi Province with a high level of malaria endemicity, which in 2015 ranked second highest API number from 15 Regencies or Cities in North Sulawesi Province with a positive malaria case was 447 cases in 2015[(4)].

Malaria affects almost all components of the blood, and thrombocytopenia is one of the hematological abnormalities encountered, and has received much attention in the scientific literature. Plasmodium infection can cause abnormalities in platelet structure and function. Some of the mechanisms postulated to cause thrombocytopenia include immune mediated lysis, sequestration of the spleen and disturbances in the bone marrow[(5)]. Research conducted by Jojera et al (2013)[(6)], in 135 patients who were malaria-positive in Gujarat, India, 89.62% of patients experienced a decrease in platelet count. Thrombocytopenia is a hematological

**Corresponding Author:**
**Linda Augustien Makalew**
Doctoral Student Faculty of Public Health, Airlangga University, Address: Jl. Mulyorejo Surabaya, Indonesia
e-mail: linda.makalew@poltekkesmanado.ac.id

finding that is common in malaria and is often used as an indicator of malaria in endemic areas. The liver is the first organ involved in the reproduction of malaria parasites. Transaminase enzyme increases can be observed in malaria patients. Transaminase enzymes include serum enzymes glutamate pyruvate transferase (SGPT) and serum glutamate oxaloacetate transferase (SGOT)[7].

## Material and Method

This type of research is analytic with cross-sectional design. The study population was malaria sufferers in Southeast Minahasa regency in April to August 2017. Samples were determined by accidental sampling, namely malaria sufferers from April to August who came to check in at 4 Puskesmas work areas (Tambelang, Touluaan, Silian and Tombatu) number of 37 patients. The mapping of the spread of malaria cases was carried out by observing all the cases of the house made as research subjects with the coordinates of Plasmodium positive malaria cases based on examination of blood preparations. Mapping the habitat distance of Anopheles sp mosquito larvae is done by tracking using GPS on all Anopheles larvae habitat in the research location. Make buffer cases and habitats using the Arc application. GIS version 9.3. Dividing the distance between larval habitat and malaria cases into 3 (three) zones:

1. Red buffer zone, which is the distance of the malaria case house which is closest to the habitat of Anopheles sp mosquito larvae with a radius of 0-100 meters.
2. The yellow buffer zone is the distance of the house of malaria cases which is a bit far from the habitat of Anopheles sp mosquito larvae with a radius of 100-200 meters.
3. Green potential zone (green buffer zone), is the distance of the case house of malaria incidence which is relatively far from the habitat of Anopheles sp mosquito larvae with a radius of 200-300 meters.

## Results

The spread of malaria cases based on Plasmodium types in Southeast Minahasa Regency can be seen in Figure 1.

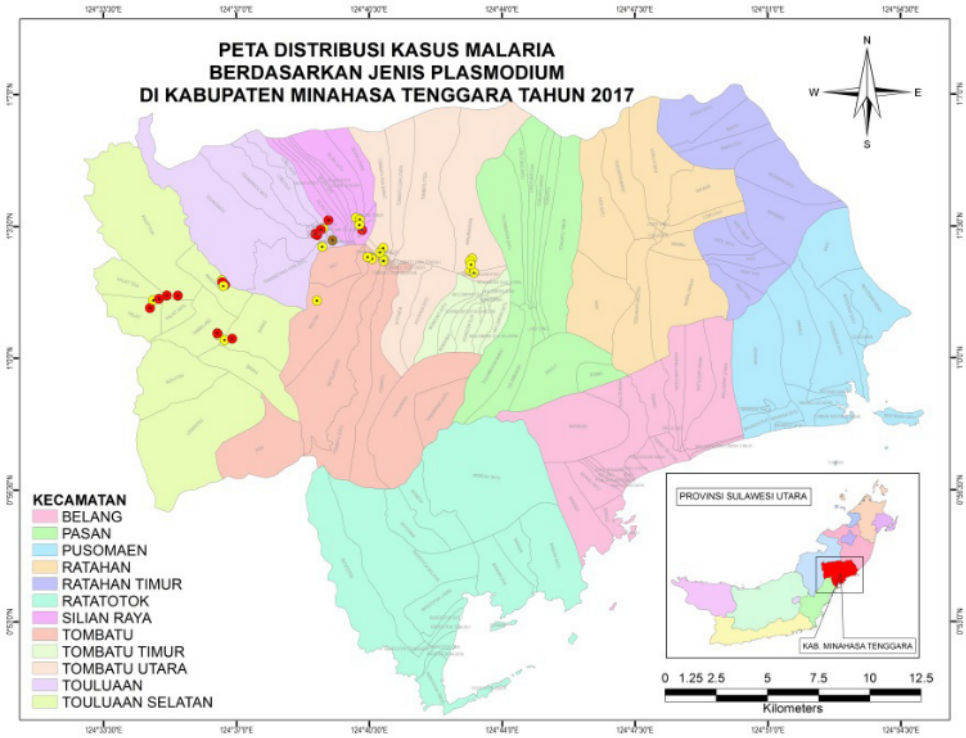


**Figure 1: Map of the spread of malaria incidence based on the type of Plasmodium in the Southeast Minahasa District in 2017**

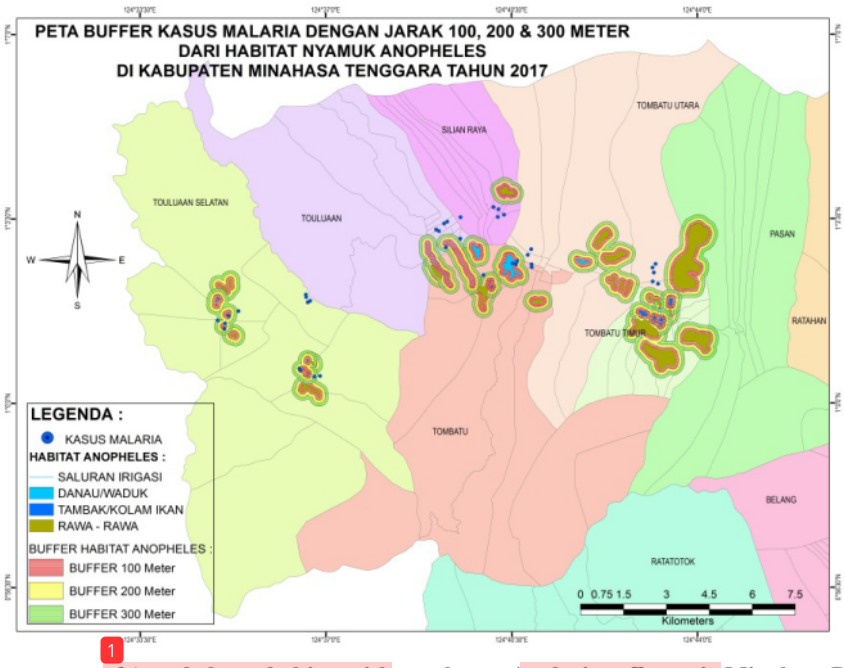


**Figure 2: Distance map of Anopheles sp habitat with case houses/malaria sufferers in Minahasa District in 2017**

Figure 1. Shows the spread of malaria cases in the Southeast Minahasa District in 2017 totaling 37 cases spread in 18 villages from 5 sub-districts in 4 Puskesmas areas that were the locations of the study. The most cases are in Winorangian Village, namely 5 sufferers. of the 37 patients who were sampled there were 13 patients who were Plasmodium falciparum positive, 23 patients with Plasmodium vivax positive and 1 positive patient with Plasmodium falciparum and Plasmodium vivax mixtures.

Habitat types obtained from Anopheles sp larvae located in the area of malaria cases in Minahasa Regency in 2017 consist of irrigation channels, lakes/ reservoirs, fish ponds/ponds and swamps. Figure 2, 37 malaria cases in the Southeast Minahasa Regency, 4 cases included in the green potential zone, 3 cases in the potential yellow zone, 7 cases in the potential red zone and 23 cases of malaria that were not included in the potential zone. Physical environmental conditions in the breeding places range from 25.2-27.9 (0c) and humidity 72%-86%. Whereas the results of the measurement of chemical conditions in the breeding places around the case location in Minahasa Tenggara District obtained results for the pH in the range of 6.2-6.7 and salinity of 0%.

Table 1 shows the physical environmental conditions (temperature and humidity) and the chemical environment (pH and salinity) in Anopheles sp. in the area of malaria sufferers in the Southeast Minahasa District of 2017.

**Table 1: The Physical Environmental Conditionsand The Chemical Environment in Anopheles sp. in The Area of Malaria Sufferers in the Southeast Minahasa District of 2017.**

| Habitat Type | Physical Environment ($\bar{x}$) | | Chemical Environment($\bar{x}$) | |
|---|---|---|---|---|
| | Temperature (°C) | Humidity (%) | pH | Salinity (Gram/kg)% |
| Swamps | 25.2 | 72 | 6.2 | 0 |
| Irrigation/Sewer Channels | 26.6 | 81 | 6.3 | 0 |
| Fishponds | 25.1 | 79 | 6.7 | 0 |
| Lake/Reservoir | 27.9 | 86 | 6.3 | 0 |

a. **Malaria Distribution Based on Plasmodium Types:** Table 2 shows the distribution of malaria in 37 patients infected with malaria parasites in the Southeast Minahasa regency based on the type of plasmodium which found that there were two types of plasmodium with Plasmodium, the most common being Plasmodium falciparum in 23 patients (62.2,%).

**Table 2: Malaria Distribution Based on Plasmodium Types in Southeast Minahasa Regency**

| Plasmodium | Σ | % |
|---|---|---|
| P. falciparum | 13 | 35.1 |
| P. vivax | 23 | 62.2 |
| P. malariae | 0 | 0 |
| P. ovale | 0 | 0 |
| Mix Plasmodium | 1 | 2.7 |
| **Total** | **37** | **100** |

b. **Plasmodium Density:** Table 3 shows 37 samples that are positive for plasmodium and continued by calculating the density obtained with the most results is + with a number of 18 patients (48.65).

**Table 3: Plasmodium density in malaria patients in Southeast Minahasa District**

| Density Plasmodium | Σ | % |
|---|---|---|
| + | 18 | 48.65 |
| ++ | 12 | 32.43 |
| +++ | 5 | 13.51 |
| ++++ | 2 | 5.41 |
| **Total** | **37** | **100** |

Hemoglobin examination results in patients infected with malaria parasites in Southeast Minahasa District. of the 37 malaria patients 23 (62.2%) had anemia because blood hemoglobin levels were below normal. More can be seen in Table 4.

**Table 4: Hemoglobin Examination Results for Malaria Patients**

| Hb examination results | Σ | % |
|---|---|---|
| Normal | 14 | 37.8 |
| Anemia | 23 | 62.2 |
| **Total** | **37** | **100** |

Statistical test results of data in table 5, the effect of Plasmodium sp density on thrombocytopenia in malaria patients in Southeast Minahasa District in 2017 using the Chi-Square test showed a relationship with p = 0.022.

**Table 5: Thrombocytopenia with Malaria**

| Trombositopenia | Σ | % |
|---|---|---|
| Trombositopenia | 22 | 59.5 |
| Non trombositopenia | 15 | 40.5 |
| Σ | 37 | 100 |

Statistical test results from the data in table 6, the influence of the density of Plasmodium sp on SGPT and SGOT on malaria patients in Southeast Minahasa District in 2017 using the Chi-Square test showed a relationship with each of p = 0.052 and 0.047.

**Table 6: Value of SGPT/SGOT in Malaria Patients**

| Resultexamination | SGPT <35 u/L | | SGOT <30 u/L | |
|---|---|---|---|---|
| Normal | 21 | 56.8 | 18 | 48.6 |
| Ubnormal | 16 | 43.2 | 19 | 51.4 |
| Σ | 37 | 100% | 37 | 100% |

## Discussion

The positive distribution of malaria cases in plasmodium at the study location was in 18 villages with different compositions. Temperature is one of the abiotic environmental factors that greatly contributes to larvae breeding in all breeding places. Based on the results of research conducted in the Southeast Minahasa Regency, the temperature of breeding places ranged from 24.2ºC-27.9ºC. the highest breeding places temperature at 27.9ºC is found in lakes/reservoirs. Temperature measurements in the range of 26 ° C-29ºC. This is a temperature that is ideal for the life of Anopheles larvae in any type of Breeding Places with varying conditions.

There is a difference in breeding places temperatures found by researchers due to differences in geographic conditions where there are breeding places that have protective plants around breeding places and there are also those that do not have protective plants that allow sun irradiation. And directly also due to differences in seasons and time of temperature measurement.

Based on the results of the study showed that the pH in breeding places ranged from 6.2-6.7. The highest pH of breeding places is 6.7 found in lakes/reservoirs. Salinity in breeding places was obtained ranging from 0-14 ‰. Examination of the density of Plasmodium amount in malaria patients from 37 respondents studied there were 18 respondents with the total density (+) (48.65%), and 12 respondents with the total density (++) (32.43%) and for (+++) amounting to 5 patients (13.51%) and 2 patients (++++) (5.41%).

The results of this study indicate that people in endemic areas have paid more attention to their health and immediately went to the health center or to the nearest hospital for the initial symptoms of the disease so that malaria cases can be detected since the initial attack. Besides that at the initial attack, the number of parasites in the peripheral blood is still low so that the parasite density is still low. Patients with ages 15-54 years are 15 people (48.65%) who are adults. This is because this age group is a productive age group where at that age it is possible to work and travel outside the house so that it is more likely to contact the malaria vector. Characteristics of malaria sufferers based on sex, showed malaria patients male as many as 18 people (63.3%) and women as many as 19 people (36.7%). The results of examination of blood smears of malaria patients showed that the most common type of Plasmodium was Plasmodium vivax, which was 23 patients (62.2%). Anemia or decrease in blood hemoglobin levels to below normal values in malaria is caused by excessive destruction of red blood cells by malaria parasites[(2)]. Examination of 18 patients (78.3%) with very mild anemia, 3 patients (13%) with mild anemia, 2 patients (8.7%) with moderate anemia. The malaria parasite is in the blood for most of its life cycle so it induces changes in the blood. Statistical test results showed that H0 was accepted, indicating a relationship between the type of plasmodium density and platelet count (p = 0.022). These results are supported by research conducted by Jojera et al in 2013[(2)] in India, where more than 80% of malaria sufferers, both pfalciparum and p.vivax infection, experienced a decrease in platelet counts and 92.48% of cases found in P. infection. falciparum. Thrombocytopenia was also found in patients with vivax malaria, in this study found 23 vivax malaria patients with complications of severe malaria.

Malaria transmission in humans is when sporozoites infect the liver. In the liver the sporozoites mature and form schizon tissue or become dormant hypnozoites. Schizonakan tissue produces a lot of merozoites and then destroys liver cells. Infection of liver cells can cause leakage of parenchymal liver enzymes (transaminases) namely SGOT and SGPT. Echo-erythrocytic cycles of malaria-causing parasitic infections invade the liver and destroy hepatocytes/liver cells thus, causing increased activity of liver enzymes as evidence of liver dysfunction and are associated with membrane integrity[(8)]. The results showed that there was a relationship between Plasmodium density and levels of SGPT/SGOT. This is because the amount of plasmodium density in 19 patients shows a density of more than +1, where the number of parasites that can destroy erythrocytes in the liver are many.

Damage to liver cells or hepatocytes during the schizogoni cycle results in cellular damage but that does not mean significant liver dysfunction. All types of Plasmodium experience the process of schizogoni in liver cells and then infect and destroy erythrocytes. Jaundice or jaundice can appear as a sign of severe malaria infection either due to severe hemolysis or due to liver involvement. Usually the SGPT value will increase along with SGOT, but increased SGPT indicates that liver function is happening because this enzyme is in the cytoplasm so it is easier to get out of the cell if the cell is damaged by parasites

## Conclusions

Dissemination of malaria incidence and distance of Anopheles sp habitat with case houses/malaria sufferers in Southeast Minahasa District in 2017. Physical environmental conditions (temperature 25.1-27.9 0c and humidity 72%-86%) and chemical environment (pH 6.2-6.7 and Salinity 0 ‰) in Anopheles sp habitat. in the area of malaria sufferers in the Southeast Minahasa Regency in 2017. The density of Plasmodium sp consists of 18 + cases, 12 ++ cases, 5 +++ cases and 2 ++++ cases.

There was no correlation between the density of Plasmodium sp and anemia in malaria patients with p = 0.24; there is a relationship between the density of Plasmodium sp to Thrombocytopenia in malaria patients with p = 0.022 and there is a relationship between the density of Plasmodium sp to SGPT/SGOT in malaria patients with p = 0.052 and 0.047

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