# Correlation between Parasitemia with Hemoglobin Levels in Malaria Patients at Hanura Health Center Working Area Pesawaran District, Lampung, Indonesia

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## ABSTRACT

**Background**: Malaria is a disease caused by the parasite *Plasmodium sp*. Plasmodium which enters human body will damage to red blood cells so that can cause hemolytic anemia, which results in increased mortality and morbidity.

**Objectives**: The purpose was to find out the correlation between the number of parasitemia and hemoglobin levels in malaria patients at work area of the Hanura Health Center in Pesawaran District.

**Materials and Methods**: This researched was an observational analytic studied with a crossed sectional researched design. The subjects in this studied were 30 malaria patient and taken by consecutive sampling method. Subjects were taken peripheral blood to checked hemoglobin levels, made thick and thin smear preparations for calculating parasitemia rates. Furthermore, the data was processed by software with the Pearson correlation test at a significance leveled of 95% ($\alpha$ = 0.05).

**Results**: The results showed that the higher rate of parasitemia would result in lower the hemoglobin level. Low hemoglobin levels occur in moderate parasitemia (28.57%) and severe parasitemia (71.43%). Based on statistical tests, the value of p was 0,001 and the r value was -0,695. **Conclusion**: There was a correlation between the number of parasitemia and hemoglobin levels in malaria patients in the Hanura Community Health Center work area.

**Keywords**: Hemoglobin level, malaria, parasitemia, plasmodium, red blood cell

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## INTRODUCTION

Malaria is a disease transmitted through the bite of female Anopheles mosquitoes that have been infected with the genus Plasmodium of protozoa. This disease is still a global concern because it can have a wide impact on quality of life and cause death. Most areas of Indonesia are still endemic of malaria[1]. One of the provinces in Indonesia that is endemic to malaria is Lampung because at some areas of Lampung Province is an area that has swamps, brackets of brackish water on the seaside, and neglected fishponds. Annual Parasite Incidence (API) or the highest malaria morbidity rate in Lampung Province is in Pesawaran District at 6.36 over 1,000 population[2]. In 2011-2015, the highest number of malaria cases was found in Hanura Health Center with 2,276 cases[3].

In malaria, sporozoite stage of Plasmodium will enter the human body to start the ecsoeritrocytic cycle, which is in the liver cells. In the liver, sporozoites will change to schizonts. The broken schizont releases merozoites and merozoites will enter the erythrocytic cycle to infect red blood cells, causing red blood cells to break and turn into smaller size. Damaged red blood that already infected can cause a decrease in hemoglobin levels (Hb)[4].

In a previous study that examined the effect of parasitic density on blood cell parameters in 2015 using semi-quantitative methods and in data analysis using the Kruskall-Wallis test, the results were significantly reduced the number of erythrocytes and hemoglobin in patients with high parasitemia compared to low and moderate parasitemia groups ($p < 0.05$)[5]. Calculation number of parasitemia with semi-quantitative method is not recommended because it is considered inconsistent in determining the density of parasites and should be replaced by other methods that more accurate. The results are reported in units of parasites / μL[6]. The number calculation of parasitaemia with semi-quantitative method performed only if the calculations with quantitative methods are not possible. The number calculation of parasitemia with quantitative methods is calculated based on the number of leukocytes or based on the number of erythrocytes[7].

Based on that condition, the researchers wanted to conduct a study to determine whether there was a correlation or not between the number of parasitemia and hemoglobin levels in malaria patients in the Hanura Community Health Center work area in Pesawaran District by calculating the number of parasitemia using quantitative methods (based on leukocyte count) and data analysis using correlation tests.

## MATERIALS AND METHODS

The research study was conducted at the Hanura Health Center in September to November 2018. This study used an analytical observation method with a cross sectional study design. The population in this study were all malaria patient in the working area of the Hanura Health Center.

Blood samples were obtained from someone suspected of suffering from malaria and blood prick samples would be taped to make thick and thin blood smear preparations. Thick and thin blood smear preparations were stained with giemsa solution for 30 minutes. In the preparation of thick blood smear, the number of parasitemia compared with the number of leukocytes was calculated. After that, hemoglobin levels were measured using easy touch digital hemoglobin meter.

The research data will be processed using a data processing program. The data were then analyzed by the Pearson correlation test. Ethical Consideration: The study was approved by the Health Research Ethics Commission of the Faculty of Medicine, University of Lampung with identification number: 3445/ UN26.18/ PP.05.02.00 /2018.

## RESULTS

### Table 1: Characteristics of Subjects

|  | Total | Percentage |
|---|---|---|
| **A.        Age** | | |
| Toddler (0-5 years) | 2 | 6.7% |
| Children (6-11 years old) | 6 | 20% |
| Teenagers (12-25 years old) | 14 | 46.7% |
| Adult (26-45 years old) | 7 | 23.3% |
| Elder (≥60 years) | 1 | 3.3% |
| **B.        Gender** | | |
| Man | 21 | 70% |
| Women | 9 | 30% |
| **C.        Territory Distribution** | | |
| Batu Menyan | 2 | 6.7% |
| Gebang | 12 | 40% |
| Hurun | 1 | 3.3% |
| Sukajaya Lempasing | 7 | 23.3% |
| Sidodadi | 8 | 26.7% |
| **D.        Plasmodium type** | | |
| *Plasmodium falciparum* | 5 | 16.7% |

| | | |
|---|---|---|
| *Plasmodium vivax* | 25 | 83.3% |
| **E. Degree of Parasitemia** | | |
| Low | 10 | 33% |
| Moderate | 6 | 20% |
| High | 14 | 47% |
| **F. Hemoglobin levels** | | |
| Normal | 23 | 76.7% |
| Low | 7 | 23.3% |

Based on table 1, characteristics of respondents by age difference stated that the ones who suffered the most were teenage patient with 14 people (46.7%), followed by adults as 7 people (23.3%). Based on gender, it was men had more malaria patient, with 21 people (70%). Based on the distribution of regions, malaria patients are mostly from Gebang Village, which is 12 people (40%). Based on the type of Plasmodium, there was 25 people (83.3%) were infected by *Plasmodium vivax*. Based on the degree of parasitemia, there were 14 people (33%) with high degree of

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severe parasitemia, 10 pearson (33%) with moderate degrees of parasitemia, and 6 people (20%) with low degrees of parasitemia. Distribution of age-based degrees of parasitemia will be presented in figure 1. Based on hemoglobin levels, 23 malaria patients were obtained (76.7%) have normal hemoglobin levels and 7 patients (23.3%) have low hemoglobin levels. Distribution of hemoglobin levels based on age, distribution of normal hemoglobin levels, distribution of low hemoglobin levels, respectively will be presented in figure 2, table 2, and table 3
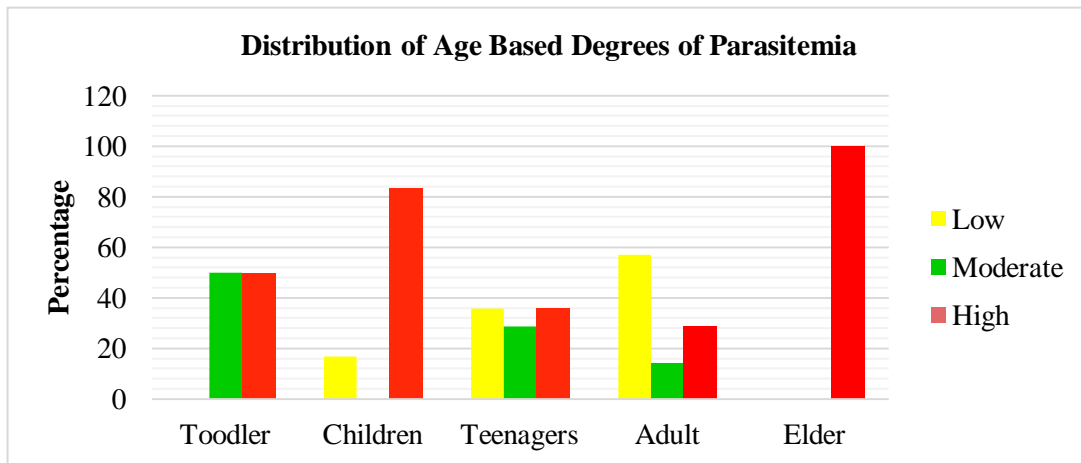


**Figure 1: Distribution of Age Based Degrees of Parasitemia**

Based on figure 1, severe degrees of parasitemia were found in the toddler age group (50%) , children (83.33%) , and elder (100%) . The degree of low parasitemia was found in many adults (57.14%) followed by teenage (35.72%).
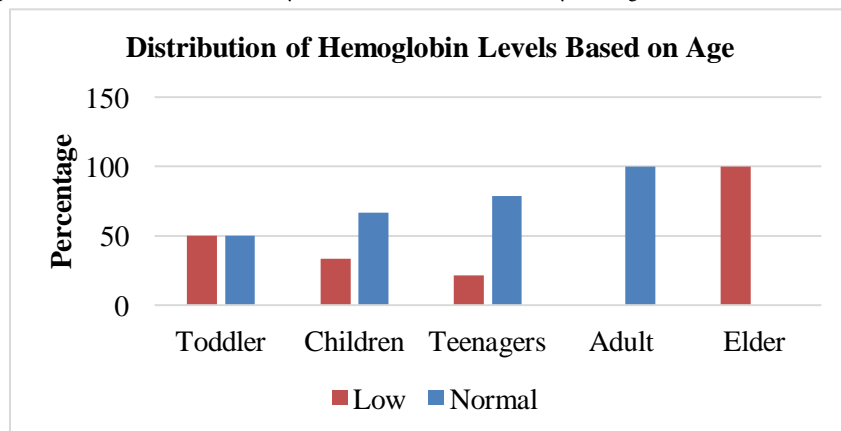


**Figure 2: Distribution of Hemoglobin Levels Based on Age**

Based on figure 2, patients with low hemoglobin levels most often occur in toddler age group (50%) and the number will decrease with age difference. One subject in this study who was elder also had low hemoglobin levels. Patients with normal hemoglobin levels most often occur in the adult age group (100%).

**Table 2: Distribution of Low Hemoglobin Levels**

| Degree of Parasitemia | | Plasmodium type | |
|---|---|---|---|
| Moderate | 2 | *Plasmodium vivax* | 2 |
| High | 5 | *Plasmodium falciparum* | 4 |
| | | *Plasmodium vivax* | 1 |

Based on table 2, it was found that 7 malaria patients who had low hemoglobin levels, 4 patients were infected with Plasmodium falciparum and 3 patients were infected with Plasmodium vivax with the number of patients all experiencing moderate to high degrees of parasitemia.

**Table 3: Pearson Correlation Test Results**

| | Number of Parasitemia | |
|---|---|---|
| Hemoglobin levels | Correlation coefficient (r) | -0.695 |
| | Significance (p) | 0.001 |

Based on table 3, the results of the Pearson correlation statistical test showed a significant correlation between parasitemia and hemoglobin levels (p = <0.05). The correlation coefficient between parasitemia with hemoglobin levels is negative, the number 0.695 which statistically shows that the strength of the study is strong (0.6 - <0.8). The direction of negative correlation interprets if the higher parasitemia, the lower the hemoglobin level in malariapatients.

### DISCUSSION

Results of Pearson correlation analysis showed a significant correlation between parasitemia and hemoglobin levels. The direction of correlation is negative, which means the higher parasitemia, the lower the hemoglobin level will be. This study is in line with the research of Lucien et al. (2010)[8], which suggests that there is a significant correlation with the negative direction between parasite density and hemoglobin level (p = 0.025 and r = -0.432) . The same results were obtained also in the study of Mulyanti et al. (2016) [9] that stated, if hemoglobin will decrease with increasing parasite density (p = <0.05 and r = -0.724). Njunda et al. also found that there is significant negative correlation between malaria parasite density and hemoglobin. That agreed with the study done by Kotepui et al. (2015) [5], who identified significantly reduced the number of erythrocytes and hemoglobin in patients with high parasitemia compared to low and moderate parasitemia groups (p <0.05).

Singh et al. (2014) [10] also suggested that mean parasite density of *Plasmodium falciparum* was significantly higher so consistently showed low hemoglobin level. That agreed with the study done by Ali et al. (2008) [11], who identified that *Plasmodium falciparum* had high parasite count was associated with severe anemia.

Characteristics of malaria patients are based on age , sex, area distribution, type of Plasmodium, degree of parasitemia, and hemoglobin level. The age of malaria patients in this study is mostly found in the age range of 12-45 years. According to Kurniawan *et al.* (2018) [12] research which states that 80% of malaria patient are in the age group 13-45 years.

A male is  have higher risk for malaria. Male are more risky towards malaria because their activities are related to the ouside activity such as, farming, raising livestock, managing ponds which are the habitat of vector mosquitoes [13]. According to Irawati *et al.* (2017) [14] who

stated that 52 malaria patients studied as the sample, the number of male patients was more than woman patient that infected, namely 28 people with the majorityof activities carried out to farm, raise livestock, and find fish. Men often gather at night around food stalls to watch soccer matches, while women willoften be at home to help their mothers cook and prepare food [15].

The distribution of malaria patient comes from Gebang Village . It is in as right by the many small puddles, ditches, trenches behind the houses. Gebang village has a large area with a large population of 5,312 inhabitants . The village of Gebang also borders the Klara Beach, Sari Runduk Beach, and the Grand Forest Park (Tahura). Forests, beaches, puddles, gutters, and trenches are places where *Anopheles sp.* mosquitoes breed [16]. In addition, many villagers were absent from the mass blood survey (MBS) program conducted by the puskesmas . MBS is an attempt to find malaria sufferers early to break the chain of malaria transmission [17].

*Plasmodium vivax* is the most common cause of malaria in the work area of Hanura Health Center because of some trophozoites *Plasmodium vivax* can form hypnozoites that can be dormant in the liver making it difficult to eradicate and easily relapse [18]. The working area of the Hanura Health Center is endemic to malaria so that 47% of the research subjects had severe degrees of parasitemia. Research subjects who oftencontact with Anopheles and Plasmodium mosquitoes so that immunity will form. One of his immunity is anti-toxin immunity which often causes parasites to remain alive in the body but asymptomatic [19].Age groups who are vulnerable to severe degrees of parasitemia are toddlers, children, and the elder age. This is influenced by the immune system that is owned [20].

Decreased hemoglobin levels are affected by the number of lytic erythrocytes. Lytic erythrocytes depend on the type of Plasmodium and the patient's immunity status [21-25]. *Plasmodium falciparum* will produce more merozoites than *Plasmodium vivax*, which is as much as 40,000 merozoites . In *Plasmodium vivax* only produce 10,000 merozoites [26]. The amount of merozoite produced will affect the density of parasites in the body.As in table 3, it was seen from 7 malaria sufferers who had low hemoglobin levels, 4 patients were infected with *Plasmodium falciparum* and all had severe degrees of parasitemia. Hemoglobin was significantly reduced in patients with high parasitemia compared with the low parasitemia group [27-29]. Merozoite will fill 2/3 of the erythrocyte [30], carry out an

active metabolism such as swallowing erythrocyte cytoplasm and destroy hemoglobin into amino acids [32]. The more number of parasites, the more erythrocytes are invaded and will cause a decrease in the amount of erythrocyte mass that is comparable so that it has an effect on the decrease [31] in hemoglobin levels too much [33].

This study discovered that there is correlation between parasitemia with hemoglobin levels in malaria patients at Hanura Health Center Working Area. This study can be useful suggestion for the Hanura Health Center Working Area to check hemoglobin levels for malaria patients. In future study, it was recommended to conduct a study of the relationship between the number of parasitemia and hemoglobin levels using two different methods and compared the results.

## CONCLUSION

From this study it can be concluded that there is a significant correlation between parasitemia and hemoglobin levels in malaria patients in the work area of the Hanura Health Center in Pesawaran District with a negative correlation direction.

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