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The Risk Factors Associated with Malaria Incidence in the Elelim Public Health Center in Yalimo District, Papua Province

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Abstract

Background: Malaria is still an endemic disease and one of Papua's health problems. Indonesia is the seventh largest in the world with 200,378 cases. In the province of Papua, the district of Yalimo is the third-highest with 18,821 cases. The Government is working to detect and prevent malaria in Papua Province by launching a program called "Malaria Elimination in Papua Province by 2030."

Research Objectives: Identify the risk factors associated with malaria incidence at the Elelim Public Health Center in Yalimo District, Papua Province.

Research method: The research method used in this study was an observational analysis with a case-control study approach. A sample of 90 patients consisted of 30 patients diagnosed with malaria as positive cases and 60 patients diagnosed with malaria as negative controls. This research was performed in July 2019. The statistical methods used in this analysis were univariate, bivariate and multivariate analyses. Data gathered through questionnaires and interviews.

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Results: The bivariate analysis showed a number of risk factors associated with the incidence of malaria in the Elelim Public Health Center in Yalimo District, Papua Province: the use of wire mesh (p = 0.013; RP = 3.237; 95% CI = 1.302-8.047), the type of house wall (p = 0.003; RP = 4.316; 95% CI = 1.696-10.981), the puddle near the house (p = 0.004; RP = 4.333; 95% CI = 1.686-11.138), the distance between house and breading place (p = 0.001; RP = 5.675; 95% CI = 2.097-15.362), the distance between house and large cattle pens (p = 0.042; RP = 2.615; 95% CI = 1.048-6.529), and the use of insecticide net (p = 0.008; RP = 6.000; 95% CI = 1.668-21.583); while age (p = 0.695; RP = 0.740; 95% CI = 0.289-1.897), sex (p = 0.412; RP = 0.474; 95% CI = 0.193-1.165), occupation (p = 0.157; RP = 0.474; 95% CI = 0.193-1.165), education (p = 0.701; RP = 0.750; 95% CI = 0.299-1.878), family income (p = 0.262; RP = 0.546; 95% CI = 0.255-1.325), the use of anti-mosquito repellent (p = 0.705; RP = 1.321; 95% CI = 0.536-3.253), and nighttime habits (p = 0.392; RP = 1.650; 95% CI = 0.668-4.075) were not associated with malaria incidence in the Elelim Public Health Center in Yalimo District, Papua Province.

Keywords: Risk factors; malaria; malaria incidence; case-control.

1. Introduction

Malaria is one of the public health problems that can cause death, especially in high-risk groups such as infants, toddlers, pregnant women; besides, malaria can directly cause anemia and reduce work productivity [1]. Malaria is an infectious disease caused by Plasmodium parasites, which live and multiply in human blood cells, transmitted by female malaria mosquitoes (anopheles sp). Malaria is also a recurring disease (a disease that has suddenly increased) [2]. Based on data from the World Health Organization (WHO), the reported incidence of malaria in 2017 is around 219 million cases, with the largest number of malaria cases and deaths in Africa reaching 435,000 per year. Death occurs every 2 minutes in children under 5 years of age due to lack of prevention and care [3]. Malaria is an infectious disease that is very common in the tropics and subtropics, and can be deadly. Malaria is already a big public health issue in Indonesia today. Total malaria cases are reported at 15 million clinical cases each year. Persons at risk of malaria are those who usually live in malaria-endemic areas, estimated at 85.1 million with low , medium and high endemic zones. Seventy percent of malaria attacks the productive ages [4]. In 2016, the Ministry of Health confirmed the prevalence of malaria in as many as 200,378 cases with an annual incidence of parasites ((API = 0.77). The highest prevalence of malaria was in Papua Province, with 128,066 cases of annual parasite incidence ((API = 39.93) relative to the other four main provinces (East Nusa Tenggara, West Papua, Central Sulawesi and Maluku). The number of malaria patients in 2016 was 2,867 cases [5]. The government sees malaria as a threat to people's health, especially to people living in remote areas. It is reflected by Presidential Regulation No. 2 of 2015 on the National Medium-Term Development Plan 2015-2019, in which malaria is a priority disease that needs to be addressed. Diseases that have an impact on the decline in the quality of human resources have a strong impact on the emergence of various social and economic problems. The strategy of eradication of malaria in Indonesia has been introduced since 1959 with the assistance of the World Health Organization (WHO) and the United States of America, Indonesia Development (USAID). A program called KOPEM (the Malaria Eradication Operation Command) was launched in 1962. With the success achieved, efforts and strategies to eradicate malaria are more focused on malaria eradication activities. In 1968, KOPEM was formally abolished and the response methods transferred to

the malaria control program [6]. Malaria prevention efforts continue, which have produced positive results. The Millennium Development Goals (MDGs) for malaria, which seek to reduce malaria incidence worldwide in 2015, have been achieved by reducing malaria incidence by 37% worldwide since 2000. While, the global malaria mortality rate has decreased to 60 per cent between 2000 and 2015, and some 6.2 million lives could be saved. The malaria program has reached the Millennium Development Goals (MDGs) and then malaria is included in the Sustainable Development Goals (SDGs) indicator in target 3.3 ending the AIDS epidemic, tuberculosis , malaria and neglected tropical diseases and combating hepatitis, waterborne diseases and other infectious diseases. In 2016, 178.7 million Indonesians (69 per cent) were living in areas free of malaria transmission; 63.6 million (25 per cent) were living in areas with low risk of malaria transmission, while the remainder were living in medium and high risk areas. Similar to the previous year, there was a percentage change, along with the number of districts / cities that had been reduced. Papua Province is one of the provinces in which the mobilization of large numbers of outside populations entering the area and, at the same time as planned and spontaneous transmigration, is at great risk of malaria. The existence of climate change, the burning of forests and the rapid development process are making the spread of this disease more widespread. The physical , chemical and biological environment of this area, which consists of swamps and forests. The predominant vector forms that spread in Papua are Anopheles farauti, Anopheles Koliensis and Anopheles punctuates, and the high incidence and prevalence of malaria suggest that malaria eradication efforts are not yet understood or not optimal [7]. Five regencies in Papua Province rated highest among 29 regenties, including Mimika Regency with 36,378 malaria cases, Keerom Regency with 23,966 malaria cases, Jayapura Regency with 22,516 malaria cases, Jayapura City with 14,888 malaria cases, and Nabire District with 10,482 cases. The malaria cases in Papua Province registered as many as 147,239 cases in 2016. Malaria rose in 2017, with a total of 261,617 cases of malaria in National and Papua 192,648 cases [8]. Yalimo Regency is one of the districts of the province of Papua. Malaria is one of the public health issues in the Yalimo regency, with an growing increase in the last three years (2012-2015). The number of cases in 2013 was 10,539; there were 11,803 cases in 2014 and 18,821 cases in 2015 [9]. The rate of malaria morbidity (Annual Parasite Incidence / API) is a measure of malaria progression. Malaria morbidity (API) was 322.6 per 1,000 population in 2015. The case fatality rate (CFR) for malaria was 0.06 percent or 12 cases in 2015. The API in the Elelim Public Health Center rose by 215.1 per cent from 2016 to 362.1 per cent in 2017 [8]. Malaria eradication and prevention efforts that have been part of our efforts to achieve the 2030 malaria eradication program in Papua. Malaria that is still difficult to eradicate in Papua is linked to poor environmental management , low population economic status, poor nutritional status, limited health services, and poor community behavior that promotes a healthy lifestyle. Various attempts to eliminate malaria in the Yalimo District in general and in the Elelim Community Health Centre, in particular, have been made under current programmes, such as prevention of vector control, active patient discovery / active case identification (ACD) or passive / PCF (Passive Case Finding), conducting treatment in clinical and laboratory-confirmed patients, severe malaria treatment, and surveillance [9]. As for the form of community participation that is expected for malaria prevention efforts: (1) adherence to anti-malaria medication so that every patient can take the medication completely; (2) prevention of mosquito bites through the use of mosquito nets, installation of mosquito nets at home, use of mosquito repellent drugs, use of long clothes; (3) Preventing the occurrence of malaria mosquito nesting by cleaning mosses in damp places or parts of the house, preventing the formation of puddles / places that may be breeding grounds for Anopheles

mosquitoes, maintaining fish-eating larvae and preventing mosquito nesting [9]. The activities carried out in the Yalimo District in general and in the Elelim Public Health Centre, in particular, did not show a decline but increased by 147 per cent. The mosquito net distribution scheme, which will begin in February 2018, is projected to be one of the strategies to minimize the incidence of malaria in the Elelim Public Health Centre. The findings of this study may be useful for the management of Elelim PHC in deciding policies related to the reduction of incidence by removing certain factors related to the incidence of malaria. On the basis of this history, the authors are interested in research "Risk factors associated with malaria incidence at the Elelim Public Health Center in Yalimo District, Papua Province."

2. Materials and Methods

2.1. Type of Research

The type of research used in this study was observational analysis with a case-control method that is commonly used, particularly in epidemiology. Patients in the Elelim Public Health Center working area of Yalimo District, Papua Province, were among the population in this report. Samples of 90 patients, including 30 patients as cases and 60 patients as controls. All selected samples have been included in this study.

2.2. Ethical Research and Data Collection

Each respondent demanded the signing of an informed consent. Primary data were obtained by conducting interviews directly with the respondent using the interview guide (questionnaire). Data processing is carried out using a computer with the help of SPSS program packages. Data was analyzed using chi-square and multiple logistic regression.

3. Result and Discussion

3.1. Univariate Analysis

An overview of the univariate used to classify each variable of the sample. This study only shows the frequency and percentage of each variable. The findings of the study can be found in Table 1:

Table 1 shows that 30 (33.3%) of the 90 samples were positive for malaria and 60 (66.7%) were negative for malaria. Of the 90 samples, the majority (65.6 per cent) were > 20 years of age, 46 (51.1 per cent) were female, 46 (51.1 per cent) did not work, 56 (62.2 per cent) were educated, 48 (53.3 per cent) had less family income, 53 (58.9 per cent) used wire mesh, 51 (56.7 per cent) used stone walls, 48 (53.3 per cent) had no puddles, 45 people (50 per cent) who have mosquito breeding near their homes, 77 people (85.6 per cent) who use insecticide-treated mosquito nets, 53 people (58.9 per cent) who do not use mosquito repellent, and 58 people (64.4 per cent) who do not often go out at night.

Table 1: Distribution of respondents by age , sex, occupation, education, family income, use of wire mesh, type of house wall, puddle near house, distance between house and breeding ground, distance between house and large cattle pens, use of insecticide nets, use of anti-mosquito repellent, night time habits, and incidence of malaria.

No	Variable	Frequency (n)	Percentage (%)
1	Age		
	< 20 years old	31	34.4
	≥ 20 years old	59	65.6
2	Sex		
	Female	46	51.1
	Male	44	48.9
3	Occupation		
	Working	44	48.9
	Not working	46	51.1
4	Education		
	Low	34	37.8
	High	56	62.2
5	Family income		
	Less	48	53.3
	Enough	42	46.7
6	Use of wire mesh		
	No	37	41.1
	Yes	53	58.9
7	Type of house wall		
	Wood	39	43.3
	Wall	51	56.7
8	A puddle near the house		
	Yes	42	46.7
	No	48	53.3
9	Distance between home and breeding place		
	Close	45	50.0
	Far	45	50.0
10	Distance between house and large cattle pens		
	Far	46	51.1
	Close	44	48.9
11	Use of insecticide net		
	No	13	14.4
	Yes	77	85.6
12	Use of Anti-Mosquito Repellent		
	No	53	58.9
	Yes	37	41.1
13	Nighttime Habits		
	Often	32	35.6
	Not often	58	64.4
14	Malaria Incidence		
	Case	30	33.3
	Control	60	66.7
Total		90	100.0

Source: Primary Data, 2019

3.2. Bivariate Analysis

Bivariate analysis was performed to determine the relationship between independent and dependent variables , i.e. age , sex, occupation, education , family income, use of wire mesh, type of house wall, puddle near the house, distance between the house and the breeding site, large animal cages, use of insecticide nets, use of anti-mosquito medicines, and night-time malaria incidence habits.

In order to assess the association between the risk factors and the incidence of malaria, the chi-square test was used at a substantial level of 5%. The results of the bivariate analysis are shown in the following tables:

a. Relationship between age and malaria incidence

Table 2: Distribution of age and incidence of malaria at Elelim Public Health Centre, Yalimo District, Papua Province.

Age	Malaria Incidence				Total	
	Case		Control			
	n	%	n	%	n	%
< 20 years old	9	30	22	36.7	31	34.4
≥ 20 years old	21	70	38	63.3	59	65.6
Total	30	100	60	100	90	100
P-value = 0.695; OR = 0.740; CI95%= (0.289 – 1.897)						

Source: Primary Data, 2019

Table 2 indicates that out of 30 malaria patients, 9 (30 per cent) were < 20 years of age and 21 (90.9 per cent) were ≥ 20 years of age. Of the 60 non-malaria patients, 22 (36.7%) were < 20 years of age and 38 (63.3%) were ≥ 20 years of age.

This indicates that in the case group, the proportion of respondents ≥ 20 years of age was higher than those < 20 years of age, while in the control group, the proportion of respondents ≥ 20 years of age was also higher than those < 20 years of age. The statistical test results obtained by OR at approximately 0.740 and 95% CI (0.289–1.897) indicate that age was not a major risk factor for malaria incidence at the Elelim Public Health Center in Yalimo District, Papua Province.

b. Relationship between sex and malaria incidence

Table 3 indicates that 13 (43.3 percent) of the 30 malaria patients were female and 17 (56.7 percent) were male. Of the 60 non-malaria patients, 33 (55.0 percent) were female and 27 (45.0 percent) were male.

This shows that the proportion of female respondents in the case group was lower than that of male respondents, while the proportion of female respondents in the control group was higher than that of male respondents.

Table 3: Distribution of sex and malaria incidence in the Elelim Public Health Center in Yalimo District, Papua Province.

Sex	Malaria Incidence				Total	
	Case		Control			
	n	%	n	%	n	%
Female	13	43.3	33	55.0	46	51.1
Male	17	56.7	27	45.0	44	48.9
Total	30	100	60	100	90	100
P-value = 0.412; OR = 0.474; CI95%= (0.193 – 1.165)						

Source: Primary Data, 2019

The statistical test result obtained by OR about 0.474 and 95% CI (0.193–1.165) show that sex was not a significant risk factor for malaria incidence in the Elelim Public Health Center in Yalimo District, Papua Province.

c. Relationship between occupation and malaria incidence

Table 4 indicates that 11 (36.7%) of the 30 malaria patients were working and 19 (63.3%) were not working. Of the 60 non-malaria cases, 33 (55.0 per cent) worked and 27 (45.0 per cent) did not work. This indicates that the proportion of working respondents in the case group was lower than those who did not work, whereas the proportion of working respondents in the control group was higher than those who did not work.

Table 4: Distribution of occupation and malaria incidence in the Elelim Public Health Center in Yalimo District, Papua Province.

Occupation	Malaria Incidence				Total	
	Case		Control			
	n	%	n	%	n	%
Working	11	36.7	33	55.0	44	45.9
Not working	19	63.3	27	45.0	46	51.1
Total	30	100	60	100	90	100
P-value = 0.157; OR = 0.474; CI95%= (0.193 – 1.165)						

Source: Primary Data, 2019

The statistical test result obtained by OR at approximately 0.474 and 95 per cent CI (0.193–1.165) shows that the occupation was not a significant risk factor for malaria incidence at the Elelim Public Health Center in Yalimo District, Papua.

d. Relationship between education and malaria incidence

Table 5 shows that of 30 malaria patients, 10 (33.3 per cent) have a low level of education and 20 (66.7 per cent) have a high level of education. Although 60 non-malaria patients, 24 (40.0%) have a low level of education, and 36 (60.0%) have a high level of education. This indicates that, in the case group, the proportion of respondents with a low level of education was lower than those with a high level of education, whereas in the control group, the proportion of respondents with a low level of education was also lower than those with a high level of education.

Table 5: Distribution of education and malaria incidence at the Elelim Public Health Center in Yalimo District, Papua Province.

Education	Malaria Incidence				Total	
	Case		Control			
	n	%	n	%	n	%
Low	10	33.3	24	40.0	34	37.8
High	20	66.7	36	60.0	56	62.2
Total	30	100	60	100	90	100
P-value = 0.701; OR = 0.750; CI95%= (0.299 – 1.878)						

Source: Primary Data, 2019

The statistical test result obtained by OR at approximately 0.750 and 95 per cent CI (0.299–1.878) indicates that education was not a major risk factor for malaria incidence at the Elelim Public Health Center in Yalimo District, Papua Province.

e. Relationship between family income and malaria incidence

Table 6 reveals that 13 (43.3 per cent) of the 30 malaria patients had less family income and 17 (56.7 per cent) had adequate family income. Of the 60 non-malaria patients, 35 (58.3 per cent) had less family income and 25 (41.7 per cent) had enough family income. This shows that in the case group, the proportion of respondents who had less family income was lower than those who had sufficient family income, while in the control group, the proportion of respondents who had less family income was higher than those who had sufficient family income.

The statistical test result obtained by OR at approximately 0.546 and 95 per cent CI (0.255–1.325) indicates that family income was not a major risk factor for malaria incidence at the Elelim Public Health Center in Yalimo District, Papua.

Table 6: Distribution of family income and malaria incidence at the Elelim Public Health Center in Yalimo District, Papua Province.

Family income	Malaria Incidence				Total	
	Case		Control			
	n	%	n	%	n	%
Less	13	43.3	35	58.3	48	53.3
Enough	17	56.7	25	41.7	42	46.7
Total	30	100	60	100	90	100
P-value = 0.262; OR = 0.546; CI95%= (0.255 – 1.325)						

Source: Primary Data, 2019

f. Relationship between the use of wire mesh and malaria incidence

Table 7 shows that out of 30 malaria patients, 18 (60.0 per cent) were not using wire mesh and 12 (40.0 per cent) were using wire mesh. While from 60 non-malaria patients, 19 (31.7 per cent) did not use wire mesh and 41 (68.3 per cent) did not use wire mesh. This indicates that in the case group, the proportion of respondents who did not use wire mesh was greater than the respondents who used wire mesh while in the control group, the proportion of respondents who did not use wire mesh was smaller than the respondents who used wire mesh.

The statistical test results obtained by OR of 3.237 and 95 per cent CI (1.302–8.047) show that the use of wire mesh was a significant risk factor for malaria in the Elelim Public Health Center in Yalimo District, Papua. OR of 3.237 means that respondents who did not use wire mesh tended to be 3.237 times more infected with malaria than respondents who used wire mesh.

Table 7: Distribution of the use of wire mesh and malaria incidence at the Elelim Public Health Center in Yalimo District, Papua Province.

Use of wire mesh	Malaria Incidence				Total	
	Case		Control			
	n	%	n	%	n	%
No	18	60.0	19	31.7	48	41.1
Yes	12	40.0	41	68.3	42	58.9
Total	30	100	60	100	90	100
P-value = 0.013; OR = 3.237; CI95%= (1.302 – 8.047)						

Source: Primary Data, 2019

g. Relationship between the type of house wall and malaria incidence

Table 8 indicates that out of 30 malaria patients, 20 (66.7%) had their house wall type of wood and 10 (33.3%) had their house wall type of wall material. While of the 60 non-malaria patients, 19 (31.7%) had the wood type of their house wall and 41 (68.3%) had the wall type of their house wall. This indicates that in the case category, the proportion of respondents who had the wood type of their house wall was greater than the respondents who had the wall type of their house wall, while in the control group, the proportion of respondents who had the wood type of their house wall was lower than the respondents who had the wall type of their house wall.

Table 8: Distribution of the type of house wall and malaria incidence in the Elelim Public Health Center in Yalimo District, Papua Province.

Type of house wall	Malaria Incidence				Total	
	Case		Control			
	n	%	N	%	n	%
Wood	20	66.7	19	31.7	39	43.3
Wall	10	33.3	41	68.3	51	56.7
Total	30	100	60	100	90	100
P-value = 0.003; OR = 4.316; CI95%= (1.696 – 10.981)						

Source: Primary Data, 2019

The statistical test results obtained by OR of 4.316 and 95 per cent CI (1.693–10.981) show that the house wall type was a significant risk factor for malaria in the Elelim Public Health Center in Yalimo District, Papua Province. OR of 4.316 indicates that respondents who had the wood type of their house wall appeared to be infected with malaria 4.316 times higher than respondents who had the wall type of their house wall.

h. Relationship between the puddle near the house and malaria incidence

Table 9 shows that out of 30 malaria patients, 21 (70.0 per cent) have puddles near their homes and 9 (30.0 per cent) do not have a puddle near their homes. While among 60 non-malaria patients, 21 (35.0 per cent) had a puddle near their home and 39 (65.0 per cent) had no puddle near their home. This indicates that in the case category, the proportion of respondents who had a puddle near their house was higher than those who had no puddle near their house, while in the control group, the proportion of respondents who had a puddle near their house was lower than those who had no puddle near their house.

The statistical test results obtained by OR of 4.333 and 95 per cent CI (1.686–11.138) show that the near-home puddle was a significant risk factor for malaria in the Elelim Public Health Center in Yalimo District, Papua Province. OR 4.333 means that respondents who had puddles near their homes appeared to be contaminated with malaria 4.333 times higher than respondents who had no puddle near their homes.

Table 9: Distribution of the puddle near the house and malaria incidence in the Elelim Public Health Center in Yalimo District, Papua Province.

A puddle near the house	Malaria Incidence				Total	
	Case		Control			
	n	%	n	%	n	%
Yes	21	70.0	21	35.0	42	46.7
No	9	30.0	39	65.0	48	53.3
Total	30	100	60	100	90	100
P-value = 0.004; OR = 4.333; CI95%= (1.686 – 11.138)						

Source: Primary Data, 2019

i. Relationship between the distance between house and breeding place and malaria incidence

Table 10 indicates that out of 30 malaria patients, 23 (76.7 per cent) have a near distance between the house and the breeding site and 7 (23.3 per cent) have a long distance between the house and the breeding site. While among 60 non-malaria patients, 22 (36.7 per cent) have a near distance between the house and the breeding site and 38 (63.3 per cent) have a long distance between the house and the breeding site. This indicates that, in the case group, the proportion of respondents who have a near distance between the house and the breeding place was greater than those who have a long distance between the house and the breeding place, while in the control group, the proportion of respondents who have a close distance between the house and the breeding place was lower than those who have a long distance between the house and the breeding place.

Table 10: Distribution of distance between house and breeding place and malaria incidence in the Elelim Public Health Center in Yalimo District, Papua Province.

Distance between house and breading place	Malaria Incidence				Total	
	Case		Control			
	n	%	n	%	n	%
Close (≤ 50 m)	23	76.7	22	36.7	45	50
Far (> 50 m)	7	23.3	38	63.3	45	50
Total	30	100	60	100	90	100
P-value = 0.001; OR = 5.675; CI95%= (2.097 – 15.362)						

Source: Primary Data, 2019

The statistical test result obtained by OR at around 5.675 and 95 per cent CI (2.097–15.362) indicates that the distance between the house and the breeding site was a significant risk factor for malaria in the Elelim Public Health Center in Yalimo District, Papua. OR of 5.675 indicates that respondents who have a near distance

between the house and the breeding site appeared to be affected with malaria 5.675 times higher than respondents who have a long distance between the house and the breeding sites.

j. Relationship between the distance between the house and large cattle pens and malaria incidence

Table 11 indicates that 20 (66.7 percent) of 30 malaria patients have a long distance between the house and the large cattle pens and 10 (33.3 percent) have a near distance between the house and the large cattle pens. While out of 60 non-malaria patients, 26 (43.4%) have a long distance between the house and the large cattle pens and 34 (56.7%) have a near distance between the house and the large cattle pens. This shows that, in the case group, the proportion of respondents who had a long distance between the house and the large cattle pens was greater than the proportion of respondents who had a close distance between the house and the large cattle pens, while in the control group, the proportion of the respondents who have far the distance between house and large cattle pens was lesser than the respondents who have close the distance between the house and large cattle pens.

Table 11: Distribution of the distance between the house and large cattle pens and malaria incidence in the Elelim Public Health Center in Yalimo District, Papua Province.

Distance between the house and large cattle pens	Malaria Incidence				Total	
	Case		Control			
	n	%	n	%	n	%
Far	20	66.7	26	43.4	46	51.1
Close	10	33.3	34	56.7	44	48.9
Total	30	100	60	100	90	100
P-value = 0.042; OR = 2.615; CI95%= (1.048 – 6.529)						

Source: Primary Data, 2019

The statistical test result obtained by OR at about 2.615 and 95 per cent CI (1.048–6.529) indicates that the distance between the house and the broad cattle pens was a major risk factor for malaria in the Elelim Public Health Center in Yalimo District, Papua. OR of 2.615 indicates that respondents who have a long distance between the house and large cattle pens appear to be 2,615 times more malaria-infected than respondents who have a near distance between the house and large cattle pens.

k. Relationship between the use of insecticide net and malaria incidence

Table 12 indicates that 9 (30.0 per cent) of the 30 malaria patients did not use net insecticide and 21 (70.0 per cent) use net insecticide. Of the 60 non-malaria patients, 26 (43.4%) did not use net insecticide and 34 (56.7%) use insecticide net. This indicates that, in the case group, the proportion of respondents who were not using net insecticide was lower than the proportion of respondents who were using net insecticide, whereas in the control group, the proportion of respondents who were not using net insecticide was also lower than the proportion of respondents who were using net insecticide.

Table 12: Distribution of the use of insecticide net and malaria incidence in the Elelim Public Health Center in Yalimo District, Papua Province.

Use of insecticide net	Malaria Incidence				Total	
	Case		Control			
	n	%	n	%	n	%
No	9	30	4	43.4	13	14.4
Yes	21	70	56	56.7	77	85.6
Total	30	100	60	100	90	100
P-value = 0.008; OR = 6.000; CI95%= (1.668 – 21.583)						

Source: Primary Data, 2019

The statistical test result obtained by OR about 6.000 and 95% CI (1.668–21.583) show that the use of insecticide net was a significant risk factor for malaria incidence in the Elelim Public Health Center in Yalimo District, Papua Province. The OR of 6.000 means that respondents who were not using insecticide net tended to be infected by malaria 6.000 times higher than the respondents who were using insecticide net.

l. Relationship between the use of anti-mosquito repellent and malaria incidence

Table 13 shows that 19 (63.3 percent) of the 30 malaria patients did not use anti-mosquito repellent and 11 (36.7 percent) use anti-mosquito repellent. Out of 60 non-malaria patients, 34 (56.7%) did not use anti-mosquito repellent and 26 (43.3%) use anti-mosquito repellent. This shows that in the case group, the proportion of respondents who were not using anti-mosquito repellent was higher than those who were using anti-mosquito repellent, while in the control group, the proportion of respondents who were not using anti-mosquito repellent was also higher than those who were using anti-mosquito repellent.

Table 13: Distribution of the use of anti-mosquito repellent and malaria incidence in Elelim Public Health Center at Yalimo District, Papua Province.

Use of anti-mosquito repellent	Malaria Incidence				Total	
	Case		Control			
	n	%	n	%	n	%
No	19	63.3	34	56.7	53	58.9
Yes	11	36.7	26	43.3	37	41.1
Total	30	100	60	100	90	100
P-value = 0.705; OR = 1.321; CI95%= (0.536 – 3.253)						

Source: Primary Data, 2019

The statistical test result obtained by OR about 1.321 and 95% CI (0.536–3.253) show that the use of anti-mosquito repellent was not a significant risk factor for malaria incidence in the Elelim Public Health Center in Yalimo District, Papua Province.

m. Relationship between nighttime habits and malaria incidence

Table 14 reveals that 13 (43.3 per cent) of 30 malaria patients have night-time habits and 17 (56.7 per cent) have no night-time habits. While out of 60 non-malaria patients, 19 (31.7%) had night-time habits and 41 (68.3%) had no night-time habits. This shows that in the case-group, the proportion of respondents who had night-time habits was lower than those who had no night-time habits, while in the control-group, the proportion of respondents who had night-time habits was also lower than those who had no night-time habits.

Table 14: Distribution of nighttime habits and malaria incidence in the Elelim Public Health Center in Yalimo District, Papua Province.

Nighttime habits	Malaria Incidence				Total	
	Case		Control			
	n	%	n	%	n	%
Often	13	43.3	19	31.7	32	35.6
Not often	17	56.7	41	68.3	58	64.4
Total	30	100	60	100	90	100
P-value = 0.392; OR = 1.650; CI95%= (0.668 – 4.075)						

Source: Primary Data, 2019

The statistical test result obtained by OR about 1.650 and 95% CI (0.668–4.075) show that nighttime habits were not a significant risk factor for malaria incidence in the Elelim Public Health Center in Yalimo District, Papua Province.

3.3. Multivariate Analysis

Multivariate analysis used in this study was multiple logistic regressions. This analysis is a mathematical model used to study the relationship between two or several independent variables and one dichotomous dependent variable [10]. This analysis was intended to determine the most dominant risk factors for malaria incidence in Elelim Public Health Center in Yalimo District, Papua Province. The results of the multivariate analysis can be seen in table 15.

Based on the results of multiple logistic regression analysis, the dominant risk factors for malaria incidence in the Elelim Public Health Center in Yalimo District, Papua Province were occupation, type of house wall, puddle near the house, the distance between house and breading place, the distance between the house and large cattle pens, and the use of insecticide net. The most dominant risk factor is the type of the house wall.

Table 15: The result of Multiple Logistic Regression Analysis with Stepwise Backward LR Method between Independent Variables on malaria incidence in Elelim Public Health Center at Yalimo District, Papua Province.

Covariate	B	P	OR	95%CI	
Occupation	-1.573	0.029	0.207	0.050	0.852
Type of house wall	2.703	0.001	14.928	3.132	71.151
Puddle near the house	1.504	0.024	4.501	1.219	16.628
Distance between house and breading place	1.345	0.039	3.838	1.067	13.809
Distance between house and large cattle pens	1.750	0.017	5.755	1.372	24.130
Use of insecticide net	2.034	0.016	7.642	1.463	39.932
Constant	-11.383	0.000	0.000		

Source: Primary Data, 2020

4. Discussion

4.1. Association between age and malaria incidence

According to Gunawan in Prastiawan [11], age and sex differences in malaria prevalence are related to the degree of immunity of a person due to variations in exposure to Anopheles mosquito bites. Adults with a variety of activities outside the home, especially in areas around mosquito breeding at night, are more likely to be in contact with mosquitoes. Women have a stronger immune response than men, but the risk of getting malaria increases during pregnancy. The results were obtained in the case group of malaria incidence in respondents aged < 20 years as many as 9 people (30%) and at the age of > 20 years as many as 21 people (70%). This indicates the same danger as the occurrence of malaria. The results of the statistical tests showed that there was no age influence with the risk of malaria incidence at the Elelim Public Health Center in the Yalimo District. In line with the research carried out by [12] in Purbalingga Regency, which indicated that age did not affect the incidence of malaria in the age group. Theoretically, age groups are usually susceptible to malaria in children. However, the results obtained in this study include not only the age group of children who may experience malaria, but also other age groups, namely the middle adult group as the majority of recurrence. The lack of age, the influence conveyed by [13], is that, in general, all people can potentially be infected with malaria. Malaria prevalence differences according to age relate to immunity due to variations in exposure to mosquito bites. The immunity of a child from his mother will protect him from malaria. Babies usually get more protection from their mother against mosquito bites so that cases rarely occur in infants. However, if there are cases in children, it is suggested that there is a high rate of malaria transmission in the region. Although the age of children is very susceptible to malaria infection, it is because the body's antibodies in children have not been properly formed while the immunity from the mother continues to decline. The incidence of malaria in children often occurs because, in general , children do not know the causes of malaria and therefore do not prevent mosquito bites. In this situation, the role of parents in protecting children from malaria infection by providing clothing that can protect children from mosquito bites and protect children while sleeping with mosquito nets is very important to prevent transmission of malaria in children [14]. Adolescence and adulthood ages are vulnerable to malaria

infection because they have high activity both during the day and at night, including at work. Teenagers usually hang out on the side of the road, around coffee shops, or other open spaces that allow mosquito bites to be exposed. But this is determined by the behavior of protecting themselves from mosquito bites by wearing good protective clothing or as an anti-mosquito repellent. While in adulthood, natural antibodies have arisen from previous infections or from individual nutritional conditions. However, adults with high work activity tend not to pay attention to and ignore mosquito bites while working. High-risk malaria control occupations, such as farmers, livestock breeding and labor, are responsible for the high incidence of malaria.

4.2. Association between sex and malaria incidence

The results of the statistical test indicated that there was no significant gender impact on malaria risk at the Elelim Public Health Center in the Yalimo District. In this study, Lestari and Salamah [15] found that sex does not affect the incidence of malaria due to other factors that cause disparities, especially in pregnant women and children who are more vulnerable to malaria. This is different from what Mantra has conveyed in Prastiawan[11], in general , the main age group for circular mobility is male. This is because men with a strong age are considered to be responsible for the family, so that in order to fulfill the economy of their family, they have to work and provide a great opportunity for men of a productive age to move around. According to Gunawan in Prastiwan [11], gender-based differences in malaria prevalence are related to the degree of immunity of a person due to variations in papacy against Anopheles mosquito bites. The nature of the people in Yalimo Regency, both men and women, to be outside the house at night is still very similar, ranging from talking on the terrace, honay, parties or sitting on the side of the highway to eating betel nuts, singing and chatting, this activity is not unique to any age groups or genders, though Anopheles mosquitoes tend to bite at night.

4.3. Association between occupation and malaria incidence

The working environment in an area may have an impact on the incidence of malaria. People living in a work environment that is endemic to malaria are more likely to suffer from malaria [13]. People who suffer from malaria are people who work as farmers, planters or at risk for jobs. Occupation can play an important role in the transmission of malaria as it relates to the environmental conditions of work. Work outside the home, in a rural area or in a plantation will have a higher risk of being bitten by malaria mosquitoes. In addition to planting or tapping palm trees and sugar Java makers, can also interact with Anopheles maculatus mosquitoes, one of the vectors on the island of Java that is closely linked to vegetation in rivers around the forest [16]. Results have shown that there is no influence of malaria risk at the Elelim Public Health Center in the Yalimo District. This is supported by the results of research conducted by [17] in the district of Kabola, East Nusa Tenggara, which works in a broad sense and is the main activity performed by humans. In the narrow sense, the word "employment" is used for a mission or a job that makes money for someone. Employment is more viewed from the possibility of special exposure and the degree of exposure and the magnitude of the risk, depending on the nature of work, which will also affect the working environment and the socio-economic nature of the workforce in certain jobs.. This is reinforced by the findings of studies in Thailand and the Philippines that indicate that research is acceptable for mosquito vector bite practices, such as going to the forest at night or remaining there

during the rainy season for logging activities that increase the risk of transmission. The population at greatest risk is the male and migrant workers involved in logging activities [18]. Respondents in this study who work at risk are generally those engaged in farming , hunting and working in companies that tend to be in open areas. This kind of work appears to be done in the morning until the afternoon. Whereas respondents whose job is not at risk in the building are less vulnerable to mosquito bites. The usual behavior of the people in the Yalimo district, both men and women, to be outside the house at night is still very close. The poor condition of the walls of the house and the use of wire mesh, just as likely as Anophele's mosquito bites at night. The degree of one's job can not directly affect the occurrence of malaria, nor the actions of anyone at risk of malaria. People who work in risky locations but have good prevention against Anopheles mosquito bites by using anti-mosquito repellent, thus reducing and avoiding exposure to Anopheles mosquito bites.

4.4. Association between education and malaria incidence

The findings show that there is no relationship between education and malaria incidence at the Elelim Public Health Center in the Yalimo District. In the malaria case group, the low-education respondents were 43.3 per cent and the higher education respondents were 56.7 per cent. This shows that low and high education have the same opportunities for malaria-infected risk. The findings of the research are in line with the research conducted by Sudarsono [19] at the West Arso Public Health Center in the Keerom District, which found that education had no effect on the incidence of malaria. Education means guidance given to someone else to understand something. It is undeniably true that the higher the education of a person, the easier they will receive information and, ultimately, the more knowledge they have. Conversely, if a person has a low level of education, it will hinder the development of that person's attitude towards receiving information and the introduction of new values[20]. For another research performed by Delil [21], the prevalence of malaria was still the main cause of death relative to fever. Bad awareness, not using a clean bed, and tropical areas with puddles are the source of malaria. Health promotion of malaria has been disseminated by local health institutions in the field of prevention, so that community action behavior has a strong impact on the prevention of malaria.

4.5. Association between family income and malaria incidence

Malaria is linked to poverty as well as to cause and effect. Malaria has a significant impact on the conditions of the poor population in remote areas far from the health care environment. Poverty plays a role in the spread of infectious diseases from various infectious diseases, because poverty is determined by the inability to meet the minimum basic needs such as food, clothing, health, housing and education needed to be able to live and work [22]. Poor people tend not to pay attention to clothing and shelter needs, because of difficulties in meeting their daily food needs. Thus, the condition of poor people's homes, which is made of cheap materials, can cause mosquitoes to enter. Poverty also causes balanced nutritional needs to be met so that the body's resistance to malaria is low so that it is susceptible to malaria. The findings showed that there was no effect on family income and the incidence of malaria in the Elelim Community Health Center in the Yalimo District. In the malaria case group, 43.3 per cent of respondents had less family income and 56.7 per cent had sufficient family income. This shows that the risk of malaria is not affected by a high socio-economic level. This work is consistent with what has been done previously by [23], which has shown that there is no socio-economic effect and risk of malaria

incidence. While malaria sufferers in the Elelim Public Health Center in the Yalimo District have higher incomes, the incidence rate of malaria remains high , suggesting that there is a lack of community willingness to use part of their income to avoid or reduce contact with mosquitoes such as wire mesh purchases or anti-mosquito repellents. The economic status will affect the incidence of malaria, but does not underlie changes in health behaviour, unless it is accompanied by preventive measures [24].

4.6. Association between the use of wire mesh and malaria incidence

A house with a ventilated environment with no mosquito net mounted would make it easier for mosquitoes to reach the house to bite humans. The results showed that there was an impact on the use of wire mesh with malaria risk in the Elelim Health Center in the Yalimo District. In the malaria case group, 60 per cent of respondents who did not use wire mesh and 40 per cent of respondents used wire mesh. The odds ratio test results were interpreted to mean that respondents who did not use wire mesh at home had a 3.237-fold higher risk of malaria compared to respondents who used wire mesh at home. This research is consistent with the previous one conducted by [19] at the West Arso Health Center at Keerom Regency and the research conducted by [25] at the Manganitu Health Center in the Sangihe Islands District has shown that the use of a wire mesh attached to the vent has affected the incidence of malaria, which is 23.3 times the risk of malaria in homes without gauze. The physical condition of the respondent's home is generally semi-permanent. Respondents who suffer from malaria due to the installation of a partially installed wire mesh, and it is also installed, but there is a hole in it. In the absence of mosquito net in the ventilation of the room, it would be easier for Anopheles spp mosquitoes to reach the house at night.

4.7. Association between the type of house wall and malaria incidence

According to the Decree of the Minister of Health RI No. 829 of 1999 concerning the requirements for the quality of a healthy home is the construction of a residential wall that is tightly closed and not made of materials that can grow or become a den of disease bacteria. The physical condition of the respondent's home in the work area of the Elelim Community Health Center is partly made up of permanent and semi-permanent houses made of wood / board. The results showed that the Elelim Public Health Center in the Yalimo District had an impact on the type of house wall at risk of malaria. In the case of malaria, the respondents had houses with wood / wood wall types as much as 66.7 per cent and the respondents whose house walls used stone walls were 33.3 per cent. The odds ratio test results are interpreted to indicate that respondents whose house walls use boards / wood are at risk of malaria incidence 4.316 times higher than respondents whose house walls are made of stone walls. The findings of a previous study conducted by [19] have shown that the form of wall of the house affects the incidence of malaria, in particular the use of walls made of boards. The results of the study are in line with the findings of [26] in Lampung that residents with inadequate wall construction are at a higher risk of malaria infection by 30 % compared to residents with adequate wall construction. Residents with house walls made of bamboo cubicles are 5.62 times more likely to be infected with malaria than residents of brick wall houses. The walls made of wood and bamboo allow mosquitoes to perch and rest. House walls made of wood or woven bamboo are more likely to have more holes used by mosquitoes as a place to reach the building. Preventive efforts can be made by families by adding plywood walls to the inside of the house and the ceiling so that walls

that are not tight can be covered with plywood that can prevent mosquitoes from entering at night.

4.8. Association between puddle near the house and malaria incidence

According to the Indonesian Ministry of Health in 2014, Anopheles subpictus, Anopheles barbirostris and Anopheles sundaicus are best suited for breeding in areas with brackish waters, while larvae are more commonly found in standing water covered by plants. Anopheles sundaicus and Anopheles subpictus prefer sunlight and habitat more often in fishponds and excavations along or along coastal areas. Anopheles barbirostris prefers living in wetlands, water bodies, drainage canals and swamps [27]. Anopheles barbirostris likes the breading in which the water is static / flows slowly, while Anopheles minimus likes the quick flow of water and Anopheles latifer likes stagnant water [28]. The findings showed that there was a major effect of malaria risk puddles at the Elelim Public Health Center in the Yalimo District. In the malaria case group, 70 % of the respondents had a pool of water and 30% did not have a pool of water. Based on the odds ratio test , respondents who have a pool of water are 4.333 times more at risk of malaria relative to respondents whose home environment had no standing water. The results of this study are consistent with previous research conducted by [19] at the West Arso Health Centre, which found that puddles had an impact on the incidence of malaria. The puddles used in this study are temporary or permanent puddles, including puddles consisting of water spinach ponds, ponds, drains whose water does not flow, flower pots, unused drums, empty cans, and others containing water.

4.9. Association between breading place and malaria incidence

The findings showed that there is an impact of the distance between the house and the breeding site at risk of malaria in the Elelim Public Health Center in the Yalimo District. The odds ratio test results interpreted that respondents living close distances between the house and the breeding site tend to have malaria infections 2.22 times higher than those living far away from the breeding site. The results of the Lefaan study [29] showed that the risk factor for the presence of mosquito breeding sites is one of the risk factors for malaria, where people living in mosquito breeding sites are 8.33 times at risk of malaria compared to people whose homes do not have mosquito breeding sites. One form of longing around the residents' homes is bushes, and apart from the mosquito breeding factor in residential areas, the incidence of malaria is also affected. The types of breeding sites in the work area of the Elelim Public Health Center are different in each field. The entire region of the Elelim Public Health Center is at risk of malaria transmission. Case distribution was observed at an average index of 50 m and the majority of cases of malaria were located at a distance of < 50 m from the breeding sites of Anopheles larvae. It indicates that near breeding sites are more at risk of malaria.

4.10. Association between large cattle pens and malaria incidence

The findings showed that there was no effect on the existence of large malaria-risk animal pens in the Elelim Public Health Center in the Yalimo District. Cages are a place of rest for malaria mosquito vectors before and after contact with humans because they are protected from sunlight and moisture. There are also several types of Anopheles mosquitoes, which are zoophilic and anthropophilic or like animal blood and human blood, so that

the presence of cattle pens is at risk for malaria cases [13]. The presence of livestock in the study area, including poultry, cattle, goats and cows, may reduce human mosquito bites. The results of the analysis of Idrus and Getrudis [30] in the Koeloda Public Health Centre, Golewa Subdistrict, Ngada Regency suggested that there is a link between raising livestock other than poultry with malaria incidence. Maintenance of livestock such as buffalo, goats and cows around the house can act as a barrier or a Cattle Barrier that can prevent human contact with mosquitoes. At night, in rural areas where livestock are present, mosquito activity is mainly found in cages and surrounding areas, so that the presence of livestock pens will help to reduce the incidence of malaria, because Anopheles mosquitoes are zoophilic so that the presence of livestock around the house will attract attention to mosquitoes, preferring biting animals [13]. The presence of a cage influences the transmission of malaria, with a minimum requirement that a safe cage is outside the house and more than 10 m away from the door, has adequate sunshine and is also not moist [27].

4.11. Association between the use of insecticide net and malaria incidence

The insecticide used in mosquito nets is safe for humans and has been used in many countries. The insecticide-treated bed net program is an alternative for controlling malaria vectors in areas with mosquito-biting behavior in homes and areas with indoor residual spray (IRS) rejection. One attempt to avoid malaria transmission is the use of insecticide-treated bednets [31]. The findings showed that there was an effect on the use of malaria-risk mosquito nets at the Elelim Health Center in the Yalimo District. In the malaria case group, 30 % of the respondents did not use insecticide-treated mosquito nets, and 70 % of the respondents used insecticide-treated mosquito nets. The odds ratio test results showed that respondents who did not use mosquito nets were 6,000 times higher at risk of malaria than those who used mosquito nets. This work is also consistent with previous research performed by Lestari and Salamah in the provinces of West Nusa Tenggara, East Nusa Tenggara, Maluku, North Maluku, Papua and West Papua. Based on the research findings of Rahmadiliyani [32], the use of insecticide-treated bed nets is very effective in reducing or preventing malaria. Insecticide-treated mosquito nets are required to keep biological activity to a minimum. The use of mosquito nets has been shown to be important by reducing the incidence of malaria. This is because respondents who do not sleep are using mosquito nets, even if they have used wire nets and walls made of bricks, mosquitoes can reach through holes that are sometimes exposed so that malaria mosquitoes may invade the room and bite if they do not sleep using mosquito nets.

4.12. Association between the use of anti-mosquito repellent and malaria incidence

The findings showed that there was an effect on the use of anti-mosquito repellent with malaria incidence in the Elelim Public Health Center in the Yalimo District. In the malaria case group, 63.3 per cent of respondents did not have the habit of using anti-mosquito repellent and 36.7 per cent of respondents used anti-mosquito repellent. Respondents who have not used anti-mosquito repellent have a higher chance of malaria incidence of 1,321 times higher than respondents who use anti-mosquito repellent. This is due to the fact that respondents who have walls made of boards and do not use gauze, but use anti-mosquito repellent will prevent malaria mosquito bites. Research conducted by [33] at the Cikeusik Subdistrict Public Health Center in Pandeglang District has shown that there is a 9.27-fold incidence of anti-mosquito drug use with a high risk of malaria

among respondents who did not use anti-mosquito drugs. Spraying mosquito repellent liquid sprayed into the room will kill mosquitoes in the short term, but a gauze-free house and walls made of boards make it possible for mosquitoes to re-enter. The key action is an individual preventive measure about how a person can prevent bites of mosquitoes.

4.13. Association between nighttime habits and malaria incidence

The findings show that there was no substantial effect on night-time malaria risk behaviors at the Elelim Health Center in the Yalimo District. This research was consistent with Hasyim [34] that the practice of going out at night was not significantly linked to malaria cases. Most Anopheles mosquitoes are crepuscular, which are active at dusk or dawn or at night, meaning that the mosquito biting activity is still active during the night, beginning from 18:00 to 06:00 and hitting a peak at 24:00-01.00. However, there are also Anopheles mosquitoes that are involved from midnight until early morning. Anopheles balabacencis blood-sucking operation appears to last all night, but the peak is about 01.00-03.00. Nighttime habits, which often and rarely occur at night, are equally at risk with malaria. Preventing the occurrence of malaria in person can be achieved by the use of repellent and long-sleeved clothing that effectively prevents malaria mosquito bites during nighttime outdoor activities. Preventive behavior is a more powerful factor that affects the habit of going out at night.

4.14. The dominant risk factors for malaria incidence

Multivariate test results showed that the dominant risk factors for malaria incidence were the type of house wall (p-value = 0.001), the use of insecticide-treated mosquito nets (p-value = 0.016), the presence of large animal pens (p-value = 0.017), standing water (p-value = 0.024) and the distance between the house and the breeding site (p-value = 0.039). The model indicates that the form of house wall is a major factor in the incidence of malaria at a rate of 14,928 times in people who have a wall system made of wooden boards. The dominant factor is caused by having a relationship with the risk of malaria, that is to say, someone who does not use or install wire nets; mosquitoes can easily enter the house, particularly the houses adjacent to the breeding grounds. Also, someone who doesn't use mosquito nets and doesn't use mosquito repellent can get mosquito bites at night. Whereas the normal practice of going out at night without using anti-mosquito repellent is at risk of mosquito bites at night.

5. Conclusion

On the basis of the findings of the data analysis and the hypothesis testing, it can be inferred as follows:

1. Based on univariate analysis, it was described that 30 (33.3%) of the 90 samples were positive for malaria and 60 (66.7%) were negative for malaria. Then, of the 90 samples, the majority (65.6 %) were > 20 years of age, 46 (51.1 %) were female, 46 (51.1 %) did not work, 56 (62.2 %) were educated, 48 (53.3 %) had less family income, 53 (58.9 %) used wire mesh, 51 (56.7 %) used stone walls, 48 (53.3 %) had no puddles, 45 people (50 %) who have mosquito breeding near their homes, 77 people (85.6 %) who use insecticide-treated mosquito nets, 53 people (58.9 %) who do not use mosquito repellent, and 58 people (64.4 %) who do not often go out at night.

2. Based on the bivariate analysis, it was found six risk factors associated with malaria incidence in the Elelim Public Health Center in Yalimo District, Papua Province; they were: use of wire mesh, type of house wall, puddle near the house, the distance between house and breading place, the distance between the house and large cattle pens, and the use of insecticide net; whereas age, sex, occupation, education, family income, use of anti-mosquito repellent, and nighttime habits were not associated with malaria incidence in the Elelim Public Health Center in Yalimo District, Papua Province.
3. Based on the multiple logistic regression analysis, it was found the dominant risk factors for malaria incidence in the Elelim Public Health Center in Yalimo District, Papua Province were occupation, type of house wall, puddle near the house, the distance between house and breading place, the distance between the house and large cattle pens, and the use of insecticide net. The most dominant risk factor was the type of the house wall.

6. Suggestion

1. Increased promotion efforts to improve the sanitation of homes that meet the requirements, in particular in the community, by providing alternatives to the types of house walls that can be tightened, the use of wire mesh, the distance between the house and the breeding site, the use of mosquito nets and the distribution of insecticide mosquito nets to the community at least once every 3 years.
2. Further to improve malaria prevention, particularly those living near breeding sites by installing wire mesh, using insecticide-treated mosquito nets, eradicating mosquito larvae by doing 3M (Menguras=draining, Menutup=closing, dan Mengubur=burying) and spreading mosquito larvae-eating fish.

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