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ANALYSIS OF ENVIRONMENTAL RISK FACTORS ON MALARIA INCIDENCE IN FAKFAK REGENCY, WEST PAPUA

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ABSTRACT

Malaria is still a significant problem in Indonesia due to its contagious nature, as it causes death, especially in children under the age of five. Based on 2019 data, there have been 409,000 deaths from malaria out of 229 million recorded malaria cases worldwide. WHO launched that in Indonesia there were 1,412 deaths from malaria from 811,636 new cases of malaria in 2021 in Indonesia. 89% of malaria cases in Indonesia occur in Papua Province. Fakfak Regency in 2023 will experience an increase in cases to 180 cases with API 2.2 per 1,000 population and still 50 Indigenous cases. This study aims to analyze the environmental factors that are most at risk for malaria incidence in Fakfak Regency, West Papua. Method: The study is observational with a Case-control research design. The 100 respondents used a total sampling consisting of 50 positive malaria cases with indigenous classification and 50 controls. Results: The most potential environmental risk factors for malaria incidence were the presence of breeding places with p-values of 0.000 and OR 13,903 (95%CI: 3,374-57,287), and night exit habits (p-value 0.045; OR 1,678). One important step is to break the chain of transmission by controlling environmental factors, namely the eradication of vector breeding sites, larvicide in puddles, cleaning of anopheles vector rest areas, the use of mosquito nets, Insect Residual Spraying (IRS), and other activities that can encourage the breaking of the chain of malaria transmission, which is carried out in an integrated manner by the community

KEYWORDS *Malaria, Anopheles, Environmental Factors, Plasmodium*

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INTRODUCTION

Malaria is caused by the Plasmodium parasite carried by anopheles mosquitoes, through the salivary glands at the time of biting to find blood for maturation of female mosquito eggs. There are 5 types of species that infect humans, namely: Plasmodium ovale, Plasmodium malariae, Plasmodium falciparum, Plasmodium vivax, and Plasmodium knowlesi (Indonesia., 2020). Plasmodium lives and multiplies in human red blood cells. P. falciparum is highly feared because it is responsible for 80% morbidity and 90% mortality. Anopheles sp mosquitoes undergo complete metamorphosis in their life cycle, namely eggs, larvae, pupae and adult mosquitoes (Soedarto, 2011).

Malaria has the main symptoms of fever with periodicity depending on the type of malaria. In addition, other symptoms such as headache, nausea, vomiting, diarrhea, aches and muscle aches are also encountered.

According to WHO's assessment of malaria cases in 2022, there are an estimated 249 million cases in 85 countries and regions where malaria is endemic, which is 5 million more cases than in 2021 (WHO, 2023b).

Eliminating the malaria epidemic is one of the Sustainable Development Goals (SDGs) and an important metric that must be met by 2030. Based on World Malaria Day 2023 in Indonesia, there were 1,412 deaths from malaria from 811,636 new cases of malaria in 2021 in Indonesia, of which 89% of malaria cases in Indonesia occurred in Papua Province (WHO, 2023a). Malaria causes considerable economic losses so it is still a problem in Indonesia. Malaria control efforts have made progress in the past decade, but 2022 is on the rise.

Malaria cases in Indonesia in 2022 are increasing with an annual incidence of parasites of 1.6 per 1,000 people. API indicators are used to classify malaria endemicity in Indonesia, where eastern Indonesia is an area with high malaria cases (M. of Health., 2023). Fakfak Regency in 2023 will experience an increase in cases to 180 cases with API 2.2 per 1,000 population and there are still 50 Indigenous cases (Office., 2022). The increase in malaria cases in Fakfak Regency is caused by high imported cases supported by environmental risk factors and low public awareness in malaria prevention and control efforts.

Environmental factors have a significant impact on malaria transmission. Environmental factors are all external conditions and influences that affect the life and development of organisms such as physical environment such as temperature, humidity, rain, altitude, wind, sunlight, water currents, state of walls, presence of wire gauze on house ventilation, ceilings, and hanging clothes, biological environment such as the presence of standing water, breeding grounds, livestock pens, larva-eating fish, chemical environments such as pH and salinity, as well as socio-cultural environments such as the use of mosquito nets, the habit of not wearing long sleeves, the use of insect repellent, various human activities such as dam construction, road construction, mining and the construction of new settlements or transmigration (Sucipto, 2015). The purpose of this study was to analyze the environmental factors most at risk for malaria incidence.

RESEARCH METHOD

This type of research is observational with *a Case control* research design, to measure the degree of risk between several *independent* variables (risk factors) as cause and *dependent variables* (incidence of malaria) as a result. The respondents numbered 100 people, consisting of 50 cases who were declared positive for malaria based on the results of microscopic examinations in all healthcare facilities recorded in *E-Sismal* from January to December 2023. The criteria for the cases to be respondents are indigenous cases domiciled in Fakfak Regency, spread across 7 districts out of 17 existing districts. While the control as many as 50 respondents, having the same characteristics as the case, were at least 100 meters away from the index case and proved by negative malaria RDT test results.

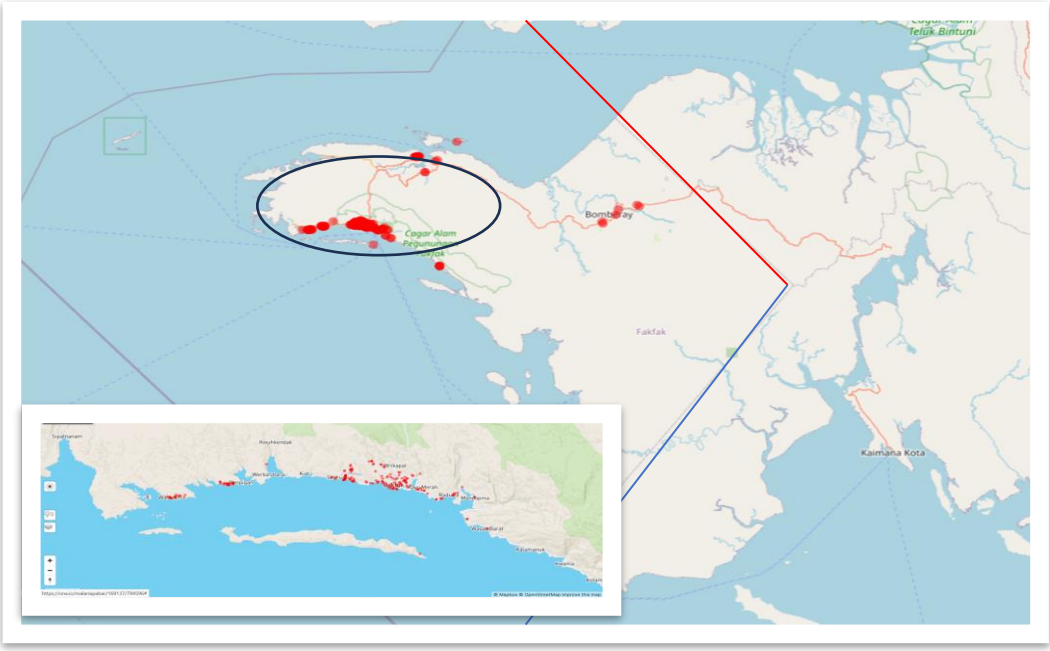
The characteristics of respondents interviewed were respondents' age, gender, race, occupation, and education level. In addition, interviews were also conducted to find out the habits of respondents outside the home, using mosquito nets, mosquito repellent, going to endemic areas, and seeking treatment themselves. Environmental factors that are measured are the temperature and humidity of the house. While observations were made to see the condition of the walls of the house, the presence of gauze on ventilation, the presence of ceilings, breeding places (puddles), Anopheles larvae and bushes.

In addition to using questionnaire sheets and observations filled out manually by surveyors, to facilitate data entry, further input into ONA DATA using Mobile through a link containing survey data. ONA DATA contains all parameters on the questionnaire and observation sheets, in addition to containing coordinate points that automatically adjust the location of respondents. Data analysis was carried out using the SPSS program version 20, including univariate, bivariate and multivariate data analysis.

RESULT AND DISCUSSION

Based on the path coefficients (influence strength) of transformational leadership, work climate, and professional attitude on organizational commitment of teachers, the priority order for improving indicators of each variable is as follows, as seen in Table 1 and Table 2.

This study was conducted in Fakfak District, West Papua Province, in the case group (50 respondents) and the control group (50 respondents). The following is a map of the distribution of indigenous cases that were the subject of research:



Source : Ona Data (inputted based on *e-Sismal data*).
Figure 1. Map of Indigenous Malaria Cases in Fakfak Regency in 2023

Based on Table 1, the distribution of respondents by sex in the case group was found to be 58% male and 42% female. While in the control group, the number of male and female respondents was as many as the case group. Similarly, the distribution of age groups has almost the same amount as controls at all levels. Based on the grouping of age groups, namely the age under 5 years (toddlers) in the case group found 18%, ages 5 to 20 years as much as 44%, ages 21-30 years as much as 4% and the rest over 30 years as much as 34%. Most cases are found in the adolescent age group. Based on data also shows that malaria cases are more suffered by the Papuan race as much as 62% than the Non-Papuan race.

Judging from the type of work of respondents, it shows the highest group of malaria cases in students, which is 36%. Likewise, in the highest control group in students as much as 34%. The selection of controls as closely as possible is sought that have the same characteristics as the group of cases, so that the data show a similarity in numbers between cases and controls. While the characteristics of respondents based on income, most respondents have income below 1 (one) million rupiah, which is as much as 80%.

Table 1. Respondent Characteristic

Characteristic	Case		Control	
	N	%	N	%
Gender				
a.Man	29	58,0	29	58,0
b.Woman	21	42,0	21	42,0
Age				
a.<5 year	9	18,0	11	22,0
b.5-20 year	22	44,0	20	40,0
c. 21-30 year	2	4,0	2	4,0
d. >30 year	17	34,0	17	34,0
Ras				
a.Papua	31	62,0	38	76,0
b.Non Papua	19	38,0	12	24,0
Education				
a.No school	9	18,0	12	24,0
b.No/not over SD	2	4,0	13	26,0
c.SD	18	36,0	10	20,0
d.SLTP	12	24,0	3	6,0
e.SLTA	8	16,0	7	14,0
f.Academic /PT	1	2,0	5	10,0
Work				
a.Not Working	14	28,0	12	24,0
b.Fishermen	0	0,0	2	4,0
c.Farmer/gardening	9	18,0	8	16,0
d.Mine labor	1	2,0	0	0,0
e.Housewives	2	4,0	5	10,0
f.PNS /TNI Polri	4	8,0	6	12,0
g.Forest encroachers	1	2,0	0	0,0
h.Merchant	1	2,0	0	0,0
i.Students	18	36,0	17	34,0
Income				
a.<Rp1.000.000	40	80,0	40	80,0
b.Rp1.000.000-2.000.000	4	8,0	8	16,0
c.>Rp2.000.000	6	12,0	2	4,0

The frequency distribution of respondents' house temperatures when surveyed in cases and controls obtained the highest temperature above 27 ^{0}C. This is also the same as the temperature outside the house, especially when observed in the environment in the bushes where mosquitoes rest, with temperatures above 27 ^{0}C. Control obtained the highest percentage at a temperature of 25-27 ^{0}C. Most of the humidity inside and outside the homes of respondents, cases and controls had a humidity of ≥60% (90%).

The frequency distribution of factors of the physical environment of the respondent's house obtained through observation of the home environment including temperature, humidity, the presence of wire gauze, the condition of the walls, and the ceiling (ceiling of the house), as follows:

Table 2. Environmental Risk Factors with the Incidence of Malaria

Environmental Risk Factors	Incident Case	Malaria Control	p=value	OR	95%CI
The condition of the walls of the house					
Not eligible	13	9	0,469	1,601	0,613-4,176
Qualify	37	41			
Kawat Kasa					
Not eligible	46	46	1,000	1,000	0,236-4,241
Qualify	4	4			
Ceiling					
Not eligible	40	42	0,795	0,762	0,273-2,125
Qualify	10	8			
The existence of cattle sheds					
There is a cattle shed ≤50m from the house	0	0	1,000	0,00	0,00-
There is a cattle shed 50m to 100m from the house	0	1			
There is no or no distance >100m from the house	50	49			
The presence of bushes					
There is a bush/forest ≤50m from home	31	25	0,214	1,330	0,848-2,086
There is a bush/forest 50m s/d100 m from the house	7	8			
There is no or no distance >100m from the house	12	17			
Existence of Breeding place					
There is a breeding place ≤50m from home	13	1	0,000	14,329	3,422-60,002
There is a breeding place 50m s/d100 m from the house	14	2			
There is no or no distance >100m from the house	23	47			
The existence of Anopheles larvae					

Found anopheles larvae HI>1	22	0	0,001	6,920	2,351-20,689
Found anopheles flick HI<1	0	2			
No flicks found	28	48			
Night out habits					
Night out habits	20	11	0,084	2,364	0,984-5,677
Not out at night	30	39			
Use of mosquito repellent re-pellent					
Not using repellents	37	34	0,659	1,339	0,563-3,189
Using repellen	13	16			
The habit of using mosquito nets					
Using mosquito nets	35	26	0,101	2,154	0,948-1,894
Do not use mosquito nets	15	24			
Travel habits to Endemic ar-eas					
Traveling to endemic areas	7	7	1,000	1,000	0,323-3,095
Not traveling to endemic areas	43	43			

Environmental risk factors analyzed statistically in this study are physical environmental factors (condition of house walls, presence of wire gauze and ceiling of the house), biological environment (livestock sheds, presence of bushes (forests), *breeding places* and the presence of *Anopheles* larvae), social environment (habits of leaving the house at night, habits of using mosquito repellent, habits of using mosquito nets, and travel habits to endemic areas).

Risk Factors for House Wall Conditions with Malaria Incidence

Based on the results of the study in table 2, the homes of respondents who did not qualify in the case group were higher (26%) than the control group (18%). The data showed that the condition of the walls of the house or the density of respondents was more qualified, both in the case and control groups. In general, people in Fakfak Regency already have permanent houses with concrete walls in line with rural development through village funds. So that the results of statistical tests are also shown with insignificant results with a *p-value* of > 0.005, which is 1.00. This means that in this study the condition of the walls of the house did not have a significant risk of malaria incidence in Fakfak Regency.

The results of this study are certainly contrary to several previous studies, where the results of Siti Madayanti's research showed a relationship between the density of the walls of the house and the incidence of malaria and respondents who had the walls of the house were not tight had a 3,872 times greater risk of malaria than respondents who had tight walls of the house (Madayanti et al., 2022).

Likewise, the results of Istiana's study showed a significant relationship between wall conditions (p = 0.048) and the incidence of malaria (Istiana et al., 2021).

In line with this study is the results of Fitni Hidayati's research which shows no significant relationship between wall conditions and malaria incidence due to the p-value of > 0.05, which is 0.203 (Hidayati et al., 2023). However, according to researchers, the condition of the walls of a good house will minimize the risk of malaria transmission because the density of the walls of the house prevents the entry of *anopheles* mosquitoes into the house. Karen E. S. Hamre said that individuals living in households with rudimentary wall materials have a higher likelihood of malaria compared to those living in homes with finished wall materials (aOR: 1.90; 95% CI: 1.11–3.23; P 5 0.02) (Hamre et al., 2023).

Risk Factors for the Presence of Gauze Wire with the Incidence of Malaria

Based on the results of the study showed that the presence of wire gauze did not show significant results with a p-value of 1.00. As many as 92% of the gauze wires in respondents' homes, both cases and controls did not meet the requirements or did not use wire gauze. The average ventilation hole is left open unprotected with wire gauze to prevent mosquitoes from entering the house. The results of this study are the same as the results of Restiani Nababan's research, that in his research did not show a relationship because both the case and control groups, all did not use wire gauze (Nababan & Umniyati, 2018).

Risk Factors for the Existence of a Ceiling (ceiling) of a House with the Incidence of Malaria.

Likewise, with the existence of ceilings or ceilings of houses, it was found that most respondents did not have a ceiling (ceiling) to prevent the entry of mosquitoes into the house. In the case group, 80% did not meet the requirements and 84% did not meet the requirements in the control group. The existence of a ceiling is said to be unqualified to mean that the house is not installed with a ceiling or only installed in part of the room. This study did not show an association between the presence of the ceiling of the house and the incidence of malaria (*p-value* = 0.795). The results of this study are not in line with previous researchers, namely the results of Siti Madayanti's research showed the relationship between the existence of the ceiling and the incidence of malaria in the Jayapura District area (p-value = 0.01: OR = 3.250). Likewise, the results of Rizka Sofia's research also showed a relationship with p = value 0.042, and Fitni Hidayati with p value results of 0.001.10-13 (Sofia, 2018).

Risk Factors for the Existence of Livestock Cages with the Incidence of Malaria

The results of the study of the existence of livestock sheds categorized based on distance from respondents' homes showed insignificant (*p-value* 1,000). OR also cannot be raised because all groups of cases are not found cattle sheds. Cattle sheds, especially cattle, are only found in transmigration areas, where there are no respondents in the area close to cattle sheds. Livestock sheds, especially cows, are

very preferred by mosquitoes as a place to rest, besides that female mosquitoes also like cow blood. Some researchers previously found significant results with the existence of livestock sheds, Hermanto Putra in his research mentioned that livestock cages have a significant relationship with the incidence of malaria (p-value 0.001) (Putra, 2020).

Risk Factors for the Presence of Bushes with the Incidence of Malaria

In general, mosquitoes rest in shady, moist and safe places (D. G. of D. C. and E. Health., 2014). Most of Papua consists of forests, so it is undeniable that there are shrubs and forests in the village area. Bushes protect the ingress of the sun from penetrating into the ground, so mosquitoes love it as a resting place because it is damp. Without realizing it, in the bush there can also be small puddles where mosquitoes breed that are not visible because they are covered by leaves. However, the results of this study showed a *p-value of* 0.214 which means that there is no significant difference between bushes and the incidence of malaria, where there are 62.2% of respondents' houses near the bushes ≤50 meters from the house, only slightly larger than in the control group (50%).

The results of this study are in line with N. Muhajer's research, with descriptive analysis conveying the results that the number of malaria cases in malaria suspects who are closer and farther from home is as many as 21 people (26.3%). The research location is in Manokwari, West Papua, which of course has almost the same regional characteristics as Fakfak Regency (Muhajir et al., 2022).

Many studies in Papua and outside Papua have shown significant results between the presence of bushes and the incidence of malaria, including researchers Ronald Markus Mofu (*p-value* 0.042) and Siti Madayanti (*p-value* 0.001 OR = 3.512) (Mofu, 2022). Getting significant results also, researchers outside Papua namely in Purworejo by Laila Isnaeni (significance 0.003 ; OR 4.313), where respondents close to bushes have a risk of 4 times getting malaria (Isnaeni et al., 2019).

Risk Factors Breeding *place* or stagnation with Malaria Events.

During its life cycle, anopheles mosquitoes need a surface to lay their eggs. The water surface needed is a stagnant water surface, puddles with heavy flow are usually free of Anopheles, sp. Researchers observed the characteristics of mountainous forest areas in Fakfak Regency, where many springs were found from downstream that did not flow rapidly upstream, but with branching streams forming pockets of water in rock crevices. The source of the spring is the source of life for the village community, whose existence must not be disturbed. This condition causes the potential source of malaria transmission in the Papua region, especially in Fakfak Regency is still happening, which is supported by the high number of imported cases because it is slow in handling.

Based on the results of statistical tests on *breeding places,* a p-value of *0.000 (95%CI: 3,422-60,002) was obtained, which means that the existence of* breeding places is significantly related to the incidence of malaria. Many previous studies have shown a significant relationship between *breeding places* and the incidence of malaria. Of the 24 articles that have been reviewed by the author, there are 15

articles that are in line with the results of this research, both in the Papua region and outside Papua. Bhondoekhan, Fiona R.P. in her research stated the results that the adjusted OR for proximity to third-order flow A and fifth-order was 2.97 (95% CI 1.04-8.42) and 2.30 (95% CI 1.04-5.09), respectively, and for the household distance index for every 50 μm was 1.24 (95% CI 0.98-1.58) (Bhondoekhan et al., 2020). This study is also in line with the research of Okunlola, Oluyemi A., that in Nigeria proximity to springs showed a positive association with malaria incidence in the OLS model (P < 0.01) (Okunlola & Oyeyemi, 2019).

Analysis of the Presence of Anopheles Mosquito Larvae with the Incidence of Malaria.

The discovery of anopheles larvae that develop a lot in an area shows that the area is receptive, which has a high risk of malaria transmission. There are many important factors related to the breeding site of anopheles mosquitoes that affect the survival of anopheles larvae / larvae, but in this study no measurements and mapping were carried out due to limited time and energy.

Based on the data, of the 27 (54%) breeding places found in the case group, there were 22 respondents found larvae with HI>1, while in the control group only 2 respondents were found anopheles larvae with HI<1. Statistical tests proved that the presence of larvae in this study was associated with the incidence of malaria with *a p-value of* 0.001 and an OR of 6,920 (95%CI 2,351-20,689). This study is in line with F Hidayati's research in Kali Gesing Purworejo, proving that the higher the density of larvae, the higher the density of anopheles mosquitoes and there is also a fairly high increase in malaria cases.

Analysis of Risk Factors of Night Out Habits with Malaria Incidents

Night out habits in this study did not show significant incidence of malaria with *a p-value* of 0.084 and OR=2.36 (95% CI: 0.984-5.677), but it was shown that people who had a habit of going out at night were 2 times more at risk compared to respondents who did not go out at night at night. The habit of going out at night when *Anopheles* mosquitoes are active will be at risk of contracting malaria. Based on interviews with respondents, the habit of going out at night is often done by teenagers to find internet networks at village halls and some are just chatting. In addition, some residents also go to spend the night in simple and open garden houses to guard the produce of the durian gardens and nutmeg asaran.

To prevent transmission, there must be protection from mosquito bites by using long sleeves and mosquito repellent, and still installing mosquito nets in the garden house. However, the authors assume that the risk of contracting malaria by infective mosquitoes, so that in control areas where no cases are found even though they have the same habit of going out at night, they have a small risk of getting malaria.

Some researchers prove that there is a significant relationship between the habit of leaving the house at night with the incidence of malaria, namely the study of H. Ferdinal Setiawan (p-value 0.032, OR: 4.2) (Setiawan et al., 2021).

Risk Factor Analysis of Habit of Using Anti-Mosquito Repellent with Incidence of Malaria.

In this study, it could not be proven that the use of mosquito repellent was at risk of malaria incidence, namely with a p-value of 0.659 and an OR of 1.339. The use of mosquito repellent repellent is one of the efforts to protect against mosquito bites. This study is not in line with Darmawansyah researchers, who prove that mosquito repellent is associated with malaria incidence with *p = value* 0.001. The habit of using repellent is considered more practical use to protect yourself from mosquito bites.

Risk Factor Analysis of Habitual Use of Mosquito Nets with the Incidence of Malaria.

The results showed that the habit of using mosquito nets with *a p-value of* 0.101 was not proven to cause malaria. This study is not in line with the research of Rahayu Lubis, which proves that people who do not sleep using mosquito nets are at risk of malaria 2.8 times compared to those who sleep with mosquito nets (Lubis et al., 2021).

Based on data from the Fakfak District Health Office, it has succeeded in achieving the target of mass mosquito net distribution every 3 (three) years, but in fact the results of respondents' observations in both case and control groups are more who do not use mosquito nets. Some respondents when interviewed, said that sleeping with mosquito nets was uncomfortably (hot), and there were respondents who said that those who were usually given mosquito nets were dead people.

Efforts to promote the use of mosquito nets to protect against mosquito bites are still very necessary. Musoke David in his research entitled "Malaria prevention practices and associated environmental risk factors in a rural community in Wakiso district Uganda proved that the use of mosquito nets in households is higher with increasing one's education level (aPR = 1.27 [95% CI: 1.00-1.60]), and higher income. In addition, respondents who did not have jobs were less likely to use mosquito nets. The incidence of malaria with the use of mosquito nets is also influenced by the IRS and the habit of closing the door of the house before 6 pm (Musoke et al., 2018).

Risk Factor Analysis of Travel Habits to Endemic Areas with Malaria Incidence.

In this study, it was found that the habit of traveling to endemic areas with (*p-value* 1,000 and OR 1,00) showed an insignificant relationship with the incidence of malaria. Based on the results of interviews, the same results were obtained between the case and control groups, of which 86% did not have a habit to malaria endemic areas. This is because this study is limited to indigenous cases based on *e-Sismal* data, with the intention of providing more focal points on environmental factors that are directly related to environmental health disciplines, namely vector control. Based on e-Sismal data derived from the results of epidemiological

investigations conducted by the malaria puskesmas officers, imported cases were 125 (69.4%) of the 180 cases in Fakfak Regency. This is due to the easy mode of transportation between provinces in Papua by using ships at a very cheap cost. Therefore, strategic efforts are still needed in handling imported cases, in addition to vector control also by increasing early detection efforts for travelers. Asep Prasetiawan in his research also found that the habit of traveling to endemic areas for more than 3 months has a risk of 35 times malaria than those who do not travel to endemic areas (Prastiawan, 2019).

The Most Potential Risk Factors on Malaria Events

Based on multivariate data analysis, there are 3 (three) variables of environmental risk factors that have the most potential for malaria incidence, namely the presence of anopheles larvae, *breeding places*, and night exit habits. *Breeding place* ranked first with a *p-value of* 0.025 and an OR of 6,061 (95%CI: 1,254-29), which means that respondents' homes found <100 meters breeding place have a 6 times risk of malaria compared to respondents' homes not found *breeding places* with a distance of <100 meters. The presence of anopheles larvae with *a p-value of* 0.083 and an OR of 3,421 (95%CI 0,86-13,764). This means that respondents whose homes were found anopheles larvae <100 meters away, were 3,4 times more likely to develop malaria than those whose anopheles larvae were not found <100 m from home. The third variable is night out habits with a significant *p-value of* 0.029 and OR 1,777, meaning respondents who have night out habits have a risk of malaria 1,7 times than those who do not have night out habits.

Table 3 Mulitivariate Analysis Data of Environmental Quality with Malaria

Environmental Quality	p- value	OR	95%CI
Breeding places	0,025	6,061	1,254-29,290
Jentik Anopheles	0,083	3,421	0,860-13,764
The habit of going out at night	0,029	1,777	1,061-2,977

Table 3 shows the results of logistic regression analysis that the presence of anopheles larvae is not significant with the incidence of malaria, so it needs to be removed and continued to the next stage with the results:

Table 4 Mulitivariate Analysis Data of Environmental Quality with Malaria step 4

Environmental Quality	p- value	OR	95%CI
Breeding places	0,000	13,903	3,374-57,287
The habit of going out at night	0,045	1,678	1,011-2,784

Nagelkerke R : 43,3%

Table 4 is the final stage of multivariate analysis, of all the variables studied only two are most at risk, namely breding place with a p-value of 0.000, OR 13.903 (95%CI: 3.374-57.287), means that it has a risk of 13 times malaria compared to those not found breeding place. Furthermore, the dominant variable is the habit of night out with a p-value of 0.045 and an OR of 1.678. Based on the results of the

analysis that the existence of breeding places and night exit habits simultaneously risk the incidence of malaria by 43.3%.

Malaria control is implemented to break the chain of transmission by reducing vector-parasite-human contact. Forms of control activities carried out such as eradication of mosquito breeding sites, *Anopheles vector rest areas,* the use of mosquito nets, IRS, and other activities that can encourage breaking the chain of malaria transmission. Proper utilization of larvicide is also very influential on the success of control. Larvicides can experience resistance that ultimately requires increased concentrations that disrupt ecosystems. The use of nanosilver for anopheles larvae is a new breakthrough that can increase effectiveness and overcome larvicide resistance (Assidiq, 2021).

CONCLUSION

One element that has an impact on the increase in malaria cases is the environment. Low environmental quality can accelerate malaria transmission and increase the spread of Anopheles vectors. The most potential environmental risk factors for malaria incidence in this study were the presence of *breeding places*, and night exit habits.

One important step is to break the chain of malaria transmission by controlling environmental factors. Environmental factors that must be controlled include physical, chemical, biological, social and cultural environments. Activities carried out in order to meet expectations in malaria control require cooperation from the health and also the community. Forms of integrated control activities carried out such as eradication of mosquito breeding sites, *Anopheles vector rest areas*, the use of mosquito nets, IRS, and other activities that can encourage breaking the chain of malaria transmission. Migration surveillance also needs to be improved, but strategic efforts in breaking the chain of transmission will not succeed if it is not carried out simultaneously in the Papua region. The author assumes that the acceleration program carried out is still routine and still in high endemic areas, so that there will continue to be transmission in low endemic areas with high modes of transportation, supported by Papua's geography which is mostly mountainous and forested.

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