

Malaria in the Borderlands of Papua Province of the Republic of Indonesia and Papua New Guinea

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Abstract

Background: Malaria remains a disease that has a high prevalence rate in Papua province of Indonesia especially in the borderland between the Republic of Indonesia and Papua New Guinea. Malaria control program should be carried out in the borderlands to reduce the prevalence of malaria in the region more broadly. The purpose of this study is to determine the incident of malaria and to understand how socio-demographic factors measured at individual and village levels are associated with individual's probability of contracting malaria. This research also illustrates the level of knowledge, attitudes, and behavior of border communities about malaria.

Methods: This research is an initial step towards a more comprehensive program to eradicate malaria on the border of the Republic of Indonesia and Papua New Guinea. Data were obtained from the Skouw Health Center from January to July 2018. The chi square is used as an analytical tool to calculate the odds ratio and the significance of age, sex, and village of residence on the contraction of malaria. In addition, questionnaires about knowledge, attitudes, and behavior about malaria were distributed to 70 respondents who were willing to fill in the questionnaire.

Results: The research shows that the age range of 13-22 years has the highest infection rate of malaria, with an incident of 40%. Based on sex, men have twice incidents (33%) than those of women. With respect to locations, Skouw Mabo village has the highest incidents of malaria among the four villages. Knowledge (68%), attitude (79%), and behavior (73%) of respondents to malaria are quite high. However, related to the causes of malaria (52.86%), the risk of malaria in pregnant women (47.14%) and the risk of not taking medication not according to the doctor's instructions (7.14%) are still low. Good knowledge will improve people's attitudes and behavior.

Conclusions: Malaria is still a disease with a high incidence in the Border Region of the Republic of Indonesia and Papua New Guinea. The malaria elimination program that will be implemented in this area needs to focus on characteristics that have a higher malaria incidence rate.

Keywords: Malaria, borderlands, risk factors

Introduction

Malaria is still an endemic disease in Indonesia (Elyazar *et al*, 2012; Sennang *et al*, 2014). In Indonesia, the API rate in 2015 was 0.85 and continued to decline from 2011 which was still at 1.75. The highest API rate occurs in Papua Province, which is 31.93 (Pusdatin, 2016). There is even a term that if a person has not been infected with malaria, one cannot believe that he/she has lived in Papua. This indicates that malaria is very close to the Papua population. Several studies that have been conducted in Papua indicate the high risk factors for malaria incidences in Papua Province (Taylor *et al*, 2013; Karyana *et al*, 2016). Langford *et al*. (2015) found that 18.6% of hospital patients suffered from malaria. In 2016, a research in Timika Regency found that 37.7% of hospital patients (968 out of 2,567) were diagnosed with malaria either through microscopic examinations or PCR (Langford *et al*, 2015). The highest incident was at the age of 5-15 years (46.3%, 278/600), then adults (36.8%, 577/1568), and children under five years (28.3%, 113/399)(Pava *et al*, 2017).

More than 3000 malaria cases occurred in the borderlands of the Republic of Indonesia and Papua New Guinea in 2015. This figure shows that the border areas of Papua and Papua New Guinea are areas with a high incidence of malaria (BPS, 2016). This high figure can be associated with the high level of malaria infections in Papua New Guinea. Of the population which visited health facilities in Papua New Guinea in 2013-2017, it was found that 42% of the patients suffered from malaria (Pulford *et al*, 2013; Feterl *et al*, 2017).

This study aims to examine the risk factors for malaria based on age, sex, and the place of residence of the respondents in the borderland areas of the Republic of Indonesia and Papua New Guinea. This study is expected to map the incident of malaria in this region. This map, in turn, will be used as preliminary data for malaria elimination efforts in the borderland areas of the Republic of Indonesia and Papua New Guinea. This study also assessed the level of knowledge, attitudes, and behavior of the community regarding malaria through a questionnaire.

Methods

This research was carried out in four villages in Muara Tami District, Jayapura City, Papua Province, Indonesia. Four villages, namely Skouw Mabo, Skouw Sae, Skouw Yambe, and Mosso were chosen as they were located on the border of the Republic of Indonesia and Papua New Guinea. Data were obtained from the results of the examination of blood samples at the Skouw Health Center from January 2018 to July 2018. The number of blood samples collected was 1,558 blood samples.

The analysis was carried out by calculating the incident rate based on the age, sex, and village where the respondents live. Its odd ratio was calculated using a Chi Square.

This study also used questionnaires to assess knowledge, attitudes, and behavior descriptively. Questionnaires were distributed to 70 respondents who were willing to answer questions related to Knowledge, Attitudes, and Behavior towards malaria. Questions about knowledge consist of 16 multiple choice questions that have one correct answer among 4 answer choices. Each respondent chooses one choice and

counts one number, so that 16 questions have the highest 16 numbers. Questions about attitude consist of 16 statements with the choices of answers: Strongly Disagree, Disagree, Agree, and Strongly Agree. Respondents who choose one of the answers “Agree or Strongly Agree” on the right attitude will get the value of one, otherwise if they choose one of the answers “Strongly Disagree or Disagree” on the wrong attitude, then they will get a value of one as well. Questions about behavior consist of 7 questions with choices of answers: Yes and No. Respondents who choose the answer “Yes” for the appropriate behavior get a value of one and if they choose the answer “No” for inappropriate behavior, then they get a value of one.

Results

Based on the results of the blood sample analysis, the incident of malaria in the borderlands between Papua province of Indonesia and Papua New Guinea is 0.28 with the incident rate for *Plasmodium falciparum* at 0.15, *Plasmodium vivax* at 0.09, and both *Plasmodium vivax* and *falciparum* at 0.04.

Table 1 shows that based on age, it appears that at the age of 13-22 years old, the incident of malaria is very high. Of the 190 respondents, 40 percent suffered from malaria with the incident rate of *plasmodium falsiparum* at 0.21, *plasmodium vivax* at 0.14, and both *plasmodium falsiparum* and *plasmodium vivax* at 0.05. At this age range, the risk of malaria is twice as high as the age range of 0-5 years with a significance level of $p < 0.000$.

Table 1. Malaria in border villages of the Republic of Indonesia and Papua New Guinea

	Sample	Positive Malaria	Pf	Pv	Pmix	OR	ρ
Overall sample	1558	439 (0.28)	0.15	0.09	0.04		
Age (years):							
0-5	346	82 (0.24)	0.11	0.10	0.03	Reference	
6-12	346	108 (0.31)	0.15	0.10	0.07	1.461	0.027
13-22	190	76 (0.40)	0.21	0.14	0.05	2.146	0.000
23-35	349	105 (0.30)	0.19	0.08	0.04	1.385	0.058
36-50	219	49 (0.22)	0.13	0.08	0.02	0.928	0.716
>50	108	19 (0.18)	0.06	0.08	0.03	0.687	0.183
Gender							
Male	818	274 (0.33)	0.18	0.11	0.04	Reference	
Female	740	165 (0.22)	0.11	0.08	0.03	0.584	0.000
Village							

Skouw Mabo	878	278 (0.32)	0.17	0.11	0.04	Reference	
Skouw Sae	291	74 (0.25)	0.13	0.09	0.03	0.736	0.045
Skouw Yambe	282	62 (0.22)	0.11	0.07	0.04	0.608	0.002
Mosso	107	25 (0.23)	0.15	0.11	0.05	0.658	0.079

Based on sex, the data show that men have a greater risk than that of women, with an incident rate at 0.33. Male respondents have a risk of malaria twice than that of female respondents with a significant influence level at ($p < 0.000$).

Based on the village where the respondents live, the table shows that Skouw Mabo village has the highest infection of malaria compared to that of other villages, which is at 0.32. This village has a risk of almost twice than those of Yambe and Mosso Skouw villages.

Based on the questionnaire collected, the characteristics of the respondents are shown in table 2.

Table 2. Distribution of of respondents by demographic characteristics

Demographic characteristics	Total	Percentage
Ages (years):		
0-25	8	11.43%
26-40	34	48.57%
> 40	28	40.00%
Gender:		
Male	23	32.86%
Female	47	67.14%
Educational Background:		
No formal schooling	6	8.57%
Elementary	13	18.57%
Junior High School	12	17.14%
Senior High School	29	41.43%
Diploma/University	10	14.29%

Village:

Skouw Mabo	20	28.57%
Skouw Yambe	15	21.43%
Skouw Sae	17	24.29%
Mosso	18	25.71%

Based on table 2, it appears that respondents who answered the most questions came from age level of 26-40 years (48.57%), female sex (67.14%), had the senior high school educational background (41.43%), and lived in Skouw Mabo Village (28.57%).

Table 3. Knowledge of respondents about malaria

No	Questions	Frequency	Percentage (%)
1	What is Malaria?	37	52.86
2	What are the Causes of Malaria?	37	52.86
3	Who can get malaria?	54	77.14
4	How is malaria transmitted?	46	65.71
5	What does someone do to avoid Malaria?	36	51.43
6	What do people do to avoid Malaria?	58	82.86
7	How can a house prevent Malaria?	55	78.57
8	What is a healthy and clean environment to avoid Malaria?	58	82.86
9	What are the symptoms of Malaria?	68	97.14
10	What do you do if you feel the symptoms of Malaria?	64	91.43
11	How do you know if you have positive malaria?	54	77.14
12	What are the risks that occur when pregnant women get malaria?	33	47.14
13	What happens when exposed to malaria?	35	50.00
14	How is Malaria treatment?	60	85.71
15	What benefits will be obtained if malaria sufferers take medication according to the doctor's instructions?	65	92.86

16	What is the risk of taking medication not according to the doctor's instructions?	5	7.14
	Averages		68.30

The level of respondents' knowledge of malaria is shown in table 3. Overall, the respondents' knowledge was quite adequate (68.30%). Respondents have been able to describe the symptoms of malaria (97.14%) and understand the benefits if patients take medication according to the doctor's instructions (92.86%). But they still do not know the risk of not taking the drug according to the doctor's instructions (7.14%).

Table 4. Attitudes of respondents about malaria

No	Attitudes	Frequency	Percentage (%)
1	Malaria is not a man-made disease	64	91.43
2	Parasites that cause Malaria	38	54.29
3	Anyone can get Malaria	63	90.00
4	The bite of a female Anopheles mosquito makes a person exposed to malaria	63	90.00
5	If someone feels heat, weakness, headache, muscle and bone pain, shivering, then it is possible to get malaria	65	92.86
6	Pain and death can occur for someone affected by malaria	58	82.86
7	When exposed to malaria, pregnant women are cared by the community	14	20.00
8	There is no influence of spirits to avoid malaria	54	77.14
9	Families put gauze at home to avoid Malaria	50	71.43
10	You will drain, hoard, and dry the puddles of water in the home environment to avoid Malaria	63	90.00
11	You will go to a health service such as a health centers or hospital when you experience symptoms of malaria	67	95.71
12	Families will sleep in insecticide mosquito nets to avoid being exposed to malaria	65	92.86
13	Positive status of malaria is obtained when a person's blood is	65	92.86

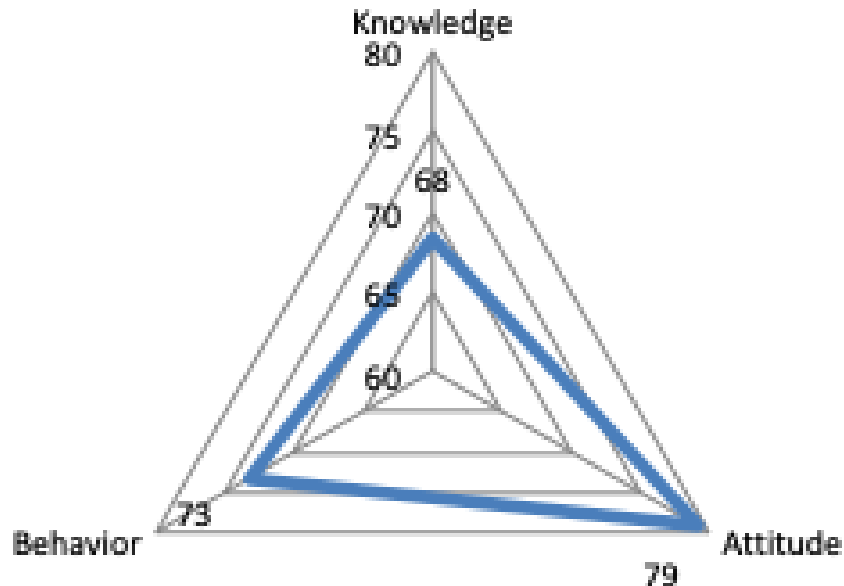
	examined in a laboratory		
14	Medication given to Malaria sufferers will be taken according to the doctor's instructions	67	95.71
15	Increasingly getting sick if you don't take medicine according to the doctor's instructions	53	75.71
16	You are resistant to Malaria drugs when taking medication not according to the doctor's instructions	38	54.29
	Averages		79.20

The attitude of respondents to malaria can be seen in table 4. Overall, the attitude of respondents to malaria is quite high (79.20%). However, there are still some attitudes that are not yet high, namely when malaria, pregnant women are not cared for (20%), malaria-causing parasites (54.29%), and they are resistant to Malaria drugs if they do not take medication according to the doctor's instructions (54.29 %). This is because the community considers that malaria is a common disease.

Table 5. Behavior of respondents to prevent and control malaria

No	Behavior	Frequency	Percentage (%)
1	Do family members sleep in insecticide nets?	60	85.71
2	Do family members not leave the house between dusk and night?	40	57.14
3	Do you drain, hoard, and dry puddles in your home environment?	57	81.43
4	Do you put gauze at home?	12	17.14
5	Do you go to health services such as health centers, or hospitals when you feel heat, weakness, headaches, sore muscles and bones, shivering?	67	95.71
6	Did you do a blood test in the laboratory for certainty of Malaria?	61	87.14
7	Do family members who are ill with Malaria take medication according to the doctor's instructions?	62	88.57
	Averages		73.27

Table 5 shows the behavior of respondents towards malaria prevention and control. It appears that overall, the behavior of respondents has been quite high at 73.27%. However, there are still some behaviors that have not been done by most of the respondents, namely gauze at home (17.14%) and family members who do not leave the house at night (57.14%).



Graphic 1. Percentage of knowledge, attitude, and behavior of respondents

The results of the study show that, on average, the level of knowledge, attitudes, and behavior of respondents is quite high, which is above 60%. However, if viewed from a number of specific questions, from the knowledge side, only 7.14% knew the risk of taking medication not according to the doctor's instructions, 47.14% knew the risk of malaria in pregnant women, 50.00% knew about what happened if they were exposed to malaria, and 51.43% knew what was done to avoid malaria. This caused their attitude towards pregnant women affected by malaria to be low at 20.00% and only 54.29% had the attitude to take the medicine according to the doctor's instructions.

Discussion

Malaria is highly prevalent in the borderland areas of the Republic of Indonesia and Papua New Guinea. The data from four villages located at the borderland areas show that the prevalent rate in the borderland areas is higher than the API for Papua Province. Data show that *Plasmodium falciparum* is higher than *Plasmodium vivax*. This study is consistent with research conducted by Langford et al (2015) who found that in Timika, Papua, *Plasmodium falciparum* was higher than other *Plasmodium* (Langford *et al*, 2015). *Plasmodium falciparum* causes a higher mortality rate compared to *Plasmodium vivax* (Langford *et al*, 2015). *Plasmodium falciparum* also causes higher anemia compared to *Plasmodium vivax* (Pava *et al*, 2016).

Overall, the spread of malaria is almost the same in each age group. However, it is found that the age range of 13-22 years old has the highest incidents of malaria. This can be attributed to this age group's high mobility and productivity (Pusdatin, 2016). Papuans living in the borderland areas move back and forth between Papua and Papua New Guinea. Many of them work or trade their agricultural products in Papua New Guinea but have their homes and gardens in Papua. This is in line with a research conducted by Kaiser *et al.* (2013) which indicates that the prevalence of *Plasmodium falciparum* increases at the age of 15-19 years old and will decrease at the next age level. Likewise, the results of a research by Pava *et al.* (2016) found that *Plasmodium falciparum* has a higher risk in adult compared to that of children.

Based on sex, the data indicate that men have a higher risk of malaria than that of women. This study is also in line with a research conducted by Kaiser *et al.* (2013). Kaiser *et al.* (2013) found that malaria infection was more significant in men compared to women. Men's higher mobility and outdoor stay contribute to the higher probability of exposure to mosquito bites. This is supported by the evidence that most villagers work as farmers.

The table also demonstrates that Skouw Mabo village has a higher incident of malaria compared to those of the other three villages. Skouw Mabo village covers an area of 87.7 km² with a population density of 14 people/km (BPS, 2016). It also has a vast area of forests and swamps which increases the risk for malaria.

The results of the study in the border area showed that only 52.86% knew the cause of malaria. When compared with previous research conducted in Jayapura Regency in 2013, 63% of respondents knew that malaria was caused by mosquitoes (Roosehermatie *et al.*, 2017). The level of knowledge is very influential in improving malaria prevention and control measures by the community. Research at Columbia shows that a high level of knowledge about malaria transmission (85%) increases the use of bed nets (>90%) in respondents (Forero *et al.*, 2014).

Based on the results of the study, few people knew about the risks of pregnant women affected by malaria (47.14%) and they receive less attention from the community (20%). Knowledge about malaria in pregnant women is very important related to the risk of anemia in the mother, premature labor, fetal death, and low birth weight babies (Lufere *et al.*, 2017; Adebayo *et al.*, 2015). Special attention in increasing knowledge, attitudes, and behavior is needed in reducing the risk of malaria in pregnant women.

Behavior of prevention and control of communities in the border area of the Republic of Indonesia-Papua New Guinea is quite high, especially in sleeping using mosquito nets (85.71%) and cleaning the home environment from mosquito breeding sites (81.43%). The use of mosquito nets is one way to prevent the risk of malaria (Forero *et al.*, 2014; Amusan *et al.*, 2017; Zingani *et al.*, 2017).

On the treatment side, the results of the study showed that 95.71% of respondents would go to health services when they felt the symptoms of malaria. There were 88.57% of respondents going to take medicine according to the doctor's instructions. However in terms of knowledge, only 7.14% of respondents knew the consequences of not taking the drug according to the doctor's instructions. Knowledge

of drug use that is in accordance with the doctor's instructions will reduce the risk of resistance to malaria drugs (Forero *et al*, 2014).

Conclusion

Malaria is still high in the border area of the Republic of Indonesia and Papua New Guinea which is dominated by the high *Plasmodium falciparum*. Malaria infects children and gets higher in adults. Judging from gender, the incidence of malaria is higher in men than in women. And in terms of region, swamp and forest areas have higher rates of malaria than coastal areas. As an initial stage in the malaria elimination program, the results of the study can map the incident of malaria in border areas.

Overall, the level of knowledge, attitudes, and behavior of respondents in the border area is quite high. However, there is still some knowledge that needs to be improved, namely the cause of malaria, the risk of malaria in pregnant women, and knowledge of risks of not taking the drug according to the doctor's instructions. The attitude and behavior of respondents depend on the level of knowledge they have.

Ethics approval and consent to participate

This study was reviewed and approved by Research and Community Service for the ethical conduct of research on human subjects at Universitas Cenderawasih, Jayapura, Indonesia.

Consent for publication

This study has the permission from the respondents for publication.

Data Availability

All data generated from the Community Health Center of Muara Tami and analysed during this study are included in this published article.

Competing Interest

The authors declare that they have no competing interests

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Authorship Statement

AI conceptualized and designed the study. AI, MH, MBA, MT collected, analysed and interpreted the data. AI drafted the manuscript. AI, MH, MBA, MT reviewed the manuscript. All authors read and approved the final manuscript.

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