Predictors of Malaria Incidence in Rural Eastern Indonesia

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Abstract

In Indonesia, the largest number of malaria cases was contributed to by Eastern Indonesia. The study aimed to analyze the predictors of malaria incidence in rural Eastern Indonesia. This study analyzes the 2018 Indonesia Basic Health Survey data. In the final stage binary logistic regression was used to determine the incidence of malaria incidence in 86,382 respondents. Variables analyzed included malaria incidence, regional/province, age, gender, educational level, work type, marital status, wealth status, and health insurance. The analysis found that people who lived in rural Maluku and rural North Maluku had a lower risk of experiencing malaria than those who lived in rural areas of East Nusa Tenggara. People in rural West Papua and rural Papua have a higher risk than those who live in rural East Nusa Tenggara. Men were 1.107 times more likely than women to have malaria incidence.People with primary school education were 1.237 times more likely to develop malaria than those without education. People with a college education were 1.440 times more likely to develop malaria than those without education. People who have a wealth of poorer status are 0.804 times more likely to have malaria than those who are poorest. People who have the richest wealth status are 0.851 times more likely to have malaria than those who are the poorest. There were 4 variables that have proven to be significant as predictors of incidence in rural Eastern Indonesia, namely regional/province, gender, education, and wealth.

Keywords: *malaria incidence, Eastern Indonesia, Indonesian basic health survey.*

Background

The Indonesian Ministry of Health at the end of 2018 reported that confirmed malaria incidence reached 180 thousand cases. This figure is the incidence in 26 districts from all regions in Indonesia[1]. This malaria incidence rate is dominated by reports from Eastern Indonesia. There are at least 5 provinces which are malaria-endemic areas, namely Maluku, North Maluku, East Nusa Tenggara, West Papua, and Papua[2].

In addition to environmental or ecosystem factors, several studies have tried to link malaria incidence with individual characteristics. Environmental factors found to be associated with malaria incidence are often related to water location and climate change. This is related to the Plasmodium ecosystem as parasites, Anopheles mosquitoes as vectors, and humans as hosts[3,4,5]. Ecosystem risks of this kind are found in many rural areas[6,7,8].

Individual characteristics and household characteristics also did not escape the attention of the researchers. This relates to individual behavior in responding to environmental conditions, including individual knowledge and behavior towards the prevention of malaria transmission, for example, the use of insecticide-treated bed nets[9,10].

Based on the background, the purpose of this study is to analyze the predictors of malaria incidence in rural Eastern Indonesia. The results of this study will be input for the Ministry of Health in determining the right target

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in malaria endemic areas in rural Indonesia.

Materials and Methods

This study analyzes secondary data from the 2018 Indonesia Basic Health Survey (Riskesdas). The survey conducted by the National Institute of Health Research and Development, the Indonesia Ministry of Health was a five-year cross-sectional survey.

The population in this study was all population> 10 years old in rural Eastern Indonesia covering 5 provinces, namely East Nusa Landmark Province, Maluku, North Maluku, West Papua, and Papua. The sampling method uses multi-stage cluster random sampling to determine samples. 86,382 respondents were found to be aged >10 years. Respondents of this age were considered mature enough to be able to answer the questions in the questionnaire submitted[2].

This study specifically analyzes respondents who live in rural Eastern Indonesia. Malaria incidence was the respondent's acknowledgment of the official diagnosis after a blood test. The variables analyzed included regional/province, age group, gender, education level, work type, marital status, wealth status, and health insurance.

A correlation test was performed using Chi-square on dichotomous variables, and T-test for continuous variables. This test was to assess whether there are statistically significant differences between regions. Estimates using Binary Logistic Regression were conducted to study disparities in malaria incidence across regions. All statistical accounts were carried out using SPSS 21 software.

Findings

Before conducting further regression tests, the co-linearity test was first performed. The results of the co-linearity test can be seen in Table 1. The test results show that there is no co-linearity between the dependent and independent variables. Table 1 shows that the tolerance value of all variables is greater than 0.10. While the VIF value for all variables is less than 10.00. Then referring to the basis of decision making in the multicollinearity test it can be concluded that there are no symptoms of multicollinearity in the regression model.

Table 1. Results for the co-linearity test of malaria incidence in rural Eastern Indonesia (n=86,382)

Variables	Collinearity Statistics	
	Tolerance	VIF
Regional/Province	0.896	1.116
Age groups	0.529	1.890
Gender	0.920	1.087
Education level	0.891	1.123
Work type	0.835	1.197
Marital status	0.538	1.859
Wealth status	0.828	1.208
Health insurance	0.982	1.018

*Dependent Variable: Malaria incidence

Table 2 is a descriptive statistics of respondent characteristics. Table 2 shows that all rural areas in the regional/province are dominated by those who have malaria. In both categories, malaria incidence is dominated by those in the 11-20 age group.

Table 2 informs that those who experience malaria incidence are dominated by men, while those without malaria are dominated by women. Based on the education level, both categories (experiencing malaria incidence or not) are dominated by those with primary school education. Based on work type, both categories (experiencing malaria incidence or not) are dominated by those who work as farmer/fisherman/labor/driver/maid.

Table 2 shows that both categories (experiencing malaria incidence or not) were dominated by those who were married. Based on wealth status, both categories (experiencing malaria incidence or not) are dominated by those who are the poorest. While based on ownership of health insurance, both categories (experiencing malaria incidence or not) are dominated by those who have health insurance.

Table 3 displays the results of the binary logistic regression test to illustrate the predictors of malaria incidence cases in rural Eastern Indonesia. As a reference, the chosen category is experiencing "malaria incidence".

Table 3 shows that people living in rural Maluku had 0.513 times the possibility of malaria compared to people living in rural East Nusa Tenggara (OR 0.513; 95% CI 0.410-0.643). People who live in rural North Maluku are 0.497 times more likely to have malaria than people who live in rural East Nusa Tenggara (OR 0.497; 95% CI 0.386-0.639). This means that people who live in rural Maluku and rural North Maluku have a lower risk of experiencing malaria than those who live in rural areas of East Nusa Tenggara.

Table 2. Descriptive Statistic of Respondent Characteristics on Malaria Incidence in Rural Eastern Indonesia (n=86,382)

Characteristics	Malaria Incidence				P
	No		Yes		
	n	%	n	%	
Regional/Province					***0.000
· East Nusa Tenggara	32572	39.3%	720	20.3%	
· Maluku	13898	16.8%	112	3.2%	
· North Maluku	11451	13.8%	93	2.6%	
· West Papua	9274	11.2%	421	11.8%	
· Papua	15634	18.9%	2207	62.1%	
Age Groups					***0.000
· 11-20	22362	27.0%	881	24.8%	
· 21-30	13414	16.2%	579	16.3%	
· 31-40	16328	19.7%	785	22.1%	
· 41-50	13743	16.6%	666	18.7%	
· 51-60	9377	11.3%	427	12.0%	
· 61-70	4911	5.9%	153	4.3%	
· > 70	2694	3.3%	62	1.7%	
Gender					***0.000

Cont... **Table 2. Descriptive Statistic of Respondent Characteristics on Malaria Incidence in Rural Eastern Indonesia (n=86,382)**

· Male (ref.)	39727	48.0%	1878	52.9%	
· Female	43102	52.0%	1675	47.1%	
Education level					***0.000
· No education (ref.)	7157	8.6%	376	10.6%	
· Primary School	38332	46.3%	1494	42.0%	
· Junior High School	14035	16.9%	559	15.7%	
· Senior High Scool	16686	20.1%	850	23.9%	
· College	6619	8.0%	274	7.7%	
Work Type					***0.000
· No work (ref.)	19112	23.1%	811	22.8%	
· Schooling	16082	19.4%	635	17.9%	
· Public servant/army/ police	4119	5.0%	225	6.3%	
· Private Employee	2932	3.5%	153	4.3%	
· Entrepreneur	4927	5.9%	253	7.1%	
· Farmer/ Fisherman/ Labor/Driver/Maid	30543	36.9%	1308	36.8%	
· Others	5114	6.2%	168	4.7%	
Marital status					***0.000
· Never married (ref.)	28051	33.9%	1078	30.3%	
· Married	49220	59.4%	2287	64.4%	
· Divorced/Widowed	5558	6.7%	188	5.3%	
Wealth status					***0.000
· Poorest (ref.)	19672	36.8%	1057	34.7%	
· Poorer	10663	19.9%	403	13.2%	
· Middle	9565	17.9%	489	16.1%	
· Richer	7206	13.5%	485	15.9%	
· Richest	6370	11.9%	611	20.1%	
Health insurance					0.052
· No (ref.)	2681	3.2%	136	3.8%	
· Yes	80148	96.8%	3417	96.2%	

Note: Note: Chi-Square test was used for dichotomous variables, and T-test for continuous variables; * $p < 0.05$; ** $p < 0.01$; * * *$p < 0.001$.

Table 3. Binary Logistic Regression of Malaria Incidence in Rural Eastern Indonesia (n=86,382)

Predictor	Malaria Incidence			
	Sig.	OR	Lower Bound	Upper Bound
Regional/Province: East Nusa Tenggara	-	-	-	-
Regional/Province: Maluku	***0.000	0.513	0.410	0.643
Regional/Province: North Maluku	***0.000	0.497	0.386	0.639
Regional/Province: West Papua	***0.000	2.885	2.509	3.318
Regional/Province: Papua	***0.000	7.745	7.026	8.536
Age Groups: 11-20	-	-	-	-
Age Groups: 21-30	0.817	0.978	0.811	1.180
Age Groups: 31-40	0.557	1.062	0.868	1.300
Age Groups: 41-50	0.131	1.173	0.954	1.443
Age Groups: 51-60	0.072	1.220	0.983	1.515
Age Groups: 61-70	0.413	1.114	0.861	1.441
Age Groups: >70	0.626	1.087	0.778	1.518
Gender: Male	*0.014	1.107	1.020	1.202
Gender: Female	-	-	-	-
Education level: No education	-	-	-	-
Education level: Primary school	**0.002	1.237	1.084	1.411
Education level: Junior High School	*0.018	1.203	1.032	1.402
Education level: Senior high school	***0.000	1.644	1.414	1.912
Education level: College	**0.001	1.440	1.158	1.792
Work Type: No work	-	-	-	-
Work Type: Schooling	0.180	1.121	0.949	1.324
Work Type: Public servant/army/police	0.454	1.084	0.878	1.338
Work Type: Private Employee	0.684	0.956	0.772	1.185
Work Type: Entrepreneur	0.271	1.102	0.927	1.310
Work Type: Farmer/Fisherman/ Labor/Driver/ Maid	0.932	1.005	0.895	1.129
Work Type: Others	0.773	0.971	0.796	1.185
Marital status: Never married	-	-	-	-
Marital status: Married	0.609	0.960	0.823	1.121
Marital status: Divorced/Widowed	0.201	0.863	0.688	1.082
Wealth status: Poorest	-	-	-	-
Wealth status: Poorer	***0.000	0.804	0.712	0.907
Wealth status: Middle	0.319	0.943	0.841	1.058
Wealth status: Richer	**0.008	0.852	0.757	0.959
Wealth status: Richest	**0.007	0.851	0.758	0.956

* $p < 0.05$; ** $p < 0.01$; ***$p < 0.001$.

Table 3 informs that people living in rural West Papua are 2.885 times more likely to have malaria than people living in rural East Nusa Tenggara (OR 2.885; 95% CI 2.509-3.318). People who live in rural Papua have a 7.745 times chance of having malaria compared to people living in rural East Nusa Tenggara (OR 7.745; 95% CI 7.026-8.536). This information shows that people in rural West Papua and rural Papua have a higher risk than those who live in rural East Nusa Tenggara.

Consistent research results were reported from a study in Kenya, Nigeria, and Ghana. The difference in malaria incidence spatially is influenced by several variables, including rainfall, proximity to water, vegetation, and population density. The differences in these variables show different effects on malaria incidence[5,7,11].

Table 3 shows that men were 1.107 times more likely than women to have malaria incidence (OR 1.107; 95% CI 1.020-1.202). Table 3 shows that people with primary school education were 1.237 times more likely to develop malaria than those without education (OR 1.237; 95% CI 1.084-1.411). People who have junior high school education are 1,203 times more likely to develop malaria than those with no education (OR 1.203; 95% CI 1.032-1.402). people with senior high school education were 1.644 times more likely to develop malaria than those with no education (OR 1.644; 95% CI 1.414-1.912). People with a college education were 1,440 times more likely to develop malaria than those with no education (OR 1.440; 95% CI 1.158-1.792).

A better level of education has a negative relationship with malaria incidence. Because those who are educated have better possibilities to understand malaria prevention behavior[12,13]. A study in Nigeria found that education level was a determinant of ownership of mosquito nets. The use of mosquito nets is one of the behaviors to prevent malaria[14].

Table 3 informs that people who have wealthy poorer status are 0.804 times more likely to have malaria than those who are poorest (OR 0.804; 95% CI 0.712-0.907). People who have wealth richer status are 0.852 times more likely to have malaria than those who are poorest (OR 0.852; 95% CI 0.757-0.959). People who have the richest wealth status are 0.851 times more likely to have malaria than those who are poorest (OR 851; 95% CI 0.758-0.956).

Similar research results were found in Rwanda. People who have lower wealth status have a higher risk of experiencing malaria incidence[15]. A study in Zambia with pregnant women subjects also found the same results. Poor pregnant women have a greater risk than pregnant women who are rich in experiencing malaria incidence[13].

Conclusions

Based on the results of the study it could be concluded that there were 3 variables that have proven to be significant as predictors of incidence in rural Eastern Indonesia. The three determinants were regional/ province, education level, and wealth status.

Acknowledgments: The author would like to thank the National Institute of Health Research and Development of the Indonesia Ministry of Health, which has agreed to allow the 2018 Indonesia Basic Health Survey data to be analyzed in this article.

Source of Funding: Self-funding

Conflict of Interests: Nil

Ethical Clearance: The 2018 Indonesia Basic Health Survey has passed the ethical test from the National Ethics Committee (ethics number: 01.1206.207). Researchers have obtained permission from the National Institute of Health Research and Development, the Indonesia Ministry of Health to conduct the analysis. The respondents' identities have all been deleted from the dataset. Respondents have provided written approval for their involvement in the study.

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