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Sociodemographic Analysis, The Environment and The Incidence of Malaria in Siabu District, Mandailing Natal Regency

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ABSTRACT

Malaria is one of the infectious diseases that is still a public health problem in Indonesia, including Mandailing Natal District. The emergence of malaria is caused by various supporting factors so that the Anopheles mosquito can survive because it adapts to the existing environment. These factors are environment, then behavior, health services and heredity. The purpose of this study was to determine socio-demographic, environmental and malaria incidence in Siabu District, Mandailing Natal Regency. This research was conducted in Mandailing District, Siabu District. This research was conducted in January-April 2015. This study used a case control design. The samples of cases and controls were 31 people each. This study uses bivariate analysis with chi-square test. There is no relationship between education, work and knowledge with the incidence of malaria in Siabu District, Mandailing Natal Regency. There is a relationship between standing water and wire netting at home with the incidence of malaria in Siabu District, Mandailing Natal Regency. Communities whose house ventilation is not installed with wire screens are 7.2 times more likely to suffer from malaria than people whose houses are installed with wire screens. The presence of standing water around the house is 5.1 times more likely to suffer from malaria than people whose houses do not have stagnant water. There is a relationship between standing water and wire netting at home with the incidence of malaria in Siabu District, Mandailing Natal Regency. Communities whose house ventilation is not installed with wire screens are 7.2 times more likely to suffer from malaria than people whose houses are installed with wire screens. The presence of standing water around the house is 5.1 times more likely to suffer from malaria than people whose houses do not have stagnant water.

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1. INTRODUCTION

Malaria is one of the infectious diseases that is still a public health problem in the world, including Indonesia. This disease affects the high mortality rate of infants, toddlers and pregnant women. Every year more than 500 million people in the world are infected with malaria and more than 1,000,000 people die. Most cases are found in Africa and several Asian countries, Latin America, the Middle East and some parts of Europe(Ministry of Health of the Republic of Indonesia, 2018).

Every year more than 500 million people are infected with malaria and more than 1,000,000 people die. Most cases are in Africa and some Asian countries, Latin America, the Middle East and some parts of Europe. The number of malaria cases and deaths recorded in 2000 was 50% or more by the end of 2010 and 75% or more by the end of 2015 (WHO, 2019).

In Indonesia, malaria is spread all over the island with different degrees of endemicity and can occur in areas with an altitude of up to 1800 meters above sea level. Based on data from the 2013 Indonesian Health Profile, it was found that there was a decrease in malaria cases per 1000 population, namely 1.75 in 2011, 1.69 in 2012 and 1.38 in 2013 but with the presence of malaria cases in Indonesia. Indonesia will continue to reduce public health status (Kementrian Kesehatan RI, 2018)

Malaria is still found in various regions in Indonesia which can be seen from the high Annual Parasite Incidence (API) per 1000 population. Indonesia Health Profile report data shows that Papua Province is the area with the highest API of 42.65 followed by West Papua province with an API of 38.44, NTT Province with an API of 16.37, Maluku Province with an API of 8.25, Province of North Maluku with an API of 4.51 and North Sumatra Province with an API of 1.30. Malaria in North Sumatra Province is still a public health problem, especially in rural areas, where Anopheles sp. many and easy to find in South Tapanuli, Mandailing Natal, Asahan, Labuhan Batu, Nias and Karo districts (Ministry of Health of the Republic of Indonesia, 2018). Malaria cases are ranked 7th in the list of the largest diseases in North Sumatra Province with an average of 82,405 clinical cases per year from 1996 to 2000. The spread of malaria is almost evenly distributed in all districts/cities but most are found in Nias District. and in Mandailing Natal District. In 2013 malaria cases occurred in 19 regencies/cities in North Sumatra Province where the highest incidence of malaria was in Mandailing Natal Regency with 8,311 cases, 9 of them died.(North Sumatra Provincial Health Office, 2014).

The emergence of malaria is caused by various supporting factors so that the Anopheles mosquito can survive because it adapts to the existing environment. These factors are environment, then behavior, health services and heredity. This is similar to that expressed by Blum (1974) that the factors that influence the degree of public health are: environment, behavior, health services, and heredity. Malaria is caused by Plasmodium parasites that live and reproduce in human red blood cells, transmitted by female malaria mosquitoes (Anopheles), can attack everyone, both men and women at all age groups from infants, children and adults.(Ministry of Health RI, 2014)). Malaria is one of the re-emerging diseases that has increased almost every year both in Indonesia and in tropical countries (Wulan, 2016; Pratama, 2015).

From all sub-districts in Mandailing Natal District, in 2014 the second highest malaria sufferer was in Siabu District with the incidence of malaria accompanied by blood tests as many as 589 cases. Meanwhile, the sub-district with the highest incidence of malaria is in the Pengabungan City District with the number of patients with blood supplies as many as 1803 cases(Mandailing Natal Health Office, 2014) Siabu Subdistrict in 2013 was included in the area with a high level of malaria endemicity (High Incidence Area) as measured by the API

indicator, namely the number of positive malaria sufferers in 1 year > 50 cases per 1,000 population of 23.1‰.

The physical environment, biological environment and socio-cultural community are factors that influence the spread of malaria, as well as environmental conditions in Siabu District, Mandailing Natal Regency, which is a very potential area for Anopheles sp. Judging from its geographical location, Mandailing Natal Regency is located between 00100 - 10500 North Latitude and 980500 - 1000100 East Longitude and the altitude is between 400-700 m. Several areas in Mandailing Natal Regency have irrigation ditches/channels, rivers, rice fields and swamps as well as fish ponds which can be the most preferred habitat for the Anopheles sp. Research result Puspaningrum (2016) explained that the mosquito An. sundaicus, An. nigerrimus and An. kochi is a malaria vector and is commonly found in rice fields, ponds, irrigation canals and former sand excavations in rivers.

Research conducted by the Malaria Control Center of Mandailing Natal Regency in 2013 explained that the types of mosquitoes in Siabu District did not change from year to year, namely the majority of An. Sundaicus, An. kochi and An. Nigeria. This is in accordance with environmental conditions in Siabu District which consists of rice fields, ponds and there is a river flow. Study Rofiqoh (2014) showed that the physical environmental factors of the house including wall density, use of wire netting on ventilation, ceilings, lighting and humidity were associated with the incidence of malaria. This is also supported by research Nasution (2019) where environmental factors have a significant influence on the incidence of malaria.

The condition of the local ecosystem is very supportive of mosquito breeding throughout the year, because potential breeding sites are found, namely rice fields, irrigation canals, rivers and fish ponds that are used by residents as additional livelihoods. The high incidence of malaria is also influenced by the behavior of the local community. This is in accordance with research Hakim (2016) and Noviarti (2016) which says that people who do malaria prevention are protected from the incidence of malaria. Another behavior is the habit of going out at night, where people who are not used to going out at night do not get malaria. This is in line with research Cania (2017) which states that there is a relationship between community behavior and the incidence of malaria. People who have low knowledge about the transmission, prevention and treatment of malaria have a risk of suffering from malaria (Siregar, 2021).

2. RESEARCH METHOD

This type of research is an analytic survey, with a case-control design to determine the effect of exposure to environmental and behavioral factors on the incidence of malaria by comparing the case group and the control group. The research was conducted in Siabu District, Mandailing Natal Regency, North Sumatra Province. The location selection took into account: 1. The high prevalence of malaria in Siabu District, Mandailing Natal Regency in 2014 was 589 cases (Siabu Malaria Clinic, 2014); 2. The environmental conditions of Mandailing Natal Regency are very supportive for the development of the Anopheles sp. This research was conducted from January 2015 to June 2015.

The case population was people who were declared positive for malaria who were hospitalized or outpatient at the Malaria Clinic, Siabu District, from March to May 2015 who lived more than two months in Siabu District. The control population was all non-malaria sufferers based on medical records at the Malaria Clinic, Siabu District and with clinical symptoms: no fever, no chills, no headache, no nausea, no vomiting, no diarrhea, no muscle

aches or aches and no paleness (anemia).) for the last two months based on the results of observations and interviews during the implementation of the research in Siabu District. From the sample calculation data, it can be seen that the number of samples is 31 people to see the frequency distribution of malaria sufferers in Siabu District.

This study uses a comparison of cases and controls 1:1, so the number of cases and controls is the same. The total sample of cases and controls in this study as a whole was 62 people. Case sampling was taken using purposive sampling method, in which case samples taken had to meet the criteria set out in the study. The criteria for sampling in this study are: 1. Age 17 years; 2. Malaria patients based on clinical diagnosis by health workers for two months prior to the study; 3. Stayed in Siabu District for two months.

1. Case Criteria

Cases are people who are declared positive for malaria who are hospitalized and treated at the Malaria Clinic in Siabu District based on data from health workers' examinations, from March to May 2015.

2. Control Criteria

Controls were non-malaria sufferers based on the results of the diagnosis by health workers taken using age and sex matching. For example, if the case is a male aged 17 years and lives in Simangambat Village, the control is also taken with these criteria

Analysis *univariate* carried out to obtain about the distribution, frequency of each independent and dependent variable in cases and controls. Bivariate analysis used Chi Square for the influence of independent variables on environmental factors (wire screens on ventilation, wall density, house ceilings, puddles, ditches/gullies, rice fields and bushes) and behavioral factors (knowledge, attitudes and actions) on variables dependent (malaria incidence) significantly by looking at the risk (odds ratio) at the 95% confidence level (p = 0.05), so that if the results of statistical analysis p value <0.05, the above variables are stated to be significantly related. Multivariate analysis used the Enter method to see the effect of the predictor variables on malaria and all the variables studied so that the independent variables with the most dominant relationship with the incidence of malaria were identified by using the multiple logistic regression method (Multiple Logistic Regression). Independent variables that are meaningful in bivariate analysis will be tested together and variables that have p value < 0.25 will be excluded sequentially starting from p value > 0.05. Then obtained the most dominant factors causing malaria. To find out which cases of malaria could be prevented by correcting the dominant risk factors, a Population Attribute Risk (PAR) calculation was carried out.

3. RESULT AND ANALYSIS

Descriptive Analysis

Table 1. Distribution Education, Profession, Puddle, Wire Mesh in the House and Knowledge with Malaria

Variable	Malaria		Not Malaria		P	OR
	f	%	f	%		
Education						
Primary School	9	29	9	29	0.63	
Junior High School	6	19.4	10	32.3		
Senior High School	13	41.9	8	25.8		
Diploma/Barchelor	3	9.7	4	1.29		

Puddle	Malaria		Not Malaria		P	OR
	f	%	f	%		
Exist	22	71	10	32.3	0.002	5,133
There is not any	9	29	21	67.7		
Profession						
Office workers	5	16.1	6	19.4	0.555	
Trader	6	19.4	5	16.1		
Farmer	16	51.6	12	38.7		
Does not work	4	12.9	8	25.8		
Wire Mesh in the House						
Yes	21	67.7	7	22.6	0.0001	7.2
Not	10	32.3	24	77.4		
Knowledge						
Bad	28	90.3	24	77.4	0.167	2.7222
Well	3	9.7	7	22.6		
Total	31	100	31	100		

Based on table 1, it is known that the last education level of respondents in the case group was mostly high school graduates, namely 13 people (41.9%). Meanwhile, from the control group, most of them graduated from junior high school as many as 10 people (32.3%). The results of statistical analysis using the Chi Square test showed p value = 0.63 <0.05, which means that there is no significant relationship between education and the incidence of malaria.

The results of this study indicate that the majority of the case group has a job as a farmer as many as 16 people (51.6%) and the control group has the most work as a farmer as many as 12 people (38.7%). The results of statistical analysis using the Chi Square test showed p value = 0.555 <0.05, which means that there is no significant relationship between work and the incidence of malaria.

In this study, it was found that from 31 cases as many as 21 respondents (67.7%) it turned out that the wire netting in their house did not meet the requirements or did not have wire netting installed at all. Meanwhile, of the 31 controls, 7 respondents (22.6%) had their house wire netting not meet the requirements or not installed at all. The results of statistical analysis using the Chi Square test showed p value = 0.0001 <0.05, which means that there is a significant relationship between the wire gauze on ventilation and the incidence of malaria. It is known that the Odd Ratio (OR) value is 7.2 (95% CI 2.327 – 22.279), so that people whose house ventilation is not installed with wire screens are 7.2 times more likely to suffer from malaria than people whose houses are installed with wire screens.

In this study, it was found that from 31 cases, as many as 22 respondents (71%) there were puddles of water around their homes. While 31 controls, as many as 10 respondents (32.3%) there are puddles of water around their homes. The results of statistical analysis using the Chi Square test showed p value = 0.002 <0.05, which means that there is a significant relationship between standing water around the house and the incidence of malaria. The Odds Ratio (OR) value of 5.1 (95% CI 1.742 – 15.131) means that if there are

puddles of water around the house, it is likely to be 5.1 times more at risk of suffering from malaria compared to people whose houses do not have puddles of water.

The house's condition that is not installed with wire netting will have a higher risk of being infected with malaria (Irawati, 2017) (Purnama, 2017). Many people do not install wire mesh in their homes because installing wire netting is felt to be difficult, inconvenient, and not important for the community (Engka, 2017) .

In this study, it was found that from 31 cases, 28 respondents (90.3%) had a poor level of knowledge about malaria, and from 31 controls, 24 respondents (77.4%) also had a poor level of knowledge about malaria. The results of statistical analysis using the Chi Square test showed p value = 0.167 > 0.05, which means that there is no significant relationship between the respondent's knowledge of the incidence of malaria.

4. DISCUS

Jobs that are not sedentary or with high mobility are at greater risk of malaria, such as official duties in endemic areas for long periods of time up to many years such as medical officers, military officers, missionaries, mining workers, and others. Jobs as plantation workers who come from non-endemic areas to endemic areas do not yet have immunity to disease in the new area, so they are at great risk of suffering from malaria. Likewise, workers who are imported from other areas will be at risk of suffering from malaria. According to research by Hasyim et al (2014), people who work outside the home at night are at risk of malaria incidence by 4.0 times compared to people who do not work outside the home at night.

The results of this study indicate that the majority of the case group has a job as a farmer as many as 16 people (51.6%) and the control group has the most work as a farmer as many as 12 people (38.7%). The results of statistical analysis using the Chi Square test showed p value = 0.555 <0.05, which means that there is no significant relationship between work and the incidence of malaria.

The results of statistical analysis using the Chi Square test showed p value = 0.0001 <0.05 and the Odd Ratio (OR) value of 7.2, which means that there is a significant relationship between the use of wire netting in home ventilation and the incidence of malaria. Respondents whose houses do not use screens for ventilation at home are 7.2 times more likely to suffer from malaria compared to respondents whose house ventilation is installed with wire screens. Then after the multivariate test, it was found that the wire gauze on ventilation was the most influential factor on the incidence of malaria in Siabu District with an Exp (B) value of 8.837 and after calculating the Population Attribute Risk (PAR) it was known that the PAR value was 84,

In general, most of the housing conditions in Siabu District do not have or use wire mesh for ventilation of their houses. However, in several houses that had been installed with wire mesh, researchers found damaged wire screens such as holes and tears. The physical condition of the house is closely related to the incidence of malaria, especially those related to the entry and exit of mosquitoes such as the absence of wire netting on the ventilation which can make it easier for mosquitoes to enter the house . The use of wire netting is very helpful in reducing the number of mosquitoes that enter the house and if installed properly can reduce the risk of malaria . The use of ventilation nets that are not comprehensive can cause mosquitoes to enter the house through ventilation that does not use screens, thereby increasing contact between mosquitoes and humans.

The location of dwellings near vector breeding sites, as well as the design and construction of houses, can minimize vector-human contact, thereby reducing the risk of vector-borne disease transmission (Engka, 2017). The physical condition of the house has a strong correlation with the incidence of malaria, particularly the entry and exit points for mosquitoes, particularly the absence of gauze on the vent, which makes it easier for mosquitoes to enter the house(Agustina, 2021; Mustafa, 2018).

Based on the results of the study, it was found that in the case group whose house did not have a ceiling as much as 58.4% and in the control group as much as 35.5%. The results of statistical analysis using the Chi Square test showed p value = 0.126 > 0.05, which means that there is no significant relationship between the ceiling of the house and the incidence of malaria. Based on observations during the field, in general, respondents' houses in both the case and control groups mostly have permanent ceilings that function to prevent the entry of mosquitoes into the house through the gaps in the roof of the house, but in some of the respondents' houses it was found that the ceiling was only on the roof. living room and bedroom only so that it can be an entry point for mosquitoes into the house.

Based on the results of the study, it is known that in the case group around the house there are puddles of water as much as 71% and in the control group as much as 32.3%. The results of statistical analysis using the Chi Square test showed the value of p = 0.002 (p <0.05), meaning that there was a significant relationship between the presence of standing water around the respondent's house and the incidence of malaria. It is also known that the OR value is 5.1, which means that if there are puddles of water around the community's house, it is likely to be 5.1 times more at risk of suffering from malaria compared to people whose houses do not have puddles of water.

Based on observations, several puddles such as fish ponds and excavated holes around the respondent's house contained mosquito larvae, but no further identification was carried out whether the larvae found were Anopheles mosquito larvae. However, this can explain that the presence of standing water can potentially become a breeding ground for mosquitoes. Anopheles mosquitoes really need a place to breed, namely water and land. Mosquitoes at an early stage (aquatic stage) need standing water for their life cycle.

Mandailing Natal District, especially Siabu District, is an area with high rainfall. The influence of rainfall in the spread of malaria is by the formation of breeding places, namely puddles of water around people's homes. The presence of water around the house is associated with the incidence of malaria. This association can occur because puddles of water around the house will become breeding places for malaria vectors, thereby bringing mosquitoes closer to humans who live in houses near the puddles. As an implication, people who live at home and there are puddles of water around their homes have the risk of being bitten by mosquitoes and the risk of contracting malaria.

Based on the results of the study, it is known that in the case group around the house there are rice fields as much as 61.3% and in the control group as much as 32.3%. Based on the results of statistical analysis using the Chi Square test, the p value = 0.022 < 0.05, so it can be concluded that there is a significant relationship between the presence of rice fields around the house in the case group and the control group on the incidence of malaria. Based on observations, in some rice fields that are in the stage of planting rice seedlings, mosquito larvae are found in the fields where the water is stagnant.

In line with this, a survey conducted by the Malaria Control Center Office of Mandailing Natal Regency at the end of 2014, generally Anopheles mosquito larvae were found in rice fields in several sub-districts in Mandailing Natal Regency. Rice fields are a habitat for

malaria vector mosquitoes. Rice fields where the water is continuously inundated tend to have a very large potential to become a breeding ground for the Anopheles sp.

The most effective countermeasures to reduce the number of vectors need an effort that does not damage the surrounding environment. One of the right ways is to apply mosquito population control methods by changing the mosquito habitat in such a way that the environment where the mosquitoes are not suitable for vector development. One method that can be done is to apply a periodic irrigation pattern.

Applying periodic irrigation patterns in rice fields can reduce the population density of Anopheles sp. meaningfully . The decrease in larval population occurred based on the length of time for water drying and re-flooding. This periodic irrigation pattern has also been proven to increase the amount of rice production in Siabu District. As an area where almost part of its territory is a rice field area, the Mandailing Natal District Government, especially Siabu District, should start implementing simultaneous planting patterns and start optimizing the periodic irrigation system so that the Anopheles sp. cannot breed in rice fields.

Research conducted by Idrus (2014) stated that there was a relationship between the distance of the house and mosquito breeding sites (rice fields) with the incidence of malaria at the Koeloda Health Center, Golewa District, Ngada Regency with p = 0.000, in line with research conducted by Hotez et al (2015) which states that people who live around their homes have rice fields at 6.5 times risk of suffering from malaria compared to people whose homes do not have rice fields. Research conducted by Hestiningsih (2019) explained that there was a relationship between Anopheles aconitus mosquito breeding sites in the form of rice fields to the incidence of malaria in Jepara Regency with p = 0.012 and OR 2.7.

From a risk perspective, the incidence of malaria is very local specific, because in addition to depending on the ecosystem, it also depends on various population factors (Lumolo et al., 2015). Malaria risk factors are always different in each population, populations living in urban areas have different risks with populations living in rural areas. Residents in rural areas are more at risk because there are rice fields, swamps and rivers which are the habitat of the Anopheles sp.

Knowledge will be the basis for someone to do or not do something, someone who has good knowledge about health tends to do health prevention and control while people who do not know malaria tend not to do malaria prevention and control (Saragih, 2020; Tarigan, 2020). Based on the results of this study, it is known that in the case group, respondents who have poor knowledge are 90.3% and in the control group respondents are 77.4%. As a result of this lack of knowledge, people in the study area have behaviors that do not support the malaria eradication program in the research area, namely the lack of knowledge of controlling using biological methods such as rearing larvae-eating fish as predators of mosquito larvae, prevention of malaria and symptoms of malaria .

The results of statistical analysis using the Chi Square test showed p value = 0.167 > 0.05, which means that there is no significant relationship between the level of knowledge and the incidence of malaria. The low level of knowledge of respondents in the case and control groups is also inseparable from the low level of education of the respondents. In general, the education level of respondents is only up to junior high and high school levels, so that respondents find it difficult to receive information about malaria that is given to them. People with a high level of education are more likely to have better knowledge about malaria, compared to people with low education. With poor knowledge, the tendency of people to be exposed to malaria is greater.

Knowledge is one of the predisposing factors, namely the factors that facilitate and underlie the occurrence of certain behaviors and exist within the person himself (Nababan, 2018; Saragih , 2019). Therefore, people who have less knowledge are not necessarily at risk for contracting malaria, and conversely people who have good knowledge are not necessarily

not infected with malaria. Although malaria is something very close and familiar in the life of the people of Siabu District. This is inseparable from respondents who think that malaria is a disease that is commonly experienced based on the observations they see and feel and there are also many people around them who have symptoms of malaria but are still alive so it does not attract the attention of respondents to find out the truth of the disease. the.

The results of this study contradict the research conducted by Herdiana (2016)with a case control design using the Chi Square test showing value = 0.001 <0.05 and the Odd Ratio (OR) value of 4.04 meaning that there is a significant influence between mother's knowledge on incidence of malaria. Knowledge becomes an important basis for determining an action. One's knowledge becomes the basis for determining an action in making a decision and knowledgeable people become wiser and more responsive in everyday life. If someone has good knowledge in preventing malaria, it will increase their chances of making efforts to prevent malaria by carrying out simple activities such as using mosquito nets, using fish that can kill malaria mosquito larvae, and carrying out simple environmental controls.

5. CONCLUSION

There is no relationship between education, work and knowledge with the incidence of malaria in Siabu District, Mandailing Natal Regency. There is a relationship between standing water and wire netting at home with the incidence of malaria in Siabu District, Mandailing Natal Regency.

Communities whose house ventilation is not installed with wire screens are 7.2 times more likely to suffer from malaria than people whose houses are installed with wire screens. The presence of standing water around the house is 5.1 times more likely to suffer from malaria than people whose houses do not have stagnant water.

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