RESEARCH ARTICLE

pISSN: 0126-074X | eISSN: 2338-6223
https://doi.org/10.15395/mkb.v55n1.2902
Majalah Kedokteran Bandung. 2023;55(1):35–41

Majalah Kedokteran Bandung (MKB)

Received: July 19, 2022
Accepted: March 6, 2023
Available online: March 31, 2023

Malaria Infection and Socioeconomics in Malaria Endemic Areas of East Nusa Tenggara, Indonesia

Nisa Fauziah,[1] Edina U. Anindhita,[2] Savira Ekawardhani,[1] Deviyanthi N. Afifah,[3] Jontari Hutagalung[4]
[1]Division of Parasitology, Department of Biomedical Sciences, Faculty of Medicine Universitas Padjadjaran, Indonesia
[2]Undergraduate Medical Study Program, Faculty of Medicine Universitas Padjadjaran, Indonesia
[3]Study Program of Pharmacy, Indonesian Health Institute, Indonesia
[4]Laboratory of Parasitology, Biomedical, and Basic Health Technology, National Institute of Health Research and Development, Ministry of Health, Indonesia

Abstract

More than 1.1 million people, or 20.90% of the population in East Nusa Tenggara (NTT), Indonesia, live below the poverty line, making NTT the third province with the highest number of poor people in Indonesia. The region of NTT, which is well known as one of the endemic areas for malaria in Indonesia, also has the highest number of adults with low nutritional status. This study aimed to assess the influence of socioeconomic factors on malaria-endemic areas in eastern Indonesia. A cross-sectional study was conducted in East Nusa Tenggara from January to March 2020. Bivariate and multivariate analyses were then performed on 317 population data of adults with low socioeconomic status. It was found that one of the socioeconomic factors, i.e., the age, is significantly associated with malaria (p-value=0.031; OR=1.684) with 40 being the age with the highest association. Thus, age is associated with malaria incidence in endemic areas.

Keywords: Malaria, socioeconomic, East Nusa Tenggara, Indonesia

Introduction

In 2021, based on socioeconomic data for the East Nusa Tenggara province report, more than 20.90% population in East Nusa Tenggara lived in poverty, most of which lived in rural areas. East Nusa Tenggara (ENT) has become Indonesia's third province with the highest poor population. However, the ENT population shows an increase in expected and mean years of schooling. Those factors contribute to the human development index, which will later determine the quality of life.[1] In terms of nutrition, ENT Province is reported to have the highest number of the adult population with low nutritional status based on body mass index (BMI), with 8.8% adult population of ENT (≥ 218 thousand adults) with low nutritional status.[2]

East Nusa Tenggara Province also has one of the highest malaria cases in Indonesia. In 2017 that reported 211.409 malaria cases annual parasite incidence (API) 5,76‰. However, in 2018 decreased become 18.053 cases with API 3,6‰.[3,4] Up to date MoH reported a decrease in the case number of malaria cases in ENT though is still in the process of malaria elimination.

Malaria in South East Asia (SEA) region alone accounts for 6.3 million cases and 9,000 deaths. World Malaria Report 2020, most of the countries in SEA, including Indonesia, reported a decrease in malaria case incidence estimated at 40% or more. However, Indonesia still keeps trying to reach being free from malaria in 2030.[5]

Other studies have suggested that socioeconomic and demographic factors are more critical for developing severe malaria than other factors. A study in Mutasa and Nyanga districts found factors such as maternal education, adequate knowledge about malaria, and the number of children associated with severe malaria. [6]

To assess individuals and communities, we used a standard form and questionnaire combination of health determinants such as the socioeconomic environment, the physical environment, and the person's characteristics and

Corresponding Author:
Nisa Fauziah
Division of Parasitology, Department of Biomedical Sciences, Faculty of Medicine Universitas Padjadjaran, Bandung, Indonesia
Email: nisa@unpad.ac.id

behaviors. In infectious diseases, socioeconomic factors hold a significant role. Poverty, illiteracy, gender inequality, and rapid urbanization are the major determinants that make the population vulnerable. Host individual characteristics usually called host factors, such as age, sex, and nutritional status, also influence one's exposure, susceptibility, or response to an agent. Understanding health determinants related to malaria will contribute to the elimination efforts of malaria and intervention programs towards the problems in the socioeconomic sector. This study will analyze malaria association with socioeconomic and host factors in a low socio-economic, malaria-endemic region, South Central Timor Regency, East Nusa Tenggara.

Methods

A cross-sectional study using data from East Nusa Tenggara was used in this study. All the analyses were conducted from January until March 2020 in the Faculty of Medicine, Universitas Padjadjaran. Three hundred seventeen data from the low social and economic adult population were obtained by systematic random sampling. Data assessments, including; age, body weight, body height, sex, occupation, education history, number of people per household, and malaria confirmation by an nPCR exam, are used in this study (Figure).

Independent variables will be classified into two categories: respondents' host factors and socioeconomic factors. All data were collected by local health workers and central researchers using a standard questionnaire including; age, sex, occupation, education, history, and the number of households. Bodyweight and body height were also collected for anthropometry measurement. BMI was obtained by calculating the body height and body weight data with the BMI equation and then classified into Indonesia's BMI classification (<18.5= underweight and 18.5-25= normal). The dependent variable is malaria status, confirmed by an nPCR examination conducted in the parasitology laboratory. Data were collected via direct assessment at a household visit.

Data analysis in this study using IBM® SPSS® 25th version software and Microsoft Excel. Bivariate and multivariate analyses were used with a p-value <0.05 and a confidence interval of 95%. Multivariate analysis with the entering method was conducted on all variables, and then the variables were eliminated one by one based on the p-value. This research has been approved by the Health Research Ethical Committee of the Faculty of Medicine, Universitas Padjadjaran, with ethical license number 1196/UN6.KEP/EC/2020.

Results

This study obtained a total sample of 317. As shown in (Table 1), the respondents were 126 males and 191 females. More than half of the respondents (59.2%) had a normal Body Mass Index. Age group 30–39 had the highest prevalence of malaria cases among all age groups. Both the prevalence of malaria nPCR positive and negative results are higher in females. Most of the respondents were homemakers, and most had elementary school as their highest level of education. Table 2 shows the results of a bivariate analysis of malaria status, host, and socio-economic factors. Of the six variables, age

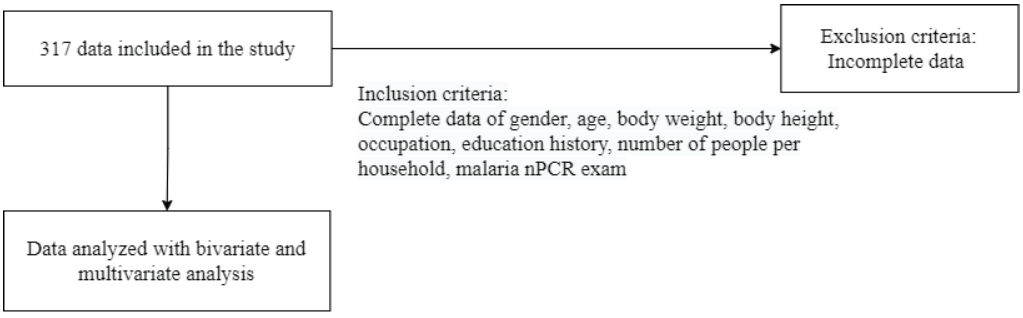

Figure Research Flowchart

Table 1 Characteristics of the Respondents

Variable	Malaria Status		n (%)
	Positive (%)	Negative (%)	
Age			
20–29	8 (7.4)	44 (21.1)	52 (16.4)
30–39	35 (32.4)	67 (32.1)	103 (32.2)
40–49	32 (29.6)	64 (30.6)	96 (30.3)
50–59	33 (30.6)	34 (16.3)	67 (21.1)
Sex			
Male	46 (42.6)	80 (38.3)	126 (39.7)
Female	62 (57.4)	129 (61.7)	191 (60.3)
BMI			
Underweight	35 (32.4)	72 (34.4)	107 (33.8)
Normal	73 (67.6)	137 (65.6)	210 (66.2)
Education			
College	3 (2.8)	9 (4.3)	12 (3.8)
Senior high school	7 (6.5)	28 (13.4)	35 (11.0)
Junior high school	18 (16.7)	38 (18.2)	56 (17.7)
Elementary school	46 (42.6)	68 (32.5)	114 (36.0)
Not finishing elementary school	34 (31.5)	66 (31.6)	100 (31.5)
Occupation			
Housewife	61 (56.5)	132 (63.2)	193 (60.9)
Private employee	6 (5.6)	4 (1.9)	10 (3.2)
Farmer	41 (38.0)	74 (34.9)	114 (36.0)
Household size			
<5	50 (46.3)	89 (42.6)	139 (43.8)
5–8	56 (51.9)	116 (55.5)	172 (54.3)
9–11	2 (1.9)	4 (1.9)	6 (1.9)

shows a significant relationship with malaria at the p-value < 0.05.

Multivariate results of malaria status, host, and socio-economic factors are shown in Table 3. All variables were included in the analysis and then excluded one by one by looking at the p-value with the entering method. The result shows that age is significant for malaria (p value=0.025) and

Table 2 Health Determinants and Association with Malaria

Variable	Malaria Status		n (%)	P-value	95% CI	
	Positive (%)	Negative (%)			Lower	Upper
Age						
<40	43 (39.8)	111 (53.1)	154 (48.6)	0.025	1.069	2.743
≥40	65 (60.2)	98 (46.9)	163 (51.4)			
Sex						
Male	46 (42.6)	80 (38.3)	126 (39.7)	0.457	.764	1.919
Female	62 (57.4)	129 (61.7)	191 (60.3)			
BMI						
Normal	73 (67.6)	137 (65.6)	210 (66.2)	0.716	.557	1.495
Underweight	35 (32.4)	72 (34.4)	107 (33.8)			
Education						
High	10 (9.3)	37 (17.7)	47 (14.8)	0.045	1.005	4.424
Low	98 (90.7)	172 (82.3)	270 (85.2)			
Occupation						
Unemployed	47 (43.5)	77 (36.8)	124 (39.1)	0.248	.472	1.215
Employed	61 (56.5)	132 (63.2)	193 (60.9)			
Household size						
<5	50 (46.3)	89 (42.6)	139 (43.8)	0.528	.729	1.854
5–11	58 (53.7)	120 (57.4)	178 (56.2)			

Note: OR: Odds Ratio, 95% CI: 95% Confidence Interval

Table 3 Multivariate Result of the Effects of Host and Socioeconomic Factors on Malaria

Initial multivariate result

Variable	B	OR	P-value	95% CI		R square
				Lower	Upper	
Constant	61.963		.999			0.064
Age	.530	1.699	.031	1.049	2.750	
Sex	-20.855	.000	.999	.000		
BMI	-.143	.866	.581	.521	1.442	
Education	.717	2.048	.063	.961	4.363	
Occupation	-21.080	.000	.999	.000		
Household size	.145	1.156	.556	.714	1.872	

Level 1

Variable	B	OR	P-value	95% CI		OR changes (%)
				Lower	Upper	
Age	.501	1.650	.041	1.022	2.664	2.899
BMI	-.180	.835	.485	.504	1.395	3.579
Education	.754	2.125	.050	1.001	4.513	3.759
Occupation	-.277	.758	.264	.466	1.232	
Household size	.177	1.193	.470	.739	1.926	3.200

Level 2

Variable	B	OR	P-value	95% CI		OR changes (%)
				Lower	Upper	
Age	.503	1.698	.029	1.055	2.733	.000
BMI	-.173	.841	.502	.508	1.394	2.886
Education	.720	2.055	.059	.972	4.344	.314
Household size	.157	1.170	.518	.727	1.885	1.196

Level 3

Variable	B	OR	P-value	95% CI		R square
				Lower	Upper	
Constant	-1.121					
Age	.521	1.684	.031	1.048	2.707	0.040
Education	.705	2.025	.064	.959	4.270	
Household size	.142	1.152	.558	.717	1.851	

age is a risk factor for malaria (OR=1.684). No variable shows OR changes >10%, meaning this study has no confounding factor.

Discussion

East Nusa Tenggara is a province with a low socio-economic level. Other than that, ENT has also known as a malaria-endemic area. Three hundred seventeen data of low socio-economic population were obtained from 5 areas of ENT based on the API level, and 108 people were positive for malaria. Malaria is a disease that can affect anyone regardless of gender and age; 42.6% of males and 57.4% of females were positive for malaria in this study. Idris et al. [7] reported that the risk for disease severity was higher in female patients, and Gondwe et al.[8] reported that female patients were at a higher risk for mortality. The female rate of malaria infection is higher, especially during pregnancy, because of the decrease in immunity.[9,10]

The age group shows a significant association with malaria (p value=0.031), an individual age ≥40 was found to be 1.684 times more susceptible to malaria. Infants, children under 5 years of age, pregnant women, immunocompromised, and nonimmune populations were said to have a higher risk of malaria. A study in southeast Nigeria by Nwaorgu et al.[9] and a study in Cameroon by Sakwe et al.[10] found that malaria is the most prevalent in children under 5 years old. An analysis of *Palcifarum* malaria in nonimmune found a significantly higher rate of severe disease and mortality among patients <40 years of age.[11] Idris et al.[7] studied imported malaria cases in South Sudan; 182 of the patients

in that study were infected with *P. falciparum.* Of these patients, 13 were defined as having severe malaria. Comparing the groups with severe and nonsevere diseases, they found that age did not significantly contribute to severity. Other studies, however, support our findings. Sylvester et al.[12] Most of these nonimmune subjects were moved to new villages in a malarious area. Mortality from malaria was highest in the youngest (<2 years) and oldest age groups (>40 years), 2.2% and 2.5%, respectively, compared with 0%–0.9% for patients who were 2–40 years of age.

Two Italian studies showed similar results. O'Brien et al.[13] studied disease in 194 cases due to *P. falciparum*, 9% of which fulfilled the criteria of severe malaria. The number of severe cases increased with age as follows: 3.2% of cases in patients who were <30 years of age; 5.3% for patients 30–39 years of age; 9.8% for patients 40–49 years of age; and 23.5%, for patients ⩽50 years of age. Eli Schwartz et al.[14], who studied mortality in malaria patients, showed a 2.3% case fatality rate in patients with malaria due to *P. falciparum*, with an increment in mortality by age. There were no deaths in this series among those patients who were <20 years of age; the mortality rate was 0.5% in patients 21–30 years of age; 2.3% in patients 31–40 years of age; 1.7% in patients 41–50 years of age; and 5.4%, in patients ⩽51 years of age.

A decline of immunity in old age is called immunosenescence. Immunosenescence causes a vulnerability to infectious diseases and causes morbidity and mortality in the old population.[15] In this study, the subject is the adult population, (20–59) immunosenescence may play a role, therefore, found that individuals with age ≥40 are more susceptible to malaria, proven by the number of cases higher in population with age group ≥40 than <40-year-old.

Nutritional status, assessed by Body Mass Index (BMI), shows no significant effect on malaria. Several studies also found the same result, but on the other hand, some studies found a two-way association between malaria and malnutrition. [10,16] This conflicting result may appear because the study was the different metrics used and subject choices.

Infectious diseases are already known to correlate with socioeconomic factors. Malaria is often mentioned as the disease of poor people with low education levels, who are more likely to develop malaria than those with higher education levels. [10,17] People with higher education levels could understand more about health education, especially about malaria disease, so they change their health-related behavior and decrease malaria infection.[10,18] People with higher education also tend to have higher income and better housing, schooling, and preventive measures such as insecticide-treated nets (ITNs) that later can prevent and lower malaria incidence.[19,20] However, the education variable in this study is not statistically significant towards malaria with OR>1 (p-value: 0.064, OR: 2.025). Population data is based on populations with low education.

Occupation, too, cannot be ignored in malaria. Some occupations may have a higher risk of malaria because of the higher time or chance exposed to Plasmodium-infected female Anopheles. In this study, the highest malaria prevalence occurred in homemakers. Traditional homemakers usually wake up early to prepare household needs or cook evening meals outdoors. The second highest malaria prevalence occurred in farmers. Working outdoors may put farmers at greater risk because they work during peak mosquito-biting time.[10]

Regarding household size, a previous study by Sharma et al.[20] in Central India reported a significant association between households and malaria, the same result obtained by Guerra et al.[21] This is because large household size results in a high concentration of mosquito-attracting human emanations that *Plasmodium*-infected mosquitos are more likely to bite those people. This study found no association between household size and malaria. Nevertheless, we did not include the housing characteristics that might influence the theory mentioned, such as the wall, roof, and floor conditions.

Indonesia is experiencing a demographic bonus, meaning the working-age population is higher than the non-working-age population. A demographic bonus is an opportunity to positively impact economic growth for Indonesia in general and for underdeveloped and poor areas like East Nusa Tenggara in particular. In this study, the subjects were of working age, and it was found that age is associated with malaria. If the population's health is not good, in this case, is infected with malaria, the opportunity cannot be fully utilized; even a demographic bonus may lead to a demographic burden.[22,23] To prevent this from happening, the malaria elimination program that has been regulated in Keputusan Menteri Kesehatan Republik Indonesia
No. 239 Tahun 2009 must be implemented correctly by the health workers and government, especially in endemic areas.
Since this study uses secondary data, there

was a limitation in the selection of variables. Additional variables that may support socio-economic factors, such as monthly income, could have been obtained so that this study can better prove the effect of socio-economic factors by first classifying the socio-economic status following an index. The R square in this study is 0.040, meaning this study only explains 4% of independent variables. Therefore, more research needs to be done to understand more about malaria.

References

1. BPS East Nusa Tenggara. Update on the socioeconomic, 2021. Monthly Socioeconomic Data Report. ENT: BPS Cataloguing Data; 2021.
2. Kemenkes RI. In nutritional status monitoring book Kemenkes RI. 2018. Kemenkes RI: Jakarta. p. 7–11.
3. BPS East Nusa Tenggara. Update on Malaria Endemic 2015-2017. 2018. Number of malaria cases by district and city in East Nusa Tenggara. ENT: BPS Cataloguing Data: 2018.
4. Kemenkes RI. Indonesia Healthy profile in data Kementerian Kesehatan Republik Indonesia. 2019. Kemenker RI: Jakarta p. 207.
5. WHO. Malaria Endemic: World Malaria Report 2020. Malaria. Global Malaria Programme.; 2020.
6. Mutsigiri-Murewanhema F, Mafaune PT, Shambira G, Juru T, Bangure D, Mungati M, Gombe NT, Tshimanga M. Factors associated with severe malaria among children below ten years in Mutasa and Nyanga districts, Zimbabwe, 2014-2015. Pan Afr Med J. 2017;27:23.
7. Idris IO, Ayeni GO, Iyamu IO. Factors influencing severity of recurrent malaria in a conflict-affected state of South Sudan: an unmatched case-control study. Confl Health. 2022.16(34):1102.
8. Gondwe T, Yang Y, Yosefe S, Kasanga M, Mulula G, Luwemba MP, et al. Epidemiological trends of malaria in five years and under children of Nsanje District in Malawi, 2015-2019. Int J Environ Res Public Health. 2021;18(23):12784.
9. Nworgu FC, Egbunike GN. Nutritional potential of centrosema pubescens mimosa invisa and pueraria phaseoloides leaf meals on growth performance responses of broiler chickens. Am. J. Exp. Agric. 2013;3(3):506–519
10. Sakwe N, Bigoga J, Ngondi J, Njeambosay B, Esemu L, Kouambeng C, et al. Relationship between malaria, anemia, nutritional and socio-economic status amongst under-ten children, in the North Region of Cameroon: A cross-sectional assessment. PLoS ONE. 2019;14(6):e0218442.
11. Manumpa, S. Influence of demographic factors and history of malaria with the incidence malaria In MORU PHC. Jurnal Berkala Epidemiologi, 2017;4(3):338–48.
12. Sylvester B, Gasarasi DB, Aboud S, Tarimo D, Massawe S, Mpembeni R. et al. Prenatal exposure to *Plasmodium falciparum* increases frequency and shortens time from birth to first clinical malaria episodes during the first two years of life: prospective birth cohort study. Malar J. 2016;15(1):379.
13. O'Brien SF, Delage G, Seed CR, Pillonel J, Fabra CC, Davison K, et al. The epidemiology of imported malaria and transfusion policy in 5 nonendemic countries. Transfus Med Rev. 2015;29(3):162–71.
14. Schwartz E, Sadetzki S, Murad H, Raveh D. Age as a risk factor for severe Plasmodium falciparum malaria in nonimmune patients. Clin Infect Dis. 2001;33(10):1774–77.
15. Workineh L, Lakew M, Dires S, Kiros T, Damtie S, Heilemichael W, et al. Prevalence of malaria and associated factors among children attending health institutions at South Gondar Zone, Northwest Ethiopia: A Cross-Sectional Study. Glob Pediatr Health. 2021;8:2333794X211059107.
16. Deribew A, Alemseged F, Tessema F, Sena L, Birhanu Z, Zeynudin A, et al. Malaria and under-nutrition: a community-based study among under-five children at risk of malaria, South-West Ethiopia. PLoS ONE. 2010;5(5):e10775.
17. Pini A, Stenbeck M, Galanis I, Kallberg H, Danis K, Tegnell A. et al. Socioeconomic disparities associated with 29 common infectious diseases in Sweden, 2005-14: an individually matched case-control study. Lancet Infect Dis. 2019;19(2):165–176.
18. Ravishankar A, Singh S, Rai S, Sharma N, Gupta S, Thawani R. Socio-economic profile of patients with community-acquired skin and soft tissue infections in Delhi. Pathog Glob Health. 2014;108(6):279–82.
19. Degarege A, Fennie K, Degarege D, Chennupati S, Madhivanan P. Improving socioeconomic status may reduce the

burden of malaria in sub-Saharan Africa: A systematic review and meta-analysis. PLOS ONE. 2019;14(1):e0211205.
20. Sharma RK, Singh MP, Saha KB, Bharti PK, Jain V, Singh PP. et al. Socio-economic & household risk factors of malaria in tribal areas of Madhya Pradesh, Central India. Indian J Med Res. 2015;141(5):567–75.
21. Guerra M, de-Sousa B, Ndong-Mabale N. Malaria determining risk factors at the household level in two rural villages of mainland Equatorial Guinea. Malar J. 2018;17(203):1–10.
22. Carter R, Karunaweera ND. The role of improved housing and living environments in malaria control and elimination. Malar J. 2020;19(385):1–6.
23. Warsito, T. Attaining the demographic bonus in Indonesia. J Pajak dan Keuang Negara. 2019;1(1):8.