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Malaria and Nutritional Status among Female Adolescents in West Sulawesi, Indonesia

Noor Bahri Noer¹, Veni Hadju², Ridwan M Thaha³, Anwar Daud⁴, Andi Imam Arundhana⁵, Anwar Mallongi⁶

¹Senior Lecturer of Department of Hospital Administration, ²Professor of Community Nutritional Department, ³Senior Lecturer of Health and Education Promotion Department, ⁴Professor of Environmental Health Department, Faculty of Public Health, ⁵Lecturer of Community Nutritional Department, ⁶Senior Lecturer of Environmental Health Department, Faculty of Public Health, Hasanuddin University, Makassar, Indonesia

ABSTRACT

Background: Adolescent girls are one of the vulnerable groups in which the nutritional demand increases. One of the most common nutritional problems in adolescent girl is anemia. This risk of anemia increases especially for those living in endemic area of malaria. The relationship between nutritional status and malaria is complex and involves many determinant factors.

Objective: This study aims to determine the relationship between anemia and nutritional status in adolescent girl in West Sulawesi Province.

Material and Method: This study was a cross-sectional and conducted in North Mamuju Regency, West Sulawesi Province. A total of 200 adolescent girls as the subjects from 4 schools were selected using two stage random sampling. The variables measured were malaria status, type of malaria, worm status, and nutritional status. Diagnosis of malaria is conducted by health professional based on the result of blood sample analysis (250-500 ml). The type of malaria was observed in the sub-sample (43 students). Nutritional status was calculated after measurement of body weight and height by using weight for height indices (WHZ score). Feces collected are to see the presence of worm infection. Bivariate and multivariate analyzes were performed using chi-square, t-test, and ANOVA analysis using SPSS 15.

Result: This study shows that most respondents have decent dwellings. It is characterized by 71.5% having own latrines, 60% having cemented wells, cemented floor (62.5%), and 73.5% tin roofs. This study also shows that the number of malaria was 21.5% and the dominant type of malaria was Tertiana (79.1%). Many of adolescent girls were malnutrition marked by BMI <17 kg/m², chronic energi deficiency, and anemia (9.5%, 54.5%, 71.9%, respectively). In addition, 28.5% of students were infected with the worms. Bivariate analysis showed that there was no significant association between malaria status and anemia ($p = 0.368$). However, it appears that those with malaria have lower mid-upper arm circumference (MUAC) than non-malaria. Similarly with the indicator of body mass index, adolescent girl with malaria had lower BMI than non-malaria (19.05 kg / m² vs. 19.39 kg / m²). However, hemoglobin levels in the malaria group were higher than the non-malaria group (11.34 vs. 11.05).

Conclusion: The current study concluded that malaria in adolescent girl may have an impact on body composition but not on hemoglobin levels. Further studies need to be done primarily to see the long-term repercussions of repeated malaria in adolescent girls.

Corresponding author:

Anwar Mallongi

Senior Lecturer of Environmental Health Department,
Faculty of Public Health, Hasanuddin University,
Makassar, Indonesia

E-mail: anwar_envi@yahoo.com

Mobile Phone: 082187724636

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INTRODUCTION

Malaria is still a substansial problem in some developing countries whose impact is very detrimental. Even the disease caused by *Plasmodium falciparum*

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infection is the main cause of morbidity and mortality in children and adolescents ¹. Malaria can have implications for losing weight, so it is very influential on one's nutritional status. On the other hand, nutritional status is the most important determinant factor especially for growth and development in adolescence. So that the incidence of malaria in adolescents will of course have an impact on the growth and development of adolescents instead of nutritional problems exacerbate susceptibility to disease ². However, interactions between malaria and nutritional status are complex and influenced by demographic and individual variation ³.

In Indonesia, malaria is classified as a public health problem with many endemic areas of malaria. In Sulawesi, Mamuju and North Mamuju are endemic areas with high malaria cases. According to Riskesdas data ⁴, malaria prevalence in Mamuju Regency is 3.5% and North Mamuju is 5.8%, whereas the national prevalence is only 2.9%. However, of the total number diagnosed with malaria, only 36.1% received treatment ⁵. The number of people receiving treatment is still very low and occurs throughout Indonesia. Though if not handled, it can cause serious consequences, including the burden of a very large cost. Governments in countries with malarial endemics issue 612 million USD for anemia national control program as well as 332 million USD for treatment ⁶.

The adolescent period is an important phase of life characterized by rapid, physical, psychological, and cognitive development. This development requires high nutritional needs ⁷. In this period also, the risk of anemia arises because of the need for iron increases especially for young women. Malaria can also lead to anemia, so young women in malaria endemic areas are particularly susceptible to nutritional problems including anemia ^{2,8}. As one of the endemic areas, a model of prevention in North Mamuju Regency will be developed. Therefore,

more specific baseline data related to malaria and nutrition are needed so that the mitigation efforts are more well planned. This study aims to determine the relationship between anemia status with nutritional status in young women in West Sulawesi Province.

MATERIAL AND METHOD

This study is a cross-sectional that conducted in West Sulawesi, North Mamuju Regency. The population was young women aged 12-18 years. The number of samples obtained is 200 young women using two stage random sampling method. The first stage is choosing sub-district which has high level of endemicity that is Baras District. Then randomly selected 4 schools to get 200 young women.

The data is collected by using questionnaires, anthropometric measurements, and laboratory tests. Several variables studied are malaria status, nutritional status, and respondent characteristics. Malaria is diagnosed by taking blood samples of 250-500 ml by health personnel. Nutritional status is obtained after measurement of body weight and height calculated to body weight by height (BB / TB). The characteristics of respondents are represented by education and employment of parents, residence, health facilities. Feces collection is also worked to see the presence of worm infection. Bivariate and multivariate analyzes are performed using chi-square, t-test, and ANOVA analyzes using SPSS 15 (SPSS Inc.).

RESULTS

The characteristics of sanitation provide a picture that most respondents have decent dwellings. It is characterized by 71.5% having own latrines, 60% having wells, dominant house floors (62.5%), and 73.5% roofs made of zinc. Nevertheless, there are still 41.5% who have wooden house walls (table 1).

Table 1. Characteristics of Sanitation and Residence

Variable	N = 200	%
Latrine		
One's own	143	71.5
Public kiosk	20	10.0
River / pond / sea	15	7.5
Bushes / open spaces	16	8.0
Others	6	3.0

Cont... Table 1. Characteristics of Sanitation and Residence

Source of drinking water		
River / embankment / reservoir	12	6.0
Cement wells	120	60.0
Well-cemented wells	22	11.0
The well is not cemented	10	5.0
Water springs	8	4.0
Hand pump	6	3.0
Water tap / municipal waterworks	6	3.0
Others	16	8.0
House floor		
Cement	125	62.5
Stone	21	10.5
Soil	3	1.5
Wood	43	21.5
Others	8	4.0
House wall		
Cement	77	38.5
Stone	33	16.5
Wood	83	41.5
Others	7	3.5
Roof		
Tile	21	10.5
Zinc	147	73.5
Palm fiber / sago palm	29	14.5
Others	3	1.5

This study also shows the history of the disease experienced by respondents in the last 1 month (can be seen in table 2).

Table 2. History of Disease and Handling

Variable	N	%
Symptoms of disease last 1 month (n = 189)		
Fever	30	15.9
Fever up and down periodically	11	5.8
Drought cold	14	7.4
Headache	53	28.0
Cough	28	14.8
Snotty	33	17.5
Difficulty	3	1.6
Shivering	1	0.5
Others	16	8.5
Handling (n = 112)		
Untreated	19	17.0
Hospital	7	6.3
Local gvt. clinic / Pustu / Posyandu	18	16.1
Orderly / BPS	14	12.5
Practice Doctor	9	8.0
Shaman	2	1.8
Treated alone	43	38.4

Menstrual history (n = 200)		
Age of first menstruation		
10-13 years	150	75.0
14-18 years	50	25.0
Long period		
3-7 days	194	97.0
8-12 days	6	3.0
Intensity of menstrual blood		
Many	47	23.5
Medium	132	66.0
a little	21	10.5

This study also shows the comparison of female teenage food intake as compared to Nutritional Adequacy Ratio (GD), it can be seen in table 4 for more detail. It appears that their macro and micro nutrient intake is very low. Intake of energy and protein is only 51.7% and 65.2% compared with AKG. Nonetheless, there are some fairly high nutrients such as Vitamin D, Vitamin B12, and Calcium (119.7%, 280.0%, 131.5%, respectively) in table 3.

Table 3. Comparison of Food Intake with Nutrition Adequacy Rate

Variable	AKG	Intake	%AKG
Energy	2100	1085.2	51.7
Protein	62	40.42	51.7
Vitamin A	500	254.1	50.8
Vitamin D	10	11.97	119.7
Vitamin E	8	3.6	45.0
Thiamin	1.0	0.41	41.0
Riboflavin	1.2	0.42	35.0
Niacin	10	6.3	63.0
Vitamin B12	1.0	2.8	280.0
Folic acid	130	82.5	63.5
Vitamin C	60	23.7	39.5
Calcium	700	139.9	20.0
Phosphor	450	591.9	131.5
Iron	19	3.45	18.2
Zink	15	3.56	23.7

According to malaria status, nutritional status, and worms status, malaria girls reach 21.5% and the dominant malaria type is tertiana 79.1%. Those with BMI <17 kg / m² are 9.5%, KEK 54.5%, and anemia of 71.9% (table 4). There are 28.5% of worms with the most worm type is Trichuris (65.9%).

Table 4. Status of Malaria, Nutrition, and Hookworm

Variable	N = 200	%
Malaria		
Yes	43	21.5
No	157	78.5
Type of Malaria (n =43)		
Falciparum	9	20.9
Tertiana	34	79.1
Body mass index		
IMT <17 Kg / m ²	19	9.5
IMT ≥17 Kg / m ²	181	90.5
KEK Status		
KEK (<23.5 cm)	109	54.5
Normal (≥23.5 cm)	91	45.5

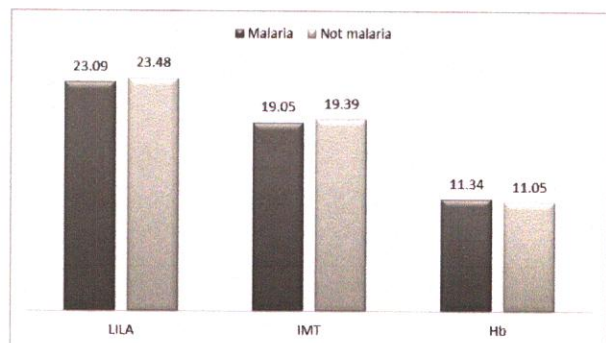
Status of Anemia		
Anemia (<12 g / dl)	69	71.9
Normal (≥12 gr / dl)	27	28.1
Status of Worms (n = 123)		
Yes	35	28.5
No	88	71.5
Types of worms (n = 44)		
Ascaris	8	18.2
Trichuris	29	65.9
Ancylostoma	3	6.8
Hymenolepisdiminuta	4	9.1

Bivariate analysis in Table 5 showed that there is no correlation between malaria status and anemia (p = 0.368). However, the status of malaria may have an impact on the nutritional status of young women.

Table 5. Malaria Relationship with Anemia in Young Women

Status of Malaria	Status of Anemia		P
	Yes (%)	No (%)	
Yes	65.4	34.6	0.368
No	74.3	25.7	

In figure 1, it is seen that those with malaria have an upper arm circumference average (LILA) lower than those not malaria.

**Figure 1. The average of LILA, IMT, and Hb level base on the malaria status**

Similarly with the indicator of body mass index, malaria young girls have lower IMT than non-malarial female teenagers (19.05 kg / m² vs. 19.39 kg / m²). However, Hb levels in the malaria group are higher than the non-malarial group (11.34 vs 11.05).

DISCUSSION

The problem of malaria cannot be ignored especially for those who are vulnerable groups such as young women living in malaria endemic areas. The

problem of clinical malaria in North Mamuju regency is very high⁵. In fact, the findings of this study, based on microscopic examination, have a very high prevalence of malaria, although still quite low compared with studies conducted in Sudan³. Many factors that encourage the occurrence of malaria, including climate and environmental factors. Unsafe environmental factors are associated with ongoing malaria transmission. The residential characteristic of the subjects in this study is quite good, characterized by the ownership of latrines, floors and cemented well walls. However, there are still households living in homes with wooden walls that can increase the risk of malaria. Studies in Cameroon indicate that individuals living in wooden house homes are significantly higher than those living in cement brick houses.⁹

On the other hand, young women need a lot of nutrients for growth and development. So young women living in this region have a high health risk. A study showed a link between *P. falciparum* malaria and nutritional status. Patients with malaria show very high symptoms of anorexia and vomiting. This is what triggers the patients unable to eat so as to obtain a low intake^{10,11}. Another study specifically showed a significant association of *P. falciparum* malaria with wasting although not on stunting¹². Malaria affects short-term nutritional status, except in those who have repeated malaria may be a cause of long-term nutritional problems such as stunting. However, recent studies in children aged 5-10 years show that malaria has a significant negative effect on growth velocity, even if it occurs in non-endemic areas and is due to *p. vivax*¹¹. Malaria studies in early adolescence also showed a negative relationship to nutritional problems. Malaria accompanied by various symptoms such as diarrhea causes decreased intake and impaired nutrient absorption¹³⁻¹⁵.

Another fundamental finding of this study is that the level of intake is quite low both macro and micronutrient. Vitamin A and zinc intake also show a very low lift compared to the needs of the body, whereas the role of vitamin A and zinc is very important. Vitamin A supports iron in the formation of hemoglobin while zinc plays a role in improving the immune system. A study showed a positive association of serum retinol levels with Hb concentrations¹⁶. The role of zinc is very large, not only helps iron and vitamin A in the formation of hemoglobin, but also play a role in the growth and

improvement of the immune system¹⁷. When associated with malaria, low intake of micronutrients especially vitamin A, zinc, iron, and folic acid, increases morbidity and mortality of malaria^{18,19}.

CONCLUSION

Based on the findings of this study, it can be concluded that malaria in adolescent girls has an impact on nutritional status. Low food intake and high levels of nutrient requirement potentially increase the risk of morbidity and mortality, especially for those who have malaria. Further studies need to be committed primarily to see the long-term repercussions of repeated malaria in young women in the future. In addition, it is necessary to screen regularly because the risk of exposure to malaria in endemic areas is very high.

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