## **Systematic Review**

DOI: http://dx.doi.org/10.18203/2394-6040.ijcmph20203966

# A literature study of anemia among malaria cases reported in Indonesia, from west to east: a parasito-epidemiology perspective

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Received: 06 August 2020 Revised: 26 August 2020 Accepted: 28 August 2020

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#### **ABSTRACT**

Severe malarial anemia (SMA) is a potentially fatal complication of malaria, a neglected parasitic tropical disease that still become a global health problem. It occurs predominantly in vulnerable groups in the community, especially children and pregnant women living in endemic areas, including Indonesia. The data on prevalence of SMA and its contributing factors are sparse and incomplete, so the aim of this simple literature study is to provide that data. The author doing the electronic literature searching on Indonesia's data concerning malaria related anemia and factors that might contribute or causing this complication. There are 37 studies found on this issue, from 2001 until 2019. All 37 studies reported that anemia that developed during the course of the disease (malaria) varies from asymptomatic to severe form. This study showed the condition of anemia related malaria in Indonesia, from 2001-2019. Malaria still a big parasito-epidemiology problem. Prevention by continuous health promotion and proper management of malaria should be conducted to eradicate malaria and its complication.

**Keywords:** Blood protozoan, *Plasmodium* spp, Transfusion, Comorbidities, Children, Pregnant women

#### INTRODUCTION

Malaria is a life-threatening disease caused by parasites that are transmitted to people through the bites of infected female Anopheles mosquitoes. There are 5 species malaria in human: Plasmodium vivax, P. falciparum, P. malariae, P. ovale and P. knowlesi. Geographic distribution of this disease is unique, especially region close to the equator. Even though potentially lethal, actually, it is preventable and curable.1-3

During 2018, a rough estimation counts 228 million cases of malaria worldwide. The estimated number of malaria related morbidity as many as 405 000 in 2018. Children, especially aged under 5 years are the most vulnerable group affected by malaria.<sup>1,2</sup> Global malaria cases already reduced slowly, even though the rate of decline is not as fast as expected. Morbidity and mortality due to malaria in endemic countries, including some part of Indonesia, still found.<sup>2</sup> Children and pregnant women are among the most vulnerable group.<sup>3,4</sup>

The majority of malarial infections to some extent are associated with various degree of anemia.<sup>5</sup> Its severity relies upon two conditions patient-related properties (e.g., gender, age, innate and acquired resistance for people living in endemic areas, comorbid) and also parasitespecific characteristics (eg, species of malaria infected, adhesiveness to the smaller vessels, and drug-resistance phenotype).<sup>6,7</sup> Anemia related malaria is capable of causing collateral, mild to even severe, morbidity and mortality, especially in vulnerable groups, e.g. children and pregnant women.<sup>8-10</sup> The most severe form of anemia in malaria named severe malarial anemia (SMA).<sup>5,8</sup> Comorbidities, e.g helminthiasis, malnutrition, HIV,

tuberculosis etc made the problem become more complex to solve.  $^{11,12}$ 

In Indonesia, due to its wide geographical coverage and the lack of documentation or publication, the study of malaria related anemia has somewhat typically underreported, belatedly, rarely and not thoroughly; even though that the result still give an excellent information needed not just by the academics and the clinicians, but to even to tourism practitioner, because some of Indonesia's best tourism destination located in region considered to be malaria endemic. <sup>13-15</sup> Publication on this topics could improve awareness and precaution. <sup>16</sup> The primary aim of this literature study is to review the incidence of anemia among Indonesia's malaria patients published in the internet, their geographic location and its related factors stated in the published studies that might consider contributing to the occurrence of anemia.

#### **METHODS**

The author did the literature searching on the internet using popular search engine Google<sup>TM</sup>, Yahoo<sup>TM</sup> and Google Scholar<sup>TM</sup>. The phrase used were "Malaria Anemia Indonesia pdf", "Anemia pada Malaria di Indonesia pdf", "Kasus Anemia pada Malaria di Indonesia pdf", "Malarial Anemia in Indonesia pdf" and "Anemia among Malaria case in Indonesia pdf" combination the search term in Bahasa Indonesia/Indonesian language and in English were conducted.

This literature searching conducted from July 27<sup>th</sup> to August 2<sup>nd</sup> 2020. Potential article was sorted based on the type of the article which must be research article or original article, the tittle and content of the abstract and then saved for further analysis. Thorough and careful reading was done in order to make sure that the potential article actually revealed the incidence of anemia on their report. Factors that might contribute to the occurrence of anemia were also screened. A brief note when considered necessary was made on these findings and will be presented in the form of a summary table.

#### **RESULTS**

From hundreds of article collected, potential articles shorten into dozens and the final number of article which is assessed by the author personally are 37 articles. Out of these 37 studies, some conducted by bachelor degree students as their final thesis, and some were conducted by health professional that taking care the malaria (+) patient and some conducted by researcher from ministries of Health. Some studies, especially those conducted in Papua were collaboration study with foreign researcher.

All 37 studies about anemia related malaria showed us that the spectrum of anemia as a consequences of malaria took place since the very early phase of infection, eventhough the clinical manifestation may occur

gradually. From all these studies (n=37) most of the study design were cross sectional (36/97.29%). A study conducted by Taylor et al have a cohort/prospective study design. The number of the respondents also varies from just dozens (e.g. Masengi et al) to hundred of thousands, and in all studies entangle both gender.

Out of these 37 studies, the data on 13 studies (35.13%) come from the subject infant, baby, toddler, children or <18 years old individuals. There are 5 studies (13.51%) with the subject were pregnant women and even one of these studies observed the outcome to that pregnancies. Even though most of these studies conducted on more diverse population. Table 1 list the summary of the findings in 37 studies conducted in some endemic areas in Indonesia concerning malarial related anemia.

The number of studies conducted on hospitalized or outpatient from Primary health care facility or hospital are 25 (67.56%), while community or population-based studies as many as 12 (32.44%). Time of study ranging from 2001 conducted by Yusroh et al in Mandailing Natal, North Sumatera (western part of Indonesia) and the most recent study conducted by Patriani et al in Southern Papua (eastern part of Indonesia), last year (2019).

From those 37 articles, in brief can be classified due to the geographic distribution based on major big island of Indonesia, namely Sumatra, Jawa/Java, Kalimantan/Borneo, Sulawesi, Ambon, Nusa Tenggara and Papua. Article no. 1-5 published data from Sumatra, article no. 6 from Java, article no. 7-8 from Kalimantan/Borneo, article no. 8-17 from Sulawesi, article 18-19 from Ambon, article no. 20-27 from Nusa Tenggara, article no. 28-37 conducted in Papua. From all 5 big island, Papua contributes the highest in number of studies (10/37=27.02%).

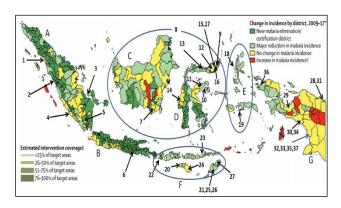


Figure 1: Recent map of malaria endemicity in Indonesia, 2018. We modified the map by adding arrow and number. Area pointed with arrow which studies conducted according to their sequence number listed in Tables 1, range from the year 2001-2019. (A-G) Are the big island in Indonesia, namely (A) Sumatra, (B) Jawa/Jawa, (C) Kalimantan/Borneo, (D) Sulawesi/Celebes, (E) Ambon islands, (F) Nusa Tenggara and (G) Papua, with modification. 13

Table 1: Summary of the findings in 37 studies conducted in some endemic areas in Indonesia concerning malarial related anemia.

S. no.	Location	Author (year of publication)	Design of study, additional info on subject/location	Total no. investigated	Findings
1	Mandailing Natal, North Sumatera, Sumatera	Yusroh et al <sup>17</sup> (2001)	Cross sectional and primary health care based	67 children malaria (+), aged <15 years old	<ul> <li>P. vivax 49/67 =73.13% mean Hb 10.41 g/dL</li> <li>P. falciparum 18/67=26.86% mean Hb 10.46 g/dL</li> <li>Malaria based on gender</li> <li>Vivax Male 8/18=44.44%, Female 10/18=63,56%</li> <li>Falciparum Male 29/49=59.18%, Female 40.81%</li> <li>All showed morphology of anemia haemolytic</li> </ul>
2	Padang, West Sumatera, Sumatera	Rahma <sup>18</sup> (2018)	Cross sectional and hospital based	76 patient's malaria (+)	<ul> <li>P. vivax 73/76=96.05%, P. falciparum 3.95%</li> <li>Gender: male 46 (60.53%), female 30 (39.47%)</li> <li>Anemia 21/76=27.63%</li> <li>Mild 12/21=57.14%</li> <li>Moderate 8/21=38.09%</li> <li>Severe 1/21=4.76%</li> <li>Anemia more prominent on female non pregnant patient</li> </ul>
3	West Bangka, Sumatera	Supriadi <sup>19</sup> (2018)	Cross sectional and primary health care based	326 patient's malaria positive	Anemia 165/326=50.61%  Gender of Malaria (+) with anemia (+) patient  • Male 141/165= 85.45%  • Female 24/165= 14.55%  Anemia more prominent on male patient  Anemia based on type of malaria  • P. vivax 16/165=9.69%  • P. falciparum 113/165=68.48%  • Mixed infection 36/165=21.81%
4	Bengkulu, Sumatera	Flora <sup>20</sup> (2013)	Cross sectional and primary health care based	55 pregnant women with history of malaria	Microscopic findings 3/55=5.45% malaria (+) All malaria (+) also suffer from anemia (+) Malaria (+) pregnant women  All suffer from anemia All had low TIBC All had Fe serum level from low to normal
5	Pesawaran, Central Lampung, Sumatera	Triwahyuni <sup>21</sup> (2014)	Cross sectional primary health care based	40 patients of malaria (+)	Mean Hb among malaria (+) with anemia (+)  • Mild anemia 11.66 g/dl  • Moderate 8.72 g/dl  • Severe 5.25 g/dl  Negative correlation between parasitemia and anemia

S. no.	Location	Author (year of publication)	Design of study, additional info on subject/location	Total no. investigated	Findings
		Mardianah <sup>22</sup>	Cross sectional	62 children with clinical history of malaria	19/62=30.64% anemia (+)
6	Pacitan, East Java	(2006)	elementary school based		29/62=46.77% experienced recent clinical malaria
7	Kab Tanah Bumbu, Kalimantan (Borneo)	Marlinae et al <sup>23</sup> (2014)	Cross sectional and population based	30 pregnant womens	Mild anemia 8/22=26,7% among pregnant women who used insecticide-treated bed nets that lived in 2 endemic areas of malaria
				206 patients	Mean Hb for P. vivax and P. falciparum 10g/dL
8	Kalimantan (Borneo) and	Avrina et al <sup>24</sup> (2011)	Cross sectional, primary health-	<ul><li>Vivax (+) 87</li><li>Falciparum (+)</li></ul>	Fever in malaria vivax 31/87=35.63%, malaria falciparum 63/119=52.94%
	Sulawesi	(2011)	patient care based	119 • Mixed (+) 23	Anemia (Hb<11g/dL) malaria vivax 66.3%, malaria falciparum 37.1%
	North Minahasa,	Mongi et al <sup>25</sup>	Cross sectional, primary health care-	50 patients with clinical	5/50=10% malaria (+) microscopically
9	Sulawesi	(2014)		symptom of malaria	All malaria (+) suffer from anemia
			patient based	<b>7</b> 1	Statistically, positive correlation of malaria with anemia
			Cross sectional, primary health care- patient based		78/150=52% malaria (+) microscopically  Sensitivity of Anemia 76.9% and specificity of Anemia 59.7%,
	Banggai, Central Sulawesi	Arsin et al <sup>26</sup> (2009)		150 patients with clinical diagnosis of suspect Malaria	accuration rate 68.7%
10					Statistically, Anemia is the most correlated clinical sign of malaria with the result of microscopic examination
					In attempt to diagnosis malaria clinically, shivering and clinical anemia are the best predictor
	Luwuk, Banggai, Central Sulawesi	Bantoyot et al <sup>27</sup> (2011-2013)	Cross sectional, hospital-patient	75 malaria (+) children <15 years old	Male 40/75=53.3%, Female 35/75=46.7% Aged 1-4 years old 26/75=34.7%
					Anemia 43/75=57.3%
11					Type of malaria
			based		• Vivax 49/75=65.3%
					• Falciparum 13/75=17.3%
	Dalaana	-	Cusas sastianal		• Clinical malaria 13/75=17.3%
12	Bolaang Mongondow, North	Lasari et al <sup>28</sup>	Cross sectional elementary school	110 students	9/110=8.18% Malaria (+) microscopically
12	Sulawesi	(2013)	based		7/9=77.77% malaria (+) were also anemia (+)
13	East Sumalata, Gorontalo, Sulawesi	Amalia <sup>29</sup> (2017)	Cross sectional elementary school based	105, children age 7-12 years old	79/105=75.2% malaria (+) microscopically, male 49 (62%), female 30 (38%); age 7-9: 17 (21.5%) and age 10-12: 62 (78.5%)
					59/79=74.7% malaria (+) were suffer from anemia (mean Hb 10.6 g/dL)
	Kab. Mamuju, West Sulawesi	Ansar et al <sup>30</sup> (2014)	Cross sectional, combination of both survey and Hb examination	314, teenage girl	60/314=19.1% had history of Malaria
14					94/314=29,9% anemia
					27/60=45.1% who had history of malaria suffer from anemia

S. no.	Location	Author (year of publication)	Design of study, additional info on subject/location	Total no. investigated	Findings
	Manado, North Sulawesi	II.alian at a131	Retrospective cross sectional, hospital- based 2000-2003	148 (+) severe malaria falciparum	Age between 1 month-13 years old
15		Halim et al <sup>31</sup> (2006)			75/148= 50.67% Male, 73/148=49.32% female
		(2000)			30/148=20.27% also suffer from anemia
	Tomohon,	Paendong et al <sup>32</sup>	Retrospective cross sectional, hospital- based, 2011-2015	92 children age 0-18 years old	58/92=63% malaria falciparum,18/92=37% malaria vivax
16					Age 5-9 years 29/92=31.5%
10	North Sulawesi	(2016)			Gender: 61/92=66% male, 31/92=34% female
		(2010)			Anemia: 1/92=1.1% suffer from anemia (+)
					Prevalence
					• 6/11=55% malaria tertian/vivax (+)
			Retrospective cross sectional, hospital- patient (pregnant women) based on data of 2013-2018		• 5/11=45% malaria tropika/falciparum (+)
	Manado, Tondano,	Masengi et		11 pregnant women	Complication: 2/6=33% pregnancy related malaria tertian/vivax ended
17	North Sulawesi	al <sup>33</sup> (2019)		malaria (+)	with prematurity, 1/6=16.66% pregnancy related malaria tertian/vivax
	1.02.02 5.00.00				ended with asphyxia
					Anemia
					• 2/6=33% malaria tertian/vivax
			<b>D</b>		• 2/5=40% malaria tropika/falciparum
	Ternate, Ambon	Afiah <sup>34</sup> (2019)	Retrospective cross sectional, hospital- based data	61 malaria (+) patient	Gender  • 35/61= 52.9% male
18					<ul> <li>35/61= 52.9% male</li> <li>26/61= 47.1% Female</li> </ul>
					Mean Hb for all samples: 10.34 g/dL
			Retrospective cross		
19	Ambon, Ambon Islands	Wabula et al <sup>35</sup> (2019)	sectional, population based	83 pregnant women on the 3rd semester	19/83=22.89% pregnant women suffer from anemia due to malaria or
					malaria infection that can caused anemia 20.2
		-			73/1197= 6.1% had asymptomatic P. falciparum with mean Hb 12.62
20	West Sumba, Nusa Tenggara timur		Cross sectional	1197 Indonesian school children, aged 5-15 years	g/dL and 18/1197=1.5% asymptomatic P. vivax parasitemia with mean
20					Hb 12.2 g/dL
					Antimalarial medication improves Hb in both groups
	Timor Tengah Selatan, Nusa Tenggara Timur	Panjaitan et al <sup>37</sup> (2019)	Case control of 181 malaria (+) vs181 malaria (-), primary	362 individuals	64/181=35.4% were suffer from anemia male 78/181=43.1%, female
21					103/181=56.9%
<b>21</b>					Age: <40 66/181=36.46%, ≥40 115/181=63.53%
			health care based		No significant correlation between Malaria and Hb
	Central Lombok, Nusa Tenggara Barat		Case control and primary health care	20 malaria vivax (+), 20 malaria falciparum (+), 20 control malaria (-)	Mean Hb
22					Malaria falciparum 10.5g/dl
					Malaria vivax 12.2g/dl
					Mean density of parasite is higher in falciparum group

S. no.	Location	Author (year of publication)	Design of study, additional info on subject/location	Total no. investigated	Findings
23	Maumere, Nusa Tenggara Timur	Fitri et al <sup>39</sup> (2014)	Cross sectional and hospital based	112 pair mother-infants, 92 evaluated for further analysis	Prevalence of congenital malaria in the endemic area 39/92=42.39% malaria (+), asymptomatic  21/39=53.84% malaria (+) suffer from anemia and 20/39=51,28% malaria (+) asymptomatic were looks ill  Only anemia correlated significantly with malaria
24	East Sumba, Nusa Tenggara Timur	Irawan et al <sup>40</sup> (2017)	Cross sectional hospital based	262 hospitalized malaria (+) patient	Male 123/262=46.9%, Female=139/262=53.1%  Age >15 years old 143/262=54.58%  Malaria falciparum 210/262=80.15%, malaria vivax 52/262=19.84%  Mean Hb: malaria falciparum 11.0 g/dL, malaria vivax 10.84 g/dL
25	Timor Tengah Selatan	Hutagalung et al <sup>41</sup> (2016)	Cross sectional, systematic random sampling and community based	555 healthy individual, aged >14 years, using nested PCR	Total 181/555=32.61% malaria (+), malaria falciparum 57/181=31.49%, malaria vivax 94/181=51.93% and mixed infection 30/181=16.57%  Anemia (Hb≤10g/dL) malaria falciparum 34/57=59.64%, malaria vivax 58/94=61.7% and mixed infection 20/30=66.66%
26	Timor Tengah Selatan	Nugraha et al <sup>42</sup> (2020)	cross-sectional study using secondary data in 2013-2014 from 5 sub-districts in South Central Timor	152 malaria (+) individual	Malaria vivax 95/152=62.5%, Malaria falciparum 57/152=37.5%  Anemia (Hb ≤11.23 g/dL) 75/152=49.34%, mean Hb vivax 43/75=57.33%, mean Hb 11.29 g/dl, falciparum 42.66% and mean Hb 11.13g/dL  Mean Hb in falciparum group is lower than in vivax
27	Atambua, Nusa Tenggara Timur	Junarli et al <sup>43</sup> (2017)	Cross sectional, hospital based September 2013 to February 2014	71 malaria tropical /malaria falciparum (+) individual	Gender: male 35/71=49.29%, Female 36/71=50.70% Febris (37,50-400C) 46/71= 64.78%  Anemia 25/71=35.21%, mean Hb 11.65g/dl mild (8-11g/dl) 18/25=72%, moderate (6-8g/dL) 5/25=20% and severe (<6g/dL) 2/25=8%
28	Jayapura, Papua	Palit et al <sup>44</sup> (2019)	Cross sectional, secondary hospital data based and regression modelling	160 malaria (+)	abnormal Hb level 80/160=50% abnormal Hb level at the age ≥40 75/80=93.75%, and < 40 5/80=6.25%  Variables that contributes to anemia age, gender, nutritional status and age is the most significant
29	Nabire, Papua	Taati <sup>45</sup> (2013)	Cross sectional, primary health care- based patient	45 toddlers	anemia 39/45=86.66%  Malaria (+) 25/45=55.55%  All malaria (+) also suffer from anemia
30	Mimika, Timika, Papua	Burdam et al <sup>46</sup> (2016)	Cross sectional, households based asymptomatic children	533 blood film collected	malaria vivax 47/533=8.8% malaria falciparum 21/533= 3.9%  105/269=39.03% soil transmitted helminth/STH (+)  Those with STH (+) were at significantly greater risk of suffer from <i>P. vivax</i> parasitemia  Anaemia (Hb<10 g/dl) was present in 24.5% (122/497) of children and associated with <i>P. vivax</i> parasitemia, <i>P. falciparum</i> parasitemia, hookworm carriage, <i>Plasmodium helminth</i> co-infection and severe stunting.

		Author	Design of study,	<u> </u>	
S. no.	Location	(year of publication)	additional info on subject/location	Total no. investigated	Findings
31	Jayapura, Northeast Papua and Papua	Taylor et al <sup>47</sup> (2013)	Cross sectional combined with/followed prospectively at day 0, 3, 7 and 28	n=57 indigenous Papuan and 105 non-Papuan with limited malaria exposure, treated with chloroquine, doxycycline or both for acute non complicated malaria vivax (n=64) and malaria falciparum (n=98)	Mean initial Hb 12.7g/dL (similar in both group), even though in vivax group, the Papuan group had lower baseline HB compared to the non-Papuan group  Hb recovery related to baseline Hb  Vivax infected malaria immune Papuan had persistently lower Hb concentrations compared to non-Papuan with limited malaria exposure
32	Southern Papua, Papua	Douglas et al <sup>48</sup> (2013)	Cross sectional, referral hospital secondary data of laboratory and clinical data from April 2004 to December 2012	219, 845 Hb measured	malaria falciparum:89,748 clinical events, 44, 171 patients malaria vivax: 54, 495 clinical events, 28, 841 patients mixed: 19, 569 clinical events from 14, 206 patients  Anemia  Mild (<10 g/ dl): 97,665/219,845=44.4%  Moderate (7-10 g/dl): 27,106/219,845=12.3%  Severe (<5g/dL): 8,151/219,845=3.7%  Mixed infections were at the greatest risk of severe anemia
33	Southern Papua, Papua	Kenangalem et al <sup>49</sup> (2016)	A three-stage, cross-sectional, community survey to determine the proportion of anemia severity (Hb <7 g/dl) attributable to patent <i>P. vivax, P. falciparum</i> and mixed parasitemia in Papua, Indonesia	3890 blood sample	Malaria type  Falciparum: 315 (8.1%)  Vivax: 250 (6.4%)  Mixed: 72 (1.9%)  Mean reduction in hemoglobin  Malaria falciparum: 1.16 g/dl  Malaria vivax: 0.66 g/dl  Mixed: 1.25 g/dl  Hb concentrations <7 g/dl in the community were estimated to be attributable to patent parasitemia  Plasmodium vivax was associated with a greater than three-fold higher attributable fraction of anaemia in infants compared with <i>P. falciparum</i>
34	Mimika district, South-Central Papua, Papua	Lampah et al <sup>50</sup> (2015)	Cross sectional, hospital based, data mainly focus on platelet count measurements (Hb included) were available in 215,479 patients, 66,421 (30.8%) of whom had clinical malaria	215,479 patients	7931/215 044=3.68% had severe anemia 1484/7931=18.7% had the risk of severe thrombocytopenia among patients with severe anemia The overall adjusted population fraction of severe thrombocytopenia attributable to <i>P. falciparum</i> infection was 35.9%, <i>P. vivax</i> was 9.1% and mixed infections was 7.0% Severe anemia is an important prognostic indicator of fatal outcome, particularly in young children

Siagian FE. Int J Community Med Public Health. 2020 Oct;7(10):4135-4145

S. no.	Location	Author (year of publication)	Design of study, additional info on subject/location	Total no. investigated	Findings
35	Southern Papua, Papua	Patriani et al <sup>51</sup> (2019)	Cross sectional, hospital-based data on children presenting with malaria (April 2004 to December 2013)	15,716 children	Prevalence  P. falciparum 6184/15,716=39.3%  P. vivax 7499/15,716=47.7%  P. malariae 203/15,716=1.3%  P. ovale 3/15,716=0,00019%  Mixed infections 1827 (11.6%)  Within 1 year, 48.4% (7620/15,716) of children represented a total of 16,957 times with malaria (range 1 to 11 episodes) the incidence of malaria being greater in patients initially presenting with P. vivax group  Mortality after initial presentation 266/15,716=1.7% within 1 year, 129/15,716=0.82% within 30 days. 137/15,716=0.87% between 31 and 365 days, no significant difference in the mortality risk in patients infected with P. vivax versus P. falciparum either before 30 days or between 31 and 365 days children <5 years with malaria vivax are at significant risk of multiple episodes of malaria and of dying within 1 year of their initial presentation
36	Southern Sorong Papua	Abdussalam et al <sup>52</sup> (2016)	Cross sectional hospitalized and out patients	45 children	Gender: 25/45=55.45 boys, 20/40=44.45% girls, 24/45=53.3% affected were between 1-5 years old. 30/45=66.7% malaria falciparum/tropical (+), 25/45=55.6% anemia (+), Hb ranging 8-10 gram/dl and 19/45=42.2% Wasting, 16/45=35.6% stunting
37	Southern Papua, Papua	Poespoprodjo et al <sup>53</sup> (2009)	Cross sectional To define malaria morbidity in the first year of life in an area where both multidrug-resistant P. falciparum and P. vivax are highly prevalent, data of all infants attending a referral hospital in Papua, Indonesia	4976 infants hospitalized	1560/4976=31.35% malaria (+) 102/187=56% had malaria vivax, and 55/187=29.41% had malaria falciparum infection equally attributable to both types of malaria. The case-fatality rate was similar for inpatients with malaria falciparum (13/599=2.2% inpatients died) and malaria vivax (6/603=1.0% died) severe malarial anemia was more prevalent in malaria vivax (193/605=32% vs 144/601=24%) and that was associated with a greater risk of anemia. In these young infants, infection with <i>P. vivax</i> was associated with a greater risk of severe anemia and severe thrombocytopenia compared to malaria falciparum.

Anemia caused by malaria reported in these studies also varies, from mild anemia with minimal subjective complaint from the patients to the severe form of anemia that can endangered the live of the patient.

#### **DISCUSSION**

Severe malarial anemia (SMA) surely marks concern as a major public health problem because of the burdens of the affected children and also pregnant women.9,10 It is possibly that these numbers may escalate as the consequences of several reasons, e.g. difficulty in making correct diagnosis, drug unavailability, potency of drug phylogeny spreads, limitation of medical resistance devices, remoteness of an area that making the health personal difficult to transfer/refer patient and possible comorbidities. If we look back to the Figure 1, Indonesia is an archipelago consists of 13.600+ islands, with a very wide area and different topograhic condition. The remoteness of an area, especially if that area is malaria endemic, is going to complicate the patient management, e.g. in case the doctors want to refer the patient to a more advanced health care facility.

Concerns have also been raised by data from recent epidemiological studies, which reported this severity related to other comorbidities. Malaria and anemia, both alos increase the host's susceptibility to other secondary infection. Even for such people living in endemic areas that already have acquired protection from acute infection, they still may succumb to severe anemia during a subacute or chronic phase of infection. Transfusing blood into such patient and managing them collectively and supportively also a very big challange. 1.2

The availability of electronic data on anemia related malaria in Indonesia is still sparse and detached. A more hollistic surveillance needed with emphasize on its comorbidities, vulnerable groups, anti-malaria treatment given and how well the patient recover.

Fatality or mortality due to severe malaria anemia should have prevented earlier. By making correct diagnosis as soon as possible and then start prompt treatment, complication can be avoid. In a community perspective, preventing recurrent malaria must be a public health priority in this vulnerable population. Preventive strategies, early diagnosis, and prompt treatment should be initiated in the correct time appropriately by all stake holder. By actively reducing the number of cases seems to be easier than sustained elimination. All of this effort if conducted simultaneously can paved the way for malaria eradication. 1,2

#### **CONCLUSION**

This brief literature study has revealed the condition of anemia related malaria from cases reported in Indonesia from 2001-2019. Eventhough many achievement have been done so far, these studies also informed us that

malaria still a big parasito-epidemiology problem in Indonesia. Prevention of transmission and proper management of malaria needed in order to avoid worse case scenario of severe malaria and its complication.

#### **ACKNOWLEDGEMENTS**

Thanks to Dr. Ribka Tjiptaning P. AAK, Dr. Charles Mesang, Dr. H. R. Agung Laksono, Dr. H. J. Indrawati Sukadis Msi, Dr. Yenni Tan, MARS whom collectively supported funding for fast track publication of this manuscript. The author states that he has no conflict of interest over funding and that the overall topics reviewed are based on freedom in scientific expression using trustworthy scientific method.

Funding: No funding sources Conflict of interest: None declared Ethical approval: Not required

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Cite this article as: Siagian FE. A literature study of anemia among malaria cases reported in Indonesia, from west to east: a parasito-epidemiology perspective. Int J Community Med Public Health 2020;7:4135-45.