

Malaria Risk Factors in Banjarnegara, Indonesia: A Matched Case-Control Study

By SULISTYAWATI

[Original]

5

Malaria Risk Factors in Banjarnegara, Indonesia: A Matched Case-Control Study

Sulistyawati SULISTYAWATI*, Rokhmayanti ROKHMYANTI and Fajar FATMAWATI

1

Department of Public Health, Universitas Ahmad Dahlan. Yogyakarta, Indonesia

Abstract : Malaria is a matter of concern in public health worldwide. Identifying its risk factors is essential to determine control efforts. We studied the potential environmental and human behaviour risk factors in malaria by a matched case-control study conducted in the Banjarmangu I Public Health Centre area, Banjarnegara, from June to August 2018. A structured questionnaire and checklist were employed to collect data from 50 participants. Data were analysed by Chi-Square, Fisher exact and logistic regression. A positive association was found between malaria and not sleeping under bed mosquito netting (OR=2.087 [95% CI: 1.148–3.795]), not using wire netting in the house ventilation (OR = 3.907 [95% CI: 0.647–24.452]), and inadequate prevention practices during outdoor activities (OR = 2.020 [95% CI: 1.033–3.953]). These three factors were identified as independent risk factors for malaria.

Keywords : malaria, risk factors, environmental, behaviour, Indonesia.

15

(Received July 22, 2019, accepted December 9, 2019)

Introduction

Malaria, which is caused by the Anopheles mosquito, is a global infectious disease. The World Health Organization (WHO) recorded 219 million malaria cases in 2017, with 435,000 deaths [1]. Malaria has been rapidly spreading all over the globe because of the effects of globalization and human movement [2]. The WHO set up the E-2020 initiative in 2015 to accelerate the efforts to eliminate malaria, with the goal of eliminating malaria in at least in 10 countries that had malaria. To fulfil this target, a state must have zero indigenous cases in 2020 [3]. Accordingly, it is essential to know the risk factors that trigger the transmission of malaria.

Indonesia, a country with some malaria-endemic places, has claimed to have successfully reduced the number of malaria cases [4]. Its target is to enter ma-

laria pre-elimination in 2020 and scale up to elimination by 2030 [5], but as of 2016, Indonesia still contributes up to 16% of reported cases of malaria in South East Asia and is responsible for 30% of malaria mortality [6]. Accordingly, its efforts to reach these goals has to improve both at the national and regional levels. Banjarnegara, which is known as one of the malaria endemic areas in Central Java, is not an exception in regards to the indigenous cases of such places [7].

Studies that were carried out on the risk factors for malaria in Banjarnegara [8–10] have reported an association between environmental and physical conditions, and also studied some human behaviors and mosquito behaviors that influence the transmission of malaria, but the effectiveness of using insect-repellant bed nets to prevent malaria has never been assessed since the program was launched in February 2018 by the local government. This is the first research study,

*Corresponding Author: Sulistyawati SULISTYAWATI, Department of Public Health, Universitas Ahmad Dahlan. UAD 3rd Campus, Street of Prof. Dr Soepomo, Janturan, Umbulharjo, Yogyakarta, Indonesia. Tel: +6274563515, Fax: +6274564604, E-mail: sulistyawati.suyanto@ikm.uad.ac.id

to the author's knowledge, to measure the usage of bed nets in the area. This research aimed to find evidence on what are the current environmental and human malaria risk factors in a sub-area of Banjarnegara. This research is essential to support the health authorities to understand the current malaria situation and what proper actions they should take to achieve the goals of the E-2020 initiative and to eliminate malaria.

Materials and Methods

This matched case-control study was carried out in the Banjarmangu I Public Health Centre (PHC) during July 2017–March 2018. Confirmed cases were defined as malaria positive people who were living in the study area ($n=37$), as confirmed by thick and thin blood smear examinations. The confirmed cases had to be listed in the malaria report system of the Banjarmangu I Public Health Centre during July 2017–March 2018. Controls were defined as healthy people without malaria ($n=72$).

The EpiTools epidemiological calculator was employed to estimate the sample size that is exclusive for case-control studies (Ausvet, Canberra, <http://epitools.ausvet.com.au/content.php?page=case-controlSS> (accessed on July 22, 2019)) by considering a 0.19 expected proportion exposed in the controls, a presumed odds ratio of 5.2 (confidence interval, 1.3 to 19.7) for wire netting [11], a confidence level of 0.95, and a desired power of 0.80. Referring to the calculations, the minimum sample size for the cases was ($n=25$). We developed a 1:1 ratio among cases and controls. Healthy controls ($n=25$) were matched by age and sex with cases, and were recruited from the same population. A total of 50 individuals participated in this study. Simple random sampling through a table of random numbers was employed to select the sample from the population list.

A standardized questionnaire and an observation list were employed for data collection. Demographic characteristics such as sex, age, occupation, education, and income were recorded. In the next section, risk factor questions were asked, such as the presence of wire netting in the in-house ventilation, the presence of cattle cages, the existence of gutters around the house, the usage of bed nets, poor prevention practices in out-

door activities, the use of mosquito repellent, the presence of spring water around the house, and the presence of shrubs around the house. A checklist was used to observe the factual data for cattle cages, bed nets and wire net condition, and distance of spring water. Oral and written explanations about this study were directed to the participants before the study, including the freedom to quit from this research anytime without any punishment.

Written informed consent was requested from the participants before the interviews. We used Chi-Square and Fisher exact at significant level 0.05. Logistic regression was then employed in multivariate analysis for a variable significance level of 0.25 in bivariate analysis. The analyses were performed using SPSS software version 24 (IBM, New York).

The Ethics Board of Universitas Ahmad Dahlan-Indonesia approved this study. IRB # 011805088.

Results

In total, fifty respondents participated in this study, comprising 25 cases and 25 controls. The majority of respondents were male (60%), and the rest were female (40%). The participants aged 45–55 had the highest proportion (24%). Most of the participants had primary school level education (42%), and the majority worked as farmers (34%). More than 70% of the participants had an income level of less than 500.000 IDR, or equal to 34 USD per month (Table 1).

Based on the bivariate analysis, two variables were significant at $P \leq 0.05$. Those variables were not sleeping under a bed net and poor prevention practices during outdoor activities (Table 2).

In the multivariate analysis we found three variables as risk factors for malaria $P < 0.05$: not sleeping under a bed net, not installs wire netting in the in-house ventilation, and poor prevention practices during outdoor activities (Table 3).

Discussion

This study assessed the association between potential risk factors and malaria in Banjarnegara, Central Java. We found a significant association between malaria and the use of bed nets, wire netting usage, and inadequate

prevention practices during outdoor activities.

We found that people who did not sleep under a bed net had significantly higher odds (6.389 times) compared to people who did sleep under a bed net. Using a bed net is one method of self-protection to avoid contact between humans and the malaria vector [12]. Bed nets are considered to be a traditional means of prevention, and it has been proven that they are useful for avoiding mosquito bites. Thus, it is obvious that our research findings are consistent with other research findings in both Indonesia [13,14] and in African countries [15, 16]. The local health authority in Banjarnegara distributes impregnated bed nets for free to all households to protect at-risk groups such

Table 1. Participant characteristic based on the univariate analysis

Characteristic	Case n (%)	Control n (%)	Total n (%)
Age			
0-5	1 (4)	1 (4)	2 (4)
6-11	5 (20)	5 (20)	10 (20)
12-16	4 (16)	4 (16)	8 (16)
17-25	2 (8)	2 (8)	4 (8)
26-35	3 (6)	3 (6)	6 (12)
36-45	1 (4)	1 (4)	2 (4)
45-55	6 (24)	6 (24)	12 (24)
56-65	3 (12)	3 (12)	6 (12)
Sex			
Male	14 (56)	16 (64)	30 (60)
Female	11 (44)	9 (36)	20 (40)
Education			
No formal education	9 (36)	10 (40)	19 (38)
Primary school	10 (40)	11 (44)	21 (42)
Junior high school	5 (20)	2 (8)	7 (14)
Senior high school	1 (4)	1 (4)	2 (4)
University	0 (0)	1 (4)	1 (2)
Occupation			
Farmer	9 (36)	8 (32)	17 (34)
Housewife	3 (12)	4 (16)	7 (14)
Mechanic	1 (4)	0 (0)	1 (2)
Builder	2 (8)	1 (4)	3 (6)
Student	9 (36)	7 (28)	16 (32)
Entrepreneur	0 (0)	1 (4)	1 (2)
Civil servant	0 (0)	1 (4)	1 (2)
Unemployed	1 (4)	3 (12)	4 (8)
Income			
<500.000	18 (72)	18 (72)	36 (72)
500.000 - 1.000.000	7 (28)	5 (20)	12 (24)
>1.000.000	0 (0)	2 (8)	2 (4)

3

11

Table 2. Bivariate analysis of malaria versus the risk factors

Variable	Case n (%)	Control n (%)	OR (95% CI)	p-value
The existence of gutters around the house (≤ 100 m)				
Yes	18 (72)	11 (44)	1.862	0.086
No	7 (28)	14 (56)	(0.954-3.633)	
The presence of cattle cages within				
No	8 (32)	4 (16)	1.490	0.321
Yes	17 (68)	21 (84)	(0.874-2.541)	
Sleeping under a bed net				
No	16 (64)	7 (28)	2.087	0.023
Yes	9 (36)	18 (72)	(1.148-3.795)	
The presence of spring water within (≤ 2 km) from the house				
Yes	25 (100)	25 (100)	-	-
The presence of shrubs within (≤ 2 km) from the house				
-	-	-	-	-
The using of mosquito repellent				
Yes	25 (100)	25 (100)	-	-
The presence of wire netting in the in-house ventilation				
No	24 (96)	19 (80)	3.907	0.098
Yes	1 (4)	6 (20)	(0.647-24.452)	
Poor prevention practices during outdoor activities				
Yes	18 (72)	10 (40)	2.020	0.046
No	7 (28)	15 (60)	(1.033-3.953)	
Repellent usage				
No	23 (92)	22 (88)	1.278	1.000
Yes	2 (8)	3 (12)	(0.421-3.881)	

OR (95% CI), odds ratio (95% confidence interval)

Table 3. Logistic regression analysis of potential risk factors for malaria

Variables	β	p-value	Adjusted OR	95% CI
The existence of gutters around the house (≤ 100 m)	1.376	0.071	3.960	0.891-17.604
Not sleeping under a bed net	1.855	0.024	6.389	1.277-31.972
The presence of wire netting in the in-house ventilation	3.495	0.011	32.935	2.198-493.540
Poor prevention practices during outdoor activities	1.824	0.022	6.198	1.303-29.480

OR, odds ratio; CI, confidence interval.

as pregnant women and **10** children under five years of age. According to research in the Wonosobo district, which is close to Banjarnegara, impregnated bed nets was proved effective until 14 weeks by killing more than 90% of mosquitos [17].

The next risk factor is the absence of wire netting in the house ventilation. This study found that people who did not install any wire netting in their house ventilation had significantly higher odds of having malaria (32.935 times) compared to people who had installed it. Wire netting is a barrier against mosquitos entering the house. Based on the field observation, most of the respondents' homes had ventilation but did not have wire netting installed. It is probably because of the lack of knowledge among the community regarding the benefits of using wire netting, which was clear from their answers when we asked them about wire netting.

The last factor in this study was the respondents' practices during outdoor activities from 6 pm to 5 am, with OR=6.198. The peak activity of the mosquito is between 6 pm and 10 pm, and it occurs outdoors [18]. Outdoor activity is known to increase the possibility of someone contracting malaria [19] because people can be bitten by *Anopheles Sp*, which contain sporozoite in their saliva [20].

This research might have some limitations: first, it did not include mosquito behaviour; and second, there might have been information bias during the interviews due to incomplete information recall.

Conclusions

In conclusion, this case-control study presents the potential risk factors, most of which are preventable. We recommend to a national initiative through cross-sectoral work to educate the at-risk population through massive health promotion. Finally, we suggest that future research include vector behaviour to get a more comprehensive picture of malaria in the research area.

Acknowledgement

2 We want to thank the Banjarnegara District Health Office and Banjarmangu I for supporting us during the research. We also wish to thank all the participants who contributed to this study.

Conflict of interest

There was no conflict of interest.

16 Funding

This study received no external funding.

References

1. World Health Organization (WHO) (2018): Malaria. <https://www.who.int/malaria/en/> (accessed February 24, 2019)
2. Saker L, Lee K, Cannito B, Gilmore A & Campbell-Lendrum D (2004): Globalization and Infectious Diseases: A Review of the Linkages. Special Topics No. 3. WHO Special Programme for Research & Training in Tropical Diseases (TDR), Geneva 62 pp
3. World Health Organization (WHO) (2018): Malaria: Q&A on the E-2020 initiative and malaria elimination. <https://www.who.int/malaria/media/e-2020-initiative-qa/en/> (accessed February 24, 2019)
4. Ministry of Health Republic of Indonesia (2016): This is the success fact of Malaria control. <http://www.depkes.go.id/article/print/16050200003/inilah-fakta-keberhasilan-pengendalian-malaria.html> (in Indonesian) (accessed July 30, 2019)
5. Elyazar IR, Hay SI & Baird JK (2011): Malaria distribution, prevalence, drug resistance and control in Indonesia. *Adv Parasitol* 74: 41-175
6. World Health Organization (WHO) (2017): World Malaria Report 2017. <https://www.who.int/malaria/publications/world-malaria-report-2017/en/> (accessed November 14, 2018)
7. Berger S (2018): Malaria. In: *Infectious Diseases of Indonesia, 2018 ed.* Gideon Informatics, California p 188
8. Pramestuti N, Ustiawan A & Trisnawati UF (2015): Potential malaria transmission in Sigeblog Village, Banjarmangu Subdistrict, Banjarnegara District. *Balaba* 11: 67-72 (in Indonesian)
9. Kuku PS & Arum S (2015): Relationship between home environment and prevention practices with malaria incidences in Kendaga Village, Banjarmangu District, Banjarnegara Regency. *Unnes Journal of Public Health* 4: 76-83 (in Indonesian)
10. Wahistina R, Lazuardi L & Umniyati SR (2018): Spa-

- tial-temporal distribution of physical environmental factors malaria in Banjarnegara. *Ber Kedokt Masy (BKM J Community Med Public Heal)* 34:159-166 (in Indonesian)
11. Pamela AA (2009): Relationship of Physical and Environmental Conditions of Houses with Malaria In Ketosari Village, Kecamatan Bener, Purworejo District. UMS Eprints. Universitas Muhammadiyah Surakarta (in Indonesian)
 12. Bloland PB & Williams HA (2002): Preventive Interventions. *In: Malaria Control during Mass Population Movements and Natural Disasters*. National Academies Press, Washington DC pp 80-92
 13. Cahyaningrum P & Sulistyawati S (2018): Malaria risk factors in Kaligesing, Purworejo District, Central Java Province, Indonesia: A case-control study. *J Prev Med Public Health* 51: 148-153, <https://doi.org/10.3961/jpmph.18.036> (accessed September 18, 2018)
 14. Pinontoan OR & Punuh MI (2017): Malarial risk factor identification in southern Minahasa, North Celebes Manado-Indonesia. *Bali Med J* 6: 440-444
 15. Okebe J, Mwesigwa J, Kama EL, Ceesay SJ, Njie F, Correa S & Bojang K (2014): A comparative case control study of the determinants of clinical malaria in The Gambia. *Malar J* 2013: 306 <https://doi.org/10.1186/1475-2875-13-306> (accessed December 16, 2018)
 16. Chirebvu E, Chimbari MJ & Ngwenya BN (2014): Assessment of risk factors associated with malaria transmission in Tubu Village, Northern Botswana. *Malar Res Treat* 2014:403069 <https://doi.org/10.1155/2014/403069> (accessed December 22, 2018)
 17. Ikawati B, Yunianto B & Paramita A (2010). Effectiveness of the use of insecticide netting in endemis malaria village in Wonosobo regency. *Balaba* 6(2): 1-6 (in Indonesian)
 18. Widyastuti U, Trapsilowati W & Boewono DT (2010): Malaria in Bakal Hamlet, Campurejo Village, Tretap Sub District, Temanggung Regency. *Jurnal Vektora* 2: 42-58 (in Indonesian) <http://ejournal.litbang.depkes.go.id/index.php/vk/article/view/17/17> (accessed July 31, 2019)
 19. World Health Organization (WHO) Nigeria (2017): WHO intensifies health sector support to avert malaria crisis in the North East Nigeria. <https://www.afro.who.int/news/who-intensifies-health-sector-support-avert-malaria-crisis-north-east-nigeria> (accessed July 16, 2019)
 20. Crutcher J. M & Hoffman, SL (1996): Malaria. *In: Medical Microbiology: 4th ed.* (Baron S, ed). University of Texas Medical Branch at Galveston, Galveston. <https://www.ncbi.nlm.nih.gov/books/NBK8584/> (accessed July 18, 2019)

インドネシアのバンジャルネガラにおけるマラリアのリスク要因の検討：対症例対照研究

スリシャワティ スリシャワティ, ロフマヤンティ ロフマヤンティ, ファジャール ファトマワティ
アフマドダーラン大学 公衆衛生学教室

要 旨：マラリアはいまだ世界の公衆衛生における懸案事項であり、リスク要因を特定することは、マラリア制御に向けた取り組みを決定するために不可欠である。今回、マラリアの潜在的な環境的リスク要因および人間の行動におけるリスク要因を研究した。2018年6月から8月にかけて、バンジャルネガラのバンジャルマング第一保健センターエリアで対症例対照研究を実施した。構造的調査票およびチェックリストを用いて50名の参加者からデータを集め、カイ二乗検定、フィッシャーの正確確率検定およびロジスティック回帰で分析した。ベッドネットの下で寝ていないこと(OR=2.087 [95%CI: 1.148-3.795]), 屋内換気に金網がないこと(OR=3.9 [95%CI: 0.624-24.452]), 野外活動時の予防策不足(OR=2.020 [95%CI: 1.033-3.953])にマラリアと正の関連がみられた。ベッドネットの下で寝ていないこと, 屋内換気に金網がないこと, 屋外で活動しているときの予防策不足が, マラリアの独立したリスク要因として特定された。

キーワード：マラリア, リスク要因, 環境, 行動, インドネシア。

J UOEH(産業医大誌) 42(2): 161 - 166 (2020)

Malaria Risk Factors in Banjarnegara, Indonesia: A Matched Case-Control Study

ORIGINALITY REPORT

10%

SIMILARITY INDEX

PRIMARY SOURCES

- 1

www.e-sciencecentral.org
Internet

68 words — 3%
- 2

Sulistyawati Sulistyawati, Rokhmayanti Rokhmayanti, Maririn Devi Pradita. "Potential Risk Factor for Malaria Infection in Banjarnegara, Indonesia: A Matched Case-control Study", International Journal of TROPICAL DISEASE & Health, 2020
Crossref

23 words — 1%
- 3

Pratiwi Cahyaningrum, Sulistyawati Sulistyawati. "Malaria Risk Factors in Kaligesing, Purworejo District, Central Java Province, Indonesia: A Case-control Study", Journal of Preventive Medicine and Public Health, 2018
Crossref

19 words — 1%
- 4

Sulistyawati Sulistyawati, Izzatun Nisa. "Climate Change and Health Teenager's Perceptions as a Basis for Interventions", International Journal of Public Health Science (IJPHS), 2016
Crossref

18 words — 1%
- 5

www.jstage.jst.go.jp
Internet

17 words — 1%
- 6

www.researchsquare.com
Internet

11 words — < 1%
- 7

Feng Yang, Hang Yu, Kamolrat Silamut, Richard J. Maude, Stefan Jaeger, Sameer Antani. "Chapter 9

11 words — < 1%

8 Abdullah Al-Taïar, Ali Assabri, Molham Al-Habori, Ahmed Azazy et al. "Socioeconomic and environmental factors important for acquiring non-severe malaria in children in Yemen: a case–control study", Transactions of the Royal Society of Tropical Medicine and Hygiene, 2009

9 words — < 1%

Crossref

9 Murhandarwati, E Elsa, Anis Fuad, Mubarika DF Nugraheni, Sulistyawati, Mahardika A Wijayanti, Barandi S Widartono, and Ting-Wu Chuang. "Early malaria resurgence in pre-elimination areas in Kokap Subdistrict, Kulon Progo, Indonesia", Malaria Journal, 2014.

9 words — < 1%

Crossref

10 Aleisha R. Brock, Joshua V. Ross, Sunil Parikh, Adrian Esterman. "The role of antimalarial quality in the emergence and transmission of resistance", Medical Hypotheses, 2018

8 words — < 1%

Crossref

11 es.scribd.com

Internet

8 words — < 1%

12 Régis Pouillot, Gonçalo Matias, Christelle Mbondji Wondje, Françoise Portaels et al. "Risk Factors for Buruli Ulcer: A Case Control Study in Cameroon", PLoS Neglected Tropical Diseases, 2007

8 words — < 1%

Crossref

13 Chidi Osuorah, Ezeudu, Onah, Anyaboluo. "Household bed net ownership and use among under-5 children in Nigeria", Research and Reports in Tropical Medicine, 2013

8 words — < 1%

Crossref

14 malariajournal.biomedcentral.com

Internet

8 words — < 1%

15

www.eje.cz
Internet

8 words — < 1%

16

Sandeep Budhiraja, Aakriti Soni, Vinitaa Jha, Abhaya Indrayan et al. "Clinical Profile of First 1000 COVID-19 Cases Admitted at Tertiary Care Hospitals and the Correlates of their Mortality: An Indian Experience", Cold Spring Harbor Laboratory, 2020
Crossref Posted Content

6 words — < 1%

EXCLUDE QUOTES ON
EXCLUDE ON
BIBLIOGRAPHY

EXCLUDE MATCHES OFF