Jurnal Kesehatan Lingkungan
Journal of Environmental Health
Journal Home Page: https://e-journal.unair.ac.id/JKL
Vol. 16 No. 2
DOI: 10.20473/jkl.v16i2.2024.118-124
ISSN: 1829 - 7285 | E-ISSN: 2040 - 881X
ORIGINAL RESEARCH Open Access

THE INFLUENCE OF POPULATION BEHAVIOR AND SETTLEMENT ENVIRONMENT ON THE INCIDENCE OF FILARIASIS IN SIGI REGENCY, CENTRAL SULAWESI, INDONESIA

Santriana Santriana[1]*, Aditya Lia Ramadona[2], Gunawan Gunawan[3]

[1]Master of Public Health Program, Faculty of Medicine, Public Health and Nursing, Gadjah Mada University, Yogyakarta 55281, Indonesia
[2]Faculty of Medicine, Public Health and Nursing, Gadjah Mada University, Yogyakarta 55281, Indonesia
[3]Research Centre of Public Health and Nutrition, National Research and Innovation Agency Republic of Indonesia, Cibinong 16911, West Java, Indonesia

Corresponding Author:
*) santrianaanti1988@gmail.com

Article Info

Submitted	: 16 November 2023
In reviewed	: 30 January 2024
Accepted	: 16 April 2024
Available Online	: 30 April 2024

Keywords : *Behavior, Filariasis, Sigi Regency*

Published by *Faculty of Public Health Universitas Airlangga*

Abstract

Introduction: *A health issue is filariasis including in Sigi Regency, brought on by filarial worms and spread by mosquito bites. Filariasis is a parasitic infection that threatens about one-third or 1.3 billion of the world's population in 83 countries that are vulnerable to filariasis. This research intends to examine the impact of behaviour and environment on the occurrence of filariasis in the Sigi Regency.* ***Methods:*** *The study used an observational analytic method with a case control approach, involving 114 people from 13 villages in Sigi Regency, of whom 38 were cases and 76 were controls. The sampling techniques in the case group is people who live in the village (Kaleke, Pandere, Dolo, Banasu, Kantewu, Gimpu, Kamipura, Nokilalaki, Kulawi, Dombusoi, Marawola, Biromaru, Lindu and Palolo). The control group is people who live in the same environment as the case group. The data collection methods were a survey and an environmental assessment. The data analysis was done using Stata software.* ***Results and Discussions****: The logistic regression analysis revealed that the most influential factors for the occurrence of filariasis in endemic regions in Sigi Regency were mosquito breeding sites with Odds Rasio (OR) value =8.57 (2.43-34.33), p-value = <0.001, existence of animal pens with OR value=5.16 (1.15-29.44), p-value = 0.044, and not using anti-mosquito medication with OR value = 6.06 (1.54-27.56), p-value = 0.013.* ***Conclusion****: The breeding habitats of disease-transmitting mosquitoes, the presence of animal pens and the habit of not using anti-mosquito medication are the dominant risk factors related to the occurrence of filariasis in endemic regions in the Sigi Regency.*

INTRODUCTION

Infectious diseases are still the leading cause of illness, disability, and even death in developing countries (1). In Indonesia, particularly the tropics, nine infectious diseases can spread from one person to another, such as leprosy, yaws, filaria, Japanese encephalitis, rabies, leptospirosis, plague, and worms (2).

Filariasis, a Neglected Tropical Disease (NTD) prevalent in many tropical and subtropical areas of the world, is a significant public health problem In Indonesia (3). Despite being a treatable condition, filariasis is the leading cause of permanent disability globally according to WHO. Filariasis infection can cause swelling and decreased function of the lymph nodes, a crucial part of the immune system. This swelling occurs due to the buildup of filarial worms and damage to surrounding tissue leading to a condition called *filariasis lymphadenitis*. Repeated swelling of the lymph nodes can lead to the formation of filarial abscesses. This abscess occurs when swelling in the lymph nodes ruptures and oozes pus and blood (4). Additionally, filariasis can also cause swelling in the scrotum or testicular (hydrocele) and limbs (5). The disease becomes infected by a mosquito's bite infected with filarial worms. In Indonesia, filariasis is a public health problem. The *nematode* filariae that cause filariasis are identified as *Wuchereria bancrofti, Brugia timori*, and *Brugia malayi,* while the filarial worm-spreading mosquitoes *are* Culex, *Aedes, Anopheles*, and *Mansonia* (6).

Cite this as :
Santriana S, Ramadona AL, Gunawan G. The Influence of Population Behavior and Settlement Environment on the Incidence of Filariasis in Sigi Regency, Central Sulawesi, Indonesia. *Jurnal Kesehatan Lingkungan*. 2024;16(2):118-124. https://doi.org/10.20473/jkl.v16i2.2024.118-124

Based on data from the World Health Organization (WHO) in 2021, it is estimated that around 863 million people in 50 countries are at risk of contracting filariasis. Filariasis is prevalent in most parts of Indonesia, and mainly in lowland regions, especially coastal, inland, paddy, marsh, and forest areas such as in Sumatra, Kalimantan, Java, Sulawesi, Nusa Tenggara, Papua, and Maluku (2,4). The disease can cause a number of debilitating conditions about 40 million people with disabilities and paralysis by this disease, 25 million men with genital diseases (generally suffering from hydroceles), and nearly 15 million people mostly women who have lymphedema or *elephantiasis* in the legs (7). In 2015, data from the data from the Central of Sulawesi Provincial Health Office revealed a high microfilariae rate of 4.07% in Sigi Regency, indicating a significant filariasis problem in the area. The ongoing presence of chronic cases further supports this. The 2020 Annual Report from the filariasis Subsection of the Ministry of Health recorded 9,829 chronic cases in Indonesia, while the Disease Prevention and Control Data from the Central of Sulawesi Provincial Health Office revealed that the number of filariasis cases in Central Sulawesi was 180 chronic cases in 13 cities/regencies, namely is Banggai Islands Regency, Banggai, Morowali, Poso, Donggala, Toli-Toli, Buoli, Parimo, Tojo Una-Una, Sig, Banggai Laut, North Morowali and Palu (8).

The region with the most cases in Central Sulawesi is Sigi Regency, where from 2013 to 2022 there are still seventy-two cases, and in 2023 there are 51 cases. Although the number of cases has decreased, filariasis is still a serious problem due to the impact of lifelong disability.

High infection rates such as this indicate that filariasis is still a significant health problem in this area, and more intensive prevention and treatment efforts may be needed to reduce the spread of the disease and limit its impact on public health (9).

Sigi Regency has a tropical climate change with temperatures ranging from 21^{0}C to 34^{0}C and average annual rainfall exceeding 151 to 220 mm. The high humidity, ranging from 62% to 95%, creates a suitable environment for mosquito breeding and activity, which can affect the lifespan of mosquito vectors (10). This study is novel in its use of large sample size and multiple variables to examine both environmental and behavioral risk factors for filariasis. To the researcher's knowledge, such a comprehensive study has not been conducted in this region before. The research was conducted using a case-control study design across 15 Sigi Regency, Central Sulawesi Province sub-districts.

By investigating these factors, the research aims to shed light on the relationship between human behavior, environmental conditions, and the occurrence of filariasis in this specific region. The study seeks to contribute valuable insights that can inform public health interventions and strategies to mitigate the spread of this disease in Sigi Regency.

METHODS

The study uses a case-control and observational analytical study. The population is all residents living in the Subdistrict of Sigi Regency who have had their finger blood examined in the Finger Blood Survey (SDJ) conducted by medical personnel or laboratory staff.

The case group comprised 38 individuals residing in the following villages within Sigi Recency: Kaleke, Pandere, Dolo, Banasu, Kantewu, Gimpu, Kamipura, Nokilalaki, Kulawi, Dombusoi, Marawola, Biromaru, Lindu and Palolo. All underwent finger blood examinations conducted by medical personnel or laboratory staff and tested positive for microfilaria. Besides, the control group comprised 76 individuals residing in the same environment as the case group and had their finger blood examined and were negative for microfilaria.

The study employed a case-control design with filarial infection status (or microfilaria positivity) in the Sigi Regency as the dependent variable. Independent variables included: gender, temperature, humidity, use of wire mesh on windows/doors, presence of livestock cages (e.g., chicken coop, animal pen), the behaviour of going out during the day, the habit of hanging clothes or ornaments outside, utilization of insecticide-treated bed nets and anti-mosquito medication/sprays, occupation, expenditure, education level, and knowledge about filariasis transmission and prevention. The research instrument used the Kobo-collect application and a checklist for direct interviews and observation of the settlement environment. The research data were analysed descriptively, and hypothesis testing was done by logistic regression and analysed using the Stata program. This study has obtained ethical clearance from the ethics commission of the FKKMK, UGM, issued with No. KE/0424/03/2023, permission from the Sigi Health Office and Primary Health Center.

RESULTS

This study was conducted on the case group totaling 38 people, who live in the villages: Kaleke, Pandere, Dolo, Banasu, Kantewu, Gimpu, Kamipura, Nokilalaki, Kulawi, Dombusoi, Marawola, Biromaru,

Lindu, and Palolo. They had their finger blood examined by medical personnel or laboratory staff and were positive for microfilaria. Besides, the control group totaling 76 people living in the same environment as the case group, had their finger blood examined and were negative for microfilaria.

The descriptive data for each variable from Table 1 explore the relationship of independent variables with filariasis events in the Sigi Regency in 2023. Among the case group, 79.1% (25 individuals) with breeding places near their homes tested positive for microfilaria, compared to only 15.9% (13 individuals) who tested negative. This suggests a positive association between having breeding places nearby and filarial infection. Then, the presence of cattle sheds within the households showed a connection with filariasis. In the case group, 42.9% (27 individuals) living near cattle sheds had positive microfilaria, while 21.6% (11 individuals) did not. The habit of going out at night shows 54.1% (33 individuals) were positive for microfilaria, while 9.4% (5 individuals) tested negative for microfilaria. Interestingly, using repellent doesn't seem to have a strong positive or negative association. Even with regular use reported by 48.9% (22 individuals) of the infected group and 23.3% (16 individuals) of the uninfected group. It means that this study didn't statistically associate mosquito repellent use with filarial infection. Temperature and humidity levels didn't show a statistically significant association with filarial infection (14 individuals or 23.0% positive, 24 individuals or 45.3% negative). However, further data analysis in Table 1 might reveal more details and observe the p-value and Odds Ratio (OR) for each variable.

Table 1. Results of Statistical Analysis of the Relationship of Free Variables with Filariasis Events in Sigi Regency in 2023

Variable	Cases n= 38	Control n= 76	p-value	OR	95 % CI	
					Lower	Upper
Breeding Places						
Yes	25 (79.1%)	7 (21.9%)	*<0.001	18.96	6.79	52.9
No	13 (15.9%)	69 (84.1%)	1			
The Presence of Cattle Sheds						
Yes	27 (42.9%)	36 (57.1%)		2.73	1.18	6.27
No	11 (21.6%)	40 (78.4%)	*0.018			
The Habit of Going Out at Night						
Yes	33 (54.1%)	28 (45.9%)	*<0.001	11.31	3.96	32.3
No	5 (9.4%)	48 (90.6%)	1			
The Habit of Using Mosquito Repellent						
Yes	22 (48.9%)	23 (51.1%)	*0.005	3.17	1.42	7.23
No	16 (23.2%)	53 (76.8%)				
Temperature and Humidity						
Good	14 (23.0%)	47 (77.0%)		2.78	1.15	6.76
Not good	24 (45.3%)	29 (54.7%)	*0.013			

The analysis revealed a statistically significant association (Chi-Square test with p <0.001) between the presence of breeding places near homes and filariasis incidence Sigi Regency. This is reflected in the Odds Ratio (OR) of 18.96 (95% CI: 6.79-52.90). In simpler terms, people residing near breeding places (e.g., the stagnant water bodies, containers holding water) had an 18.95 times higher risk of being infected with filarial parasites compared to those without such breeding sites nearby.

The analysis revealed a statistically significant association (Chi-Square test with p <0.001) between the presence of breeding places near homes and filariasis incidence Sigi Regency. This is reflected in the Odds Ratio (OR) of 18.96 (95% CI: 6.79-52.90). In simpler terms, people residing near breeding places (e.g., the stagnant water bodies, containers holding water) had an 18.95 times higher risk of being infected with filarial parasites compared to those without such breeding sites nearby.

Similarly, a significant connection (Chi-Square test with $p = 0.018$) was observed between the presence of livestock cages near houses and filariasis incidence (OR = 2.73, 95% CI: 1.18-6.27). This suggests that people living near livestock shelters have a 2.73 times higher risk of filariasis infection compared to those without nearby livestock. One potential explanation for this association is that these livestock shelters might create suitable breeding grounds for mosquitoes within close proximity (less than 200 meters) of homes.

Moreover, the analysis revealed a statistically significant association (Chi-Square test with p <0.001) between spending time outdoors at night and filariasis occurrences in Sigi Regency's endemic areas. This is reflected in the OR of 11.31 (95% CI: 3.96-32.3). In other words, people who frequently spend time outdoors at night have an 11.31 times higher risk of filarial parasite infection than those who limit outdoor activity. This is likely because mosquitoes, the vectors of filariasis parasites, are most active during dusk and dawn, increasing the risk of mosquito bites for those outdoors.

As shown by the OR of 3.17 (95% CI: 1.42-7.23) and the Chi-Square test p = 0.005, there is a significant association between mosquito repellent use and filariasis occurrence in Sigi Regency. This means that people who do not use mosquito repellent have a 3.17 times higher risk of filarial parasite infection compared to those who do. Mosquito repellents work by masking human scent or creating a repellent vapor that deters mosquitoes from biting. The behavioral factors of spending time outdoors at night and using mosquito repellent can be influenced by various social and cultural

factors like knowledge about filariasis transmission, beliefs about mosquito bites, and ingrained habits within the community. While spending time outdoors at night increases exposure to mosquitoes, it is essential to note that mosquito bites are not sufficient for filarial infection. The analysis identified a significant correlation between temperature and humidity levels and filariasis occurrence (OR = 2.78, 95% CI: 1.15-6.76, Chi-Square test with p = 0.013). This means that the risk of filariasis is 2.78 times higher for people who live in unfavorable temperature and humidity conditions than for those who live in favorable ones. However, it is also crucial to note that the relationship between these environmental factors and filariasis transmission can be complex and inconclusive in some studies. Further investigation is needed to understand the specific role of temperature and humidity in Sigi Recency's context. The relationship test results are presented in Table 2.

Table 2. Recapitulation of Relationship Test Results

Variable	r	p-value
Breeding Place with Filariasis Occurrence	8.57	* 0.001
The Existence of Livestock Cages with Filariasis Events	5.16	*0.044
Not using mosquito repellent	6.06	*0.013

DISCUSSION

Breeding Place and Filariasis Occurrence in Sigi Regency's Endemic Areas

The presence of bushes, puddles, swamps, ponds, rice fields, and aquatic plants increases filariasis transmission risk. Stagnant water bodies, like swamps overgrown with aquatic plants such as water hyacinths, provide ideal breeding grounds for Mansonia mosquitoes, a known vector of filariasis (11). Even though a substantial proportion of the control group (21.9%) also had breeding places nearby, this percentage was significantly lower compared to the case group (78.1%). Besides, the hi-square test revealed a significant relationship between breeding place and filariasis incidence, with a *p*-value <0.001. The multivariable analysis of breeding places also indicated a significant association, with *p*-value = 0.001, OR = 8.57, and 95% CI = 2.43-34.33. This means that living near breeding places increased the risk of filariasis by 8.57 times compared to living without breeding places nearby.

This situation is to the results of research that houses with breeding places have a risk of 1,185 times compared to houses without breeding places (12). The same study showed that reeding place, resting place, knowledge, and attitude were variables that had a significant association with filariasis incidence in Semarang, as shown by their p-values and OR values (13).

The presence of bushes, puddles, swamps, ponds, rice fields, and aquatic plants increases filariasis transmission risk. Stagnant water bodies, like swamps overgrown with aquatic plants such as water hyacinths, provide ideal breeding grounds for Mansonia mosquitoes, a known vector of filariasis (14). Even though a substantial proportion of the control group (21.9%) also had breeding places nearby, this percentage was significantly lower compared to the case group (78.1%). Besides the chi-square test revealed a significant relationship between breeding place and filariasis incidence, with a p-value <0.001. The multivariable analysis of breeding places also indicated a significant association, with p-value = 0.001, OR = 8.57, and 95% CI = 2.43-34.33. This means that living near breeding places increased the risk of filariasis by 8.57 times compared to living without breeding places nearby. This situation result that houses with breeding places have a risk of 1,185 times compared to houses without breeding places (15). The same study also that breeding place, resting place, knowledge, and attitude were variables that had a significant association with filariasis incidence in Semarang, as shown by their p-values and OR values (16).The presence of breeding places around a person's home increases the risk of filariasis, as these stagnant water sources allow mosquitoes to breed and gather. In Sigi Regency, breeding places can include rice fields, bushes, puddles, ponds, discarded water containers, and household septic tanks. These stagnant waters provide an ideal breeding ground for filarial parasite vectors like *Anopheles sp.,* which prefers calm water found in swamps, and *Mansonia sp.* (15,17).

This difference between the case and control groups allows researchers to pinpoint behavioral, environmental, or individual characteristics potentially associated with a lower risk of filariasis transmission. Some factors influencing why some people might not get infected include being aware of the risk of mosquito bites and adopting self-protection practices such as using mosquito nets while sleeping or using mosquito repellent will have a lower risk of contracting filariasis, individual health, and immune conditions can also affect the response rate to filarial parasites (18).

Cattle Barns and Filariasis Cases in High-Risk Zones of Sigi District

The analysis revealed a connection between animal barns and filariasis risk. Participants in both groups (42.9% of the case group, and 57.1% of the control group) frequently owned various animals such as cows, goats, chickens, dogs, and pigs. A chi-square test (p-value = 0.018) revealed a significant association between the

existence of animal barns and the occurrence. This association was further strengthened by a multivariable analysis, which showed that people living near cattle barns had a 5.16 times higher risk of filariasis (OR = 5.16, 95% CI: 1.15-29.44, p-value = 0.044) compared to those without nearby cattle barns. This suggests that the presence of cattle barns, in particular, might be a contributing factor to filariasis transmission in these areas.

This study aligns with findings that reported a significant association between animal barns and filariasis (p-value = 0.025). The existence of livestock cages in this study is the presence or absence of livestock cages in the house or a distance of less than 100 meters from the house as a mosquito breeding place (16). This study is similar in Papua, observed a 57.1 times higher risk of filariasis in Papua near livestock sheds (17). However, a study in Pekalongan found no such link (p-value of 0.720) (17). This discrepancy highlights the potential influence of local factors on the relationship between livestock and filariasis transmission. Livestock sheds provide ideal conditions for mosquito development due to temperature, humidity, and lighting, hence increasing mosquito populations and filariasis transmission risk. If there are cattle sheds around the house, then the risk of developing filariasis also increases. Therefore, filariasis prevention measures can be taken through vector control and reducing mosquito breeding and resting places. The existence of cattle sheds is considered a resting place for mosquitoes, so it is recommended that livestock sheds are not inside the house or within less than one hundred meters (100 meters) from the vicinity of the respondent's house (18).

The Effect of Mosquito Repellent on Filariasis Cases in Filariasis-Prone Regions of Sigi District

Respondents in this study primarily used insect repellents, such as DEET-based sprays or creams, particularly at night. These repellents typically provide protection for several hours, preventing mosquito bites after application. The study revealed that those who did not use mosquito repellent were 6.06 times more likely to develop filariasis compared to those who did (3,19). In Kertoharjo Village, a significant association between repellent use and filariasis was observed (p-value of 0.002 and an OR value of 15.17). This indicates that people who did not use repellent were more susceptible to filariasis (20). People who did not use mosquito repellent had a 6.32 times higher risk of filariasis than those who did, with a p-value of 0.03 (21). However, in Barito Kuala District, where they got a p-value of 0.441 and an OR value of 2.04. Possible explanations for this discrepancy include variations in repellent types used, mosquito species prevalence, or environmental factors across the study locations (16).

Mosquito repellents play a crucial role in filariasis prevention by masking human scent or creating a repellent vapor that deters mosquitoes from biting (22). This reduces the risk of exposure to filarial parasites transmitted through mosquito bites. However, studies have shown that repellent use can be lower than desired due to various factors, such as cost or limited awareness (1,23). Interviews with respondents in this study revealed that mosquito repellents were sometimes seen as less essential compared to other household needs. It is essential to remember that for optimal protection, mosquito repellents should be used alongside protective clothing, particularly long pants, and long sleeves, during peak mosquito biting times (dusk and dawn), and using mosquito repellants, such as repellants and mosquito coils, is one way to avoid mosquito bites (10,24–26). Even when indoors, repellent use can provide additional protection.

ACKNOWLEDGMENTS

The Dean of the Faculty of Medicine, Public Health, and Nursing at Gadjah Mada University in Yogyakarta, Indonesia, the Central Sulawesi Provincial Health Office leader, the Sigi District Health Office chief, and the Poltekkes Kemenkes Palu director are all gratefully acknowledged by the author. The author also expresses appreciation to the Sanitarian team members (Ibu Christien, Fatmawati, Dandi Ardian, and Moh. Bayu Fahrezi).

CONCLUSION

This analysis suggests that various environmental and behavioral factors significantly influence filariasis occurrence in the Sigi Regency. Biological factors, such as the presence of breeding sites and animal shelters near homes, were strongly associated with filariasis risk. Similarly, cultural factors like staying outdoors at night and not using mosquito repellent were significantly linked to filariasis prevalence. Physical factors like temperature and humidity also showed a significant association with filariasis incidence. The main risk factors for filariasis in Sigi Regency include the presence of breeding places near homes, proximity to animal shelters (e.g. livestock sheds), and lack of mosquito repellent use. These findings suggest that multifaceted interventions are needed to address

filariasis in the Sigi Regency. These could include community education campaigns promoting mosquito repellent use, environmental management efforts to reduce breeding sites near homes, and exploring strategies to encourage people to limit nighttime outdoor activity when possible.

REFERENCES

1. Moini J, Akinso O, Ferdowsi K, Moini M. Infectious diseases. Health Care Today in the United States. United States: Elsevier; 2023. p. 239–281. https://doi.org/10.1016/B978-0-323-99038-7.00017-5
2. Ministry of Health of Republic Indonesia. The Global Goal of Elimination of Lymphatic Filariasis as a Public Health Problem by the Year 2020. Jakarta: Ministry of Health of Republic Indonesia; 2020.
3. Aisyah DN, Kozlakidis Z, Diva H, Trimizi SN, Sianipar LR, Wijayanti E, et al. The Spatial-Temporal Distribution of Chronic Lymphatic Filariasis in Indonesia: A 18-Year Registry-Based Analysis. *Microbiol Res (Pavia)*. 2022;13(4):681–690. https://doi.org/10.3390/microbiolres13040049
4. World Health Organization. Lymphatic filariasis. Geneva: World Health Organization; 2023.
5. Wangdi K, Sheel M, Fuimaono S, Graves PM, Lau CL. Lymphatic Filariasis in 2016 in American Samoa: Identifying Clustering and Hotspots Using Non-Spatial and Three Spatial Analytical Methods. *PLoS Negl Trop Dis*. 2022;16(3):1–22. https://doi.org/10.1371/journal.pntd.0010262
6. Nurjana MA, Anastasia H, Widjaja J, Srikandia Y, Widayati AN, Murni, et al. Program Pengendalian Filariasis di Kabupaten Donggala , Sulawesi Tengah. *J Vektor Penyakit*. 2020;14(2):103–112. https://doi.org/10.22435/vektorp.v14i2.2512
7. Sungpradit S, Sanprasert V. Chapter 4 - Lymphatic filariasis. In: Misra G, Srivastava V, editors. Molecular Advancements in Tropical Diseases Drug Discovery. United States: Academic Press; 2020. p. 65–94. https://doi.org/10.1016/B978-0-12-821202-8.00004-9
8. Province Health Office of Sulawesi Tengah. Profil Kesehatan Provinsi Sulawesi Tengah 2021. Palu: Province Health Office of Sulawesi Tengah; 2021.
9. District Health Office of Sigi. Profil Kesehatan Kabupaten Sigi Thaun 2022. Sigi: District Health Office of Sigi; 2022.
10. Conga DF, El Bizri HR, González Crespo C, Gomez-Puerta LA, Ulloa-Urizar GM, Pérez-Peña PE, et al. Environmental Predictors of Filarial Infection in Amazonian Primates: Ecological Factors and Primate Filarial Infection. *Acta Trop*. 2022;235(106670):1-7. https://doi.org/10.1016/j.actatropica.2022.106670
11. Tantipat C, Wongkamchai M, Zaelai K, Amesombun A, Wongkamchai S. A Rare Case of Ocular Filariasis Caused by Brugia malayi. *Parasitol Int*. 2022;90(102606):1-3. https://doi.org/10.1016/j.parint.2022.102606
12. Astriana Y, Afni N, Andri M, Yani A. Analisis Faktor Risiko Kejadian Filariasis di Kecamatan Dolo Barat Kabupaten Sigi. *J Kolaboratif Sains*. 2022;5(1):36–44. https://doi.org/10.56338/jks.v5i1.2185
13. Ardias A, Setiani O, Darundiati YH. Faktor Lingkungan dan Perilaku Masyarakat yang Berhubungan dengan Kejadian Filariasis di Kabupaten Sambas. *J Kesehatan Lingkungan Indonesia*. 2019;11(2):199–207. https://doi.org/10.14710/jkli.11.2.199%20-%20207
14. Milati TPN, Siwiendrayanti A. Iklim, Sumber Agen, Breeding Places dan Resting Places Sekitar Penderita Filariasis Pesisir. *Higeia J Public Heal Res Dev*. 2021;5(1):133–44. https://journal.unnes.ac.id/sju/higeia/article/view/36329/18218
15. Rahanyamtel R, Nurjazuli N, Sulistiyani S. Faktor Lingkungan dan Praktik Masyarakat Berkaitan Dengan Kejadian Filariasis di Kabupaten Semarang. *J Kesehatan Lingkungan Indonesia*. 2019;18(1):8-11. https://doi.org/10.14710/jkli.18.1.8-11
16. Rahmat A, Rahmayanti D, Rachmawati K. Faktor-Faktor yang Berhubungan dengan Kejadian Filariasis di Kabupaten Barito Kuala. *J Keperawatan dan Kesehat*. 2020;8(1):48–58. https://doi.org/10.20527/dk.v8i1.6919
17. Kobak N, Yusuf A, Syafar M, Juhanto A. Perilaku Masyarakat terhadap Kepatuhan Minum Obat Filariasis di Wilayah Kerja Puskesmas Dekai Distrik Dekai Kabupaten Yahukimo Provinsi Papua. *J Solipu Media Komun Sivitas Akad dan Masy*. 2022;22(2):2003–2005. https://doi.org/10.32382/sulolipu.v22i2.2899
18. Risch F, Ritter M, Hoerauf A, Hübner MP. Human Filariasis—Contributions of the *Litomosoides Sigmodontis* and *Acanthocheilonema Viteae* Animal Model. *Parasitol Res*. 2021;120(12):4125–4143. https://doi.org/10.1007/s00436-020-07026-2
19. Laman M, Tavul L, Karl S, Kotty B, Kerry Z, Kumai S, et al. Mass Drug Administration of Ivermectin, Diethylcarbamazine, Plus Albendazole Compared with Diethylcarbamazine Plus Albendazole for Reduction of Lymphatic Filariasis Endemicity in Papua New Guinea: A Cluster-Randomised Trial. *Lancet Infect Dis*. 2022;22(8):1200–1209. https://doi.org/10.1016/S1473-3099(22)00026-3
20. Amalia IS, Annashr NN. Faktor Sosiodemografi dan Perilaku yang Berhubungan dengan Kejadian Filariasis di Kabupaten Kuningan. *J Kampus STIKES YPIB Majalengka*. 2018;6(13):1–19. https://doi.org/10.51997/jk.v6i1.3
21. Rahmi IR, Sutiningsih D, Hestiningsih R, Saraswati LD. Faktor-Faktor yang Berhubungan dengan Kasus Filariasis di Indonesia : Sistematik Review. *J Epidemiol Kesehat Komunitas*. 2022;7(2):501–521. https://doi.org/10.14710/jekk.v7i2.11515

22. Dhimal M, Kramer IM, Phuyal P, Budhathoki SS, Hartke J, Ahrens B, et al. Climate Change and Its Association with the Expansion of Vectors and Vector-Borne Diseases in the Hindu Kush Himalayan region: A systematic synthesis of the literature. *Adv Clim Chang Res*. 2021;12(3):421–429. https://doi.org/10.1016/j.accre.2021.05.003
23. Afra D, Harminarti AO. Faktor-Faktor yang Berhubungan dengan Kejadian Filariasis di Kabupaten Padang Pariaman Tahun 2010-2013. *J Kesehat Andalas*. 2020;1(1):1–6. http://dx.doi.org/10.25077/jka.v5i1.453
24. Haynes E, Cleveland CA, Garrett KB, Grunert RKA, Bryan JA, Sidouin M, et al. Characterization of the Genetics and Epidemiology of *Brugia sp.* in Domestic Dogs in Chad, Africa. *Vet Parasitol Reg Stud Reports*. 2022;35(100784):. https://doi.org/10.1016/j.vprsr.2022.100784
25. Christine CC. Analisis Faktor Risiko Kejadian Filariasis Di Wilayah Kerja Puskesmas Kaleke Dan Puskesmas Baluase Kabupaten Sigi Tahun 2019. J Kesehat Masy Andalas. 2021;14(1):3-8. https://doi.org/10.24893/jkma.v14i1.534
26. Maryen Y, Kusnanto H, Indriani C. Risk Factors of Lymphatic Filariasis in Manokwari, West Papua. *Trop Med J*. 2018;4(1):60-64. https://doi.org/10.22146/tmj.37186