Disease Prevention and Public Health Journal
Vol. 16, No. 2, September 2022, pp. 70-77
e-ISSN: 2720-9997

The Presence of Aedes Aegypti Mosquito larvae in Bandung City in 2021

Agung Sutriyawan*, Karlina Wirawati, Suherdin
Public Health Study Program, Universitas Bhakti Kencana, Bandung, Indonesia
*corresponding author, email: agung.sutriawan@bku.ac.id

ARTICLE INFO

Article history
Received **11/10/21**
Revised **12/12/21**
Accepted **01/05/22**

Keywords
Aedes aegypti
Draining behavior
Closing behavior
Abate usage behavior

ABSTRACT

Background: Dengue Hemorrhagic Fever (DHF) is the vector-borne disease with the highest prevalence rate in the world. Bandung city itself is included in the 5 regencies/cities with the highest number of cases today. The disease is transmitted through the *Aedes aegypti* mosquito. The purpose of this study is to find out the effect of mosquito nests on the presence of *Aedes aegypti* mosquitoes. **Method**: This research uses quantitative research methods with a design cross-sectional survey. The population in this study is the entire community in Bandung. The sample number was 510 respondents. The research instrument used questionnaires and observation sheets. Data analyzed descriptively, chi-square test, and binary logistic regression. **Results**: The presence of *Aedes aegypti* mosquitoes is influenced by several risk factors for *Pemberantasan Sarang Nyamuk* (PSN) behavior, including not draining water shelters once a week (OR=3.219; CI 95%= 2.194-4.724; p<0.025), not closing water reservoirs (OR=1.719; CI 95%= 1.171-2.521; p<0.025), and abate use behavior (OR=1.6; CI 95%= 1.070-2.437; p<0.025). **Conclusion**: In this study, most of them found no flicks in water reservoirs. The presence of *Aedes aegypti* mosquitoes can increase if it drains water reservoirs less than once a week, closes unsalted water reservoirs or open water shelters, does not use abate. To prevent the presence of a flick at home it is necessary to drain the water shelter regularly, always close the water shelter and sprinkle abate powder at least once every 3 months.

1. Introduction

Dengue Hemorrhagic Fever (DHF) is a vector-borne disease with the highest prevalence rate globally, with 2.5 billion people worldwide at risk of contracting DHF [1]. Several previous studies stated that DHF has always shown an increasing number of cases in several countries in the last ten years [2-4]. Of the 30 DHF endemic countries, Indonesia ranks the second highest in terms of the number of cases in the world [5], while West Java Province ranks the second-highest in 2019 [6], the City of Bandung itself is included in the five regencies/cities with the highest number of cases in 2020 with a total of 2,363 cases [7]. This disease is transmitted by the Aedes aegypti mosquito [8], which breeds in water reservoirs [9]. Several previous studies have stated that the Aedes aegypti mosquito prefers to breed in open water reservoirs and is rarely cleaned [10-11]. It is necessary to take preventive measures to overcome the problem. So far, preventive efforts carried out since 2016 are PSN behavior [12]. Previous research has proven that dengue prevention can be done through PSN behavior in the form of 3M Plus activities, namely draining water reservoirs, closing water reservoirs, recycling or reusing used goods, sowing abate, and

other prevention activities such as not hanging clothes, planting mosquito repellent plants, keeping larvae-eating fish, installing mosquito nets on ventilation, and others [14-15]. PSN 3M Plus is carried out to eliminate mosquito nests that like to be occupied by dengue vectors, namely Aedes aegypti. In addition, this is to reduce contact or mosquito bites. PSN 3M Plus is essential because there are more mosquito nests in the house. This action needs to be taken by the whole community to reduce the incidence of DHF [13].

Another study that examined the presence of larvae looked at the type of water reservoir, the dark color of the container, and the materials used, such as cement, which are the favorite places for mosquitoes to breed [16-17]. Meanwhile, whatever water reservoirs are used, if 3M plus practices are not carried out, the water reservoirs will still be used as breeding grounds for mosquitoes. Therefore, it is necessary to conduct research on the presence of Aedes aegypti mosquito larvae in terms of the behavior of eradicating mosquito nests. This study aimed to determine the effect of eradicating mosquito nests on the presence of Aedes aegypti mosquito larvae.

2. Materials and Method

This research is quantitative research with a cross-sectional survey design. The population in this study is the entire community in the city of Bandung. The sample is calculated using the formula for the one-sample proportions test, and the minimum sample is 510 respondents. The sample was taken based on the highest number of cases in the sub-district area. Therefore, the sample was taken from 13 sub-districts in the city of Bandung. Sampling in the sub-districts used simple random sampling, using the criteria of respondents being at least 17 years old, living at home alone, and allowing researchers to make observations into the house. The research instruments were in the form of questionnaires and observation sheets. The primary data used in this study were respondent characteristics, mosquito larvae survey, and mosquito nest eradication activities. The data obtained were then analyzed descriptively to determine the characteristics of respondents, mosquito larvae, and mosquito nest eradication activities. After that, the researchers conducted a chi-square test and binary logistic regression to determine the effect of eradicating mosquito nests on the presence of mosquito larvae. All respondents have agreed to the research protocol and signed the consent form to become respondents. The Ethics Committee has approved this research of STIK Immanuel Bandung under Number 054/KEPK/STIKI/VI/2021.

3. Results and Discussion

3.1. Results

Table 1 shows that most of the respondents are female (69.2%), are in the 21-30 year age group (27.5%), have a high school education (42.2%), and work as housewives (47.6%). Table 2 shows that in most of the respondents' homes were not found Aedes aegypti mosquito larvae (61.6%), more than half of the respondents drained water reservoirs or *Tempat Pembuangan Air* (TPA) once a week (56.9%), closed water reservoirs (52.7%), did not sprinkle abate powder (62.5%), did not have mosquito repellent plants (65.3%), did not recycle used goods (91.6%), and did not hang clothes (50.8%).

Table 3 explains that based on the results of the chi-square test, PSN behavior related to the presence of Aedes aegypti mosquito larvae is obtained, namely the behavior of draining water reservoirs (OR = 3.379; 95% CI = 2.328-4.905; p <0.05), the behavior of closing water reservoirs (OR=1.670; 95% CI=1.166-2.393; p<0.05), and use of abate (OR=2.035; 95% CI=1.385-2.990; p<0.05). Table 4 explains that the presence of Aedes aegypti larvae is influenced by several risk factors for PSN behavior, including not draining water reservoirs once a week (OR=3.219; 95% CI= 2.194-4.724; p<0.025), not closing water reservoirs tightly (OR=1.719; 95% CI=1.171-2.521; p<0.025), and abatement behavior (OR=1.6; 95% CI= 1.070-2.437; p<0.025).

Table 1. Characteristics of Respondents

Characteristics	n	%
Gender		
Male	157	30,8
Female	353	69,2
Age (year)		
≤20	35	6,9
21-30	140	27,5
31-40	134	26,3
41-50	119	23,3
51-60	61	12,0
>60	21	4,1
Education		
Elementary school	73	14,3
Junior High School	129	25,3
Senior High School	215	42,2
College/University	93	18,2
Occupation		
Housewife	243	47,6
Private labor	82	16,1
Entrepreneur	75	14,7
Students	29	5,7
Civil Servant	30	5,9
Labor	41	8,0
Not Working	10	2,0

Table 2. Characteristics of PSN Behavior and Presence of Aedes Aegypti Larvae

Research Variable	n	%
Aedes Aegypti larvae		
Exist	196	38,4
Does not exist	314	61,6
Draining TPA		
No	220	43,1
Yes	290	56,9
Closing TPA		
No	241	47,3
Yes	269	52,7
Recycling used goods		
No	467	91,6
Yes	43	8,4
Larvaside		
No	319	62,5
Yes	191	37,5
Hanging Clothes		
Yes	25	49,2
No	259	50,8
Mosquito repellent plants		
Exist	333	65,3
Does not exist	177	34,7

Table 3. Bivariate Analysis

PSN Behavior	Aedes Aegypti Larvae				*P-Value*	OR 95% CI
	Exist		Does not exist			
	n	%	n	%		
Draining TPA						
No	120	54.5	100	45.5	0.000	3.379 (2.328-4.905)
Yes	76	26.2	214	73.8		
Closing TPA						
No	108	44.8	133	55.2	0.005	1.670 (1.166-2.393)
Yes	88	32.7	181	67.3		
Recycling used goods						
No	181	38.8	286	61.2	0.617	1.181 (0.614-2.272)
Yes	15	34.9	28	65.1		
Using abate						
No	142	44.5	177	55.5	0.000	2.035 (1.385-2.990)
Yes	54	28.3	137	71.7		
Hanging Clothes						
No	92	35.5	167	64.5	0.170	1.284 (0.898-1.836)
Yes	104	41.4	147	58.6		
Mosquito Repellent Plants						
No	129	38.7	204	61.3	0.845	1.038 (0.713-1.511)
Yes	67	37.9	110	62.1		

Table 4. Multivariate Analysis

PSN Behavior	B	Sig.	Exp(B)	95% C.I.for EXP(B)	
				Lower	Upper
Draining TPA (No)	1.169	0.000	3.219	2.194	4.724
Closing TPA (No)	0.541	0.006	1.719	1.171	2.521
Recycling used goods (No)	-0.041	0.909	0.960	0.474	1.944
Using abate (No)	0.479	0.022	1.615	1.070	2.437
Hanging Clothes (yes)	-0.304	0.118	0.738	0.504	1.081
Mosquito Repellent Plants (No)	0.042	0.838	1.043	0.699	1.556

3.2. Discussion

DHF is one of the public health problems, especially in the city of Bandung. The number of cases has continued to increase over the last three years. This study was conducted to see the effect of the presence or absence of Aedes aegypti mosquito larvae seen in the behavior of eradicating mosquito nests carried out by the community. PSN behavior is a healthy lifestyle whose purpose is to control mosquito breeding grounds and as an effort to avoid the bite of the Aedes aegypti mosquito, which is the vector of dengue disease [13].

In this study, the value of Exp(B)>1 means that PSN behavior is considered a risk factor for the presence of Aedes aegypti mosquito larvae. Therefore, it can be concluded that the behavior of draining water reservoirs is one of the determining factors for the presence or absence of Aedes aegypti mosquito larvae. Most of the respondents who did not drain the water reservoir once a week were found to have larvae. Previous research in Yogyakarta stated a relationship between draining behavior and the presence of mosquito larvae [18]. Meanwhile, a study in Pekanbaru found that those who did not drain the water reservoir were a risk factor for the incidence of DHF [19].

In general, respondents are considered not to drain the water reservoir once a week due to inappropriate drainage behavior. Most of them do the draining only by throwing away dirty water and then replacing it with new water without brushing the water reservoir first so that Aedes aegypti mosquito larvae are still found attached to the walls of the container. In addition, some respondents

rarely drain the water reservoir. They drain it if the water in the water reservoir is considered dirty. Another study found that people's habits are draining water reservoirs when the water looks dirty. This habit occurs in those who have large water reservoirs [20]. A case study conducted in East Java stated that the main reason for respondents to drain water reservoirs was not to eliminate mosquito larvae but to drain water reservoirs if they felt that the water conditions were dirty, smelly, and not clear [15].

One of the efforts to eradicate the Aedes aegypti mosquito is by draining water reservoirs regularly and at least once a week. It is done so that it does not become a resting place that can become a breeding ground for mosquitoes and grow into adult mosquitoes [9]. Shelters that are frequently cleaned can suppress the larvae population so that they do not grow and develop into adult mosquitoes [21]. Draining the water reservoir properly needs to be done by brushing the walls of the water reservoir, then dousing it with hot water, so that if there are mosquito larvae attached to the wall that is difficult to clean, they can immediately melt with hot water [11].

This study also shows that closing water reservoirs not tightly is a risk factor for the presence of Aedes aegypti mosquito larvae. It is in line with previous research proving that closing water reservoirs is related to mosquito larvae that cause DHF [22]. Meanwhile, research in Palu City stated that closed but not tightly closed water reservoirs often contained mosquito larvae. Mosquitoes prefer this condition to lay eggs because the room is darker than water that is not covered at all [23].

This study found that most of the respondents who closed the water reservoir tightly did not find many mosquito larvae. Based on the statements of several respondents, they closed the water reservoirs tightly because the water reservoirs used are quite large and are usually used for several days, considering that Bandung City is one of the most densely populated cities and most people use clean water sourced from the wellbore or municipal waterwork (PDAM). Efforts to prevent dengue fever are to carry out 3M practices, namely to tightly close water reservoirs at home, especially water reservoirs that are used as water reserves that are used from time to time [24].

The use of Abate is a risk factor for the presence of Aedes aegypti mosquito larvae. In line with research in Jambi which stated that the administration of larvicides was associated with the presence of larvae [25]. Another study conducted in urban areas stated that sowing abate powder in water reservoirs was significantly associated with the incidence of DHF [26].

This study found that there was still a lack of knowledge about the benefits of using Abate, which caused respondents to feel unsafe to sow Abate. They think that Abate harms health. Abate is safe for health because abate powder will immediately stick to the water storage wall, so its levels in drinking water are lower than in water reservoirs. It is known that the adhesive power can last 2 to 3 months, so the use of Abate can be carried out every 2-3 months [17]. The existence of Aedes aegypti larvae in people who use Abate can be influenced by temperature, water, and the level of use of Abate (temephos), which is still not intensive [27]. The community can get Abate for free at the puskesmas through cadres in their area. However, because the Abate is limited, not all people can receive the Abate. Therefore, facilities are needed so that people want to sow abate powder [28].

In this study, we could not prove that the behavior of recycling used goods, hanging clothes, and having mosquito repellent plants were risk factors for the presence of larvae. This study is consistent with previous studies, which stated that there was no relationship between the behavior of reusing or recycling used goods and the presence of Aedes aegypti mosquito larvae [22]. Another study stated that the behavior of 3M plus, mainly recycling used goods was not a risk factor for the incidence of DHF [14].

The results of field observations show that almost all respondents do not recycle used goods. People prefer to throw garbage in its place compared to recycling used goods. Moreover, the city of Bandung is an administrative area, so used goods or plastic waste will be transported by cleaners regularly. In society, especially in urban areas, used goods will usually be transported by cleaners so the behavior of recycling used goods tends to be low so that behavior will be difficult to measure [14].

This study did not analyze people's habits in disposing of waste in its place. However, based on the field findings, the community's behavior in disposing of waste in its place and the frequency with which janitors pick up the garbage is more measurable than the behavior of reusing or recycling used goods, primarily used goods that can hold water. Garbage disposed of by the community, both inside and outside will routinely be transported by cleaners or janitors [29].

The results showed that half of the respondents hang used clothes, mostly found behind bedroom and bathroom doors. Although many clothes were found hanging on when the observations were made, no mosquito larvae were found. Some respondents stated that the clothes hanging behind the door did not last long. They were always put into the washing machine every one or two days. Clothes are hung when you get home from work. The next day they are placed in the washing machine. Another study stated that there was no relationship between hanging clothes and the incidence of DHF. Hanging clothes were found in bright places [30], whereas Aedes aegypti mosquitoes prefer dark and humid conditions [31].

We also cannot prove that having mosquito repellent plants around the house is a risk factor for larvae. Most of the respondents in this study did not have mosquito repellent plants. This result is in line with research in Ngawi Regency, which also could not prove that mosquito repellent plants can affect the incidence of DHF [32].

Effective prevention of dengue fever is to break the chain of transmission by controlling vectors. Community behavior regarding the prevention and eradication of DHF needs to be improved so that the spread of DHF can be prevented [33]. The current vector control program is through PSN activities [34]. This PSN is carried out to eradicate mosquito eggs, mosquito larvae, and breeding grounds. This activity is one of the main priorities in eradicating dengue disease. According to local conditions and culture, this activity directly involves the community directly [35].

4. Conclusion

Most of the larvae were not found in water reservoirs. Aedes Aegypti larvae can increase if they drain water reservoirs less than once a week, do not close water reservoirs tightly or open water reservoirs, and do not use abate. It is necessary to drain the water reservoir regularly to prevent larvae at home; always close the water reservoir tightly and sprinkle abate powder at least once every three months. In addition, it is necessary to optimize the task of the larva monitoring custodian (Jumantik) in carrying out the eradication of mosquito nests. It needs to be reviewed regarding the reuse or recycling of used goods in the 3M Plus PSN program.

Declaration

Acknowledgments: We would like to thank 1) Institute for Research and Community Service at Bhakti Kencana University (LPPM-UBK) for supporting this research to be carried out as expected. 2) Ministry of Research and Technology/National Research and Innovation Agency (RISTEK-BRIN) has provided full funding to carry out this research. 3) Bandung City Health Office has been pleased to allow the author to conduct research in the Bandung City Region.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Nugraha F, Haryanto B, Wulandari RA, Pakasi TT. Studi Ekologi Hubungan Kejadian Demam Berdarah Dengue (DBD) dengan Faktor Iklim di Kota Administrasi Jakarta Pusat, Indonesia Tahun 1999-2018. *J Ilmu Kesehat Masy*. 2021;10(03):142–8. doi: https://doi.org/10.33221/jikm.v10i03.923
2. Liu K, Hou X, Wang Y, Sun J, Xiao J, Li R, et al. The Driver of Dengue Fever Incidence in Two High-Risk Areas of China: A Comparative Study. *Sci Rep*. 2019;9(1):1–9. doi: https://doi.org/10.1038/s41598-019-56112-8
3. Chanyasanha C, Guruge GR, Sujirarat D. Factors Influencing Preventive Behaviors For Dengue Infection Among Housewives in Colombo, Sri Lanka. *Asia Pacific J Public Heal*. 2015;27(1):96–104. doi: https://doi.org/10.1177/1010539514545646
4. O'Reilly KM, Hendrickx E, Kharisma DD, Wilastonegoro NN, Carrington LB, Elyazar IRF, et al. Estimating the Burden of Dengue and the Impact of Release of Wmel Wolbachia-Infected

Mosquitoes in Indonesia: A Modelling Study. *BMC Med*. 2019;17(1):1–14. doi: https://doi.org/10.1186/s12916-019-1396-4
5. Haryanto B. Indonesia Dengue Fever: Status, Vulnerability, and Challenges. *Curr Top Trop Emerg Dis Travel Med*. 2018;5:81–92. doi: https://doi.org/10.5772/intechopen.82290
6. Sari DP, Rahayu P. Pendidikan Kesehatan Berpengaruh terhadap Pengetahuan dan Perilaku Masyarakat tentang Demam Berdarah Dengue. *J Ilm Permas J Ilm STIKES Kendal.* 2021;11(3):595–602. doi: https://doi.org/10.32583/pskm.v11i3.1540
7. Kementerian Kesehatan RI. *Data Kasus Terbaru DBD di Indonesia* [Internet]. Kementerian Kesehatan RI. 2021 [cited 2021 Nov 6]. Available from: https://sehatnegeriku.kemkes.go.id/baca/umum/20201203/2335899/data-kasus-terbaru-dbd-indonesia/
8. Noshirma M, Willa RW, Kazwaini M, Wibowo A. Deteksi Virus Dengue pada Nyamuk Aedes aegypti (Diptera: Culicidae) yang Tersebar di Kabupaten Sumba Timur dan Sumba Barat Daya. *J Vektor Penyakit.* 2020;14(1):57–64. doi: https://doi.org/10.22435/vektorp.v14i1.2421
9. Couret J, Notarangelo M, Veera S, LeClaire-Conway N, Ginsberg HS, LeBrun RL. Biological Control of Aedes Mosquito Larvae with Carnivorous Aquatic Plant, Utricularia Macrorhiza. *Parasit Vectors*. 2020 Apr 21;13(1):208. doi: 10.1186/s13071-020-04084-4. PMID: 32317006; PMCID: PMC7175535.
10. Mejía-Guevara MD, Correa-Morales F, González-Acosta C, Dávalos-Becerril E, Peralta-Rodríguez JL, Martínez-Gaona A, Hernández-Nava M, Ramírez-Huicochea C, Rosas-Trinidad L, Carmona-Pérez M, Salazar-Bueyes V, Tapia-Olarte F, Moreno-García M. Aedes Aegypti, the Dengue Fever Mosquito in Mexico City. Early Invasion and its Potential Risks. *Gac Med Mex*. 2020;156(5):382-389. English. doi: 10.24875/GMM.M20000425. PMID: 33372934.
11. Junges MT, Harburguer L, Lorenzo MC, Eisenberg P, Masuh H, Carbajo AE. Soil Presence Reduces the Control Effectiveness of A Slow-Release Formulation of Pyriproxyfen On Aedes Aegypti (Diptera: Culicidae) Larvae. *Trop Med Int Health*. 2020 Feb;25(2):216-221. doi: 10.1111/tmi.13333. Epub 2019 Nov 20. PMID: 31691403.
12. Kumosani TA, Al-Malki AL, Razvi SS, Balgoon MJ, Kaleem M, Huwait EA, Alghamdi MA, Yaghmoor SS, Abualnaja KO, Barbour EK, Al-Madani KA, AlToukhi MH, Kumosani AT, Moselhy SS. Hemorrhagic Fever in Saudi Arabia: Challenge to Public Health, Effective Management and Future Considerations. *Afr Health Sci*. 2020 Sep;20(3):1153-1163. doi: 10.4314/ahs.v20i3.17. PMID: 33402960; PMCID: PMC7751520.
13. Rakhmani AN, Limpanont Y, Kaewkungwal J, Okanurak K. Factors Associated with Dengue Prevention Behaviour in Lowokwaru, Malang, Indonesia: A Cross-Sectional Study. *BMC Public Health.* 2018 May 11;18(1):619. doi: 10.1186/s12889-018-5553-z. PMID: 29751758; PMCID: PMC5948848.
14. Makrufardi F, Phillabertha PS, Safika EL, Sungkono. Factors Associated with Dengue Prevention Behaviour in Riverbank Area: A Cross-sectional Study. *Ann Med Surg (Lond).* 2021 Jun 2;66:102450. doi: 10.1016/j.amsu.2021.102450. PMID: 34141421; PMCID: PMC8187934.
15. Susilowati I, Cahyati WH. Kejadian Demam Berdarah Dengue (DBD): Studi Kasus di Wilayah Kerja Puskesmas Wonokarto. *Indones J Public Heal Nutr*. 2021;1(2):244–54.
16. Ryan SJ, Lippi CA, Nightingale R, Hamerlinck G, Borbor-Cordova MJ, Cruz B M, Ortega F, Leon R, Waggoner E, Stewart-Ibarra AM. Socio-Ecological Factors Associated with Dengue Risk and *Aedes aegypti* Presence in the Galápagos Islands, Ecuador. I*nt J Environ Res Public Health*. 2019 Feb 26;16(5):682. doi: 10.3390/ijerph16050682. PMID: 30813558; PMCID: PMC6427784.
17. Azizah FN, Hermawati E, Susanna D. Menguras dan Menutup Sebagai Prediktor Keberadaan Jentik pada Kontainer Air di Rumah. *Ber Kedokt Masy*. 2018;34(6):242–7.
18. Nadeev AP, Maltseva YG, Shishkina EY, Porotnikova EV, Khokhlova NI. Likhoradka denge s letal'nym iskhodom [Fatal dengue fever]. *Arkh Patol.* 2020;82(1):52-55. Russian. doi: 10.17116/patol20208201152. PMID: 32096491.
19. Sari TW, Putri R. Pemberantasan Sarang Nyamuk 3M Plus terhadap Kejadian Demam Berdarah Dengue di Puskesmas Payung Sekaki Kota Pekanbaru; Studi Kasus Kontrol. *J Epidemiol Kesehat Indones*. 2019;3(2):55–60. doi: https://doi.org/10.7454/epidkes.v3i2.1781
20. Castillo Signor LDC, Edwards T, Escobar LE, Mencos Y, Matope A, Castaneda-Guzman M, Adams ER, Cuevas LE. Epidemiology of dengue fever in Guatemala. *PLoS Negl Trop Dis.* 2020 Aug 19;14(8):e0008535. doi: 10.1371/journal.pntd.0008535. PMID: 32813703; PMCID: PMC7458341.

21. Sahak MN. Dengue Fever as An Emerging Disease in Afghanistan: Epidemiology of the First Reported Cases. *Int J Infect Dis*. 2020 Oct;99:23-27. doi: 10.1016/j.ijid.2020.07.033. Epub 2020 Jul 29. PMID: 32738489.
22. Nguyen-Tien T, Do DC, Le XL, Dinh TH, Lindeborg M, Nguyen-Viet H, Lundkvist Å, Grace D, Lindahl J. Risk Factors of Dengue Fever in An Urban Area in Vietnam: A Case-Control Study. *BMC Public Health*. 2021 Apr 7;21(1):664. doi: 10.1186/s12889-021-10687-y. PMID: 33827489; PMCID: PMC8028770.
23. Rau MJ, Banilai PAS. Risk of Environmental Factors and Efforts to Eliminate Mosquito Nest with Dengue Fever in The Working Area of The Kamonji Health Center. *Prev J Kesehat Masy*. 2020;11(2):121–33.
24. Padmaprakash KV, Jha VK, Bhushan S, Deepkamal, Sowmya KC. Demographic and Clinical Profile of Dengue Fever in a Tertiary Care Hospital of South India. *J Assoc Physicians India*. 2020 Nov;68(11):24-27. PMID: 33187032.
25. Poudyal P, Sharma K, Dumre SP, Bastola A, Chalise BS, Shrestha B, Poudel A, Giri A, Bhandari P, Shah Y, Poudel RC, Khadka D, Maharjan J, Ngwe Tun MM, Morita K, Pandey BD, Pandey K. Molecular study of 2019 dengue fever outbreaks in Nepal. *Trans R Soc Trop Med Hyg*. 2021 Jun 2;115(6):619-626. doi: 10.1093/trstmh/traa096. PMID: 32987406.
26. Sutriyawan A, Aba M, Habibi J. Determinan Epidemiologi Demam Berdarah Dengue (DBD) Di Daerah Perkotaan: Studi Retrospektif. *J Nurs Public Heal*. 2020;8(2):1–9. doi: https://doi.org/10.37676/jnph.v8i2.1173
27. Bhatt M, Soneja M, Farooqui FA, Singla P, Vikram NK, Biswas A, Roy A, Wig N. Myocarditis in admitted patients with dengue fever. *Infection*. 2020 Dec;48(6):899-903. doi: 10.1007/s15010-020-01500-w. Epub 2020 Aug 11. PMID: 32780310.
28. Liu X, Zhang M, Cheng Q, Zhang Y, Ye G, Huang X, Zhao Z, Rui J, Hu Q, Frutos R, Chen T, Song T, Kang M. Dengue Fever Transmission Between a Construction Site and Its Surrounding Communities in China. *Parasit Vectors.* 2021 Jan 6;14(1):22. doi: 10.1186/s13071-020-04463-x. PMID: 33407778; PMCID: PMC7787407.
29. Gutu MA, Bekele A, Seid Y, Mohammed Y, Gemechu F, Woyessa AB, Tayachew A, Dugasa Y, Gizachew L, Idosa M, Tokarz RE, Sugerman D. Another Dengue Fever Outbreak in Eastern Ethiopia-An Emerging Public Health Threat. *PLoS Negl Trop Dis.* 2021 Jan 19;15(1):e0008992. doi: 10.1371/journal.pntd.0008992. PMID: 33465086; PMCID: PMC7845954.
30. Sasongko HP. Faktor yang Berhubungan dengan Kejadian Demam Berdarah Dengue (DBD) di Dusun Krajan Desa Barurejo Kecamatan Siliragung. *J Ilm Kesehat Rustida.* 2020;7(1):68–82. doi: https://doi.org/10.33088/jmk.v5i2.189
31. Kusuma WD. Gambaran Bionomik Nyamuk Aedes Aegypti Di Kelurahan Perumnas Way Kandis Kota Bandar Lampung. *Ruwa Jurai J Kesehat Lingkung*. 2021;12(2):95–101. doi: https://doi.org/10.26630/rj.v12i2.2762
32. Qamash T, Jamil J, Kalsoom, Khan FA, Saira, Sultan A, Begum N, Din SU. Epidemiological study of dengue fever in District Swabi, Khyber Pakhtunkhwa, Pakistan. *Braz J Biol.* 2021 Mar-May;81(2):237-240. doi: 10.1590/1519-6984.216284. PMID: 32696850.
33. Setyawan DA, Setyaningsih W. Spatial Distribution of Dengue Hemorrhagic Fever (DHF) Casesin Sragen. *Dis Prev Public Heal J*. 2021;15(1):42–9. doi: https://doi.org/10.12928/dpphj.v15i1.2178
34. Kurniawati RD, Ekawati E. Analisis 3M Plus Sebagai Upaya Pencegahan Penularan Demam Berdarah Dengue Di Wilayah Puskesmas Margaasih Kabupaten Bandung. *Vektora J Vektor dan Reserv Penyakit*. 2020;12(1):1–10. doi: https://doi.org/10.22435/vk.v12i1.1813
35. Langkulsen U, Promsakha Na Sakolnakhon K, James N. Climate Change and Dengue Risk in Central Region of Thailand. *Int J Environ Health Res*. 2020 Jun;30(3):327-335. doi: 10.1080/09603123.2019.1599100. Epub 2019 Mar 28. PMID: 30919662.