Review Article

The Impact of Environmental and Behavioral Factors on the Incidence of Dengue Hemorrhagic Fever in Indonesia: Meta-analysis

Fadel T. Muhamad[1], R. Azizah[1*]

[1] Department of Magister Environmental Health, Faculty of Public Health, Universitas Airlangga, Surabaya, Indonesia

(Correspondence author email, azizah@fkm.unair.ac.id)

ABSTRACT

Cases of dengue fever in Indonesia will increase to 143,000 by the end of 2022. The aim of the research is to examine the impact of environmental and behavioral factors on the incidence of dengue hemorrhagic fever in Indonesia. This research uses the Meta-Analysis Method with PICOS technology. Some sources of information used include Google Scholar, Research Gate, and Plos ONE, with the help of keywords such as "Environmental factors" and "Behavior." 193 articles were obtained, 151 articles came from Google Scholar, 37 articles from Research Gate, and 5 articles from Plos ONE. The articles obtained were filtered using inclusion criteria such as articles that had a 2x2 table, and discussed dengue fever and behavior with the number of selected articles being 21. At the screening stage, researchers used a cross-sectional research design. JASP application version 0.16.3.0 was used to process meta-analysis data. The key findings show that the habit of hanging clothes has a 2.386 higher risk as a cause of dengue hemorrhagic fever, with the pooled OR value as follows e0.87 = 2.386 (CI 95% 0.17-1.57). The presence of larvae has a risk of 2.075 for dengue fever with the following pooled value e0.73 = 2.075 (CI 95% 0.12-1.33). Meanwhile, the 3 M movement has a risk of 0.406 for the incidence of dengue fever with the following pooled value e-0.90 = 0.406 (CI 95% -1.66-0.15). the conclusion is There is an influence of the habit of hanging clothes, the presence of larvae and the 3M movement on the incidence of dengue hemorrhagic fever.

Keywords: *Presence of Larvae, Habit of Hanging Clothes, 3M Movement, Dengue Hemorrhagic Fever*

INTRODUCTION

Dengue Virus (DENV) is a virus that causes dengue fever, a viral infection spread by the Aedes aegypti and Ae. albopictus mosquito [1,2]. DENV infection sufferers experience various clinical manifestations, ranging from asymptomatic to severe dengue fever, such as dengue hemorrhagic fever and dengue shock syndrome, or dengue fever [3,4]. Dengue fever infections are estimated to occur 390 million times a year, of which 96 million cause symptoms due to the increasing incidence of DENV infections.[5] In addition, it is estimated that there were 565,900 disabilities and 9,110 deaths in 2013 due to dengue virus infection[6-8]. The first licensed recombinant attenuated dengue fever vaccine (Dengvaxia) was recently clinically available. However, high risks and adverse effects were found among vaccinated individuals.[9-12] Severe and fatal dengue cases are consistently reported in several endemic areas, such as Southeast Asia, the Western Pacific and the Americas[13-17].

It was also reported that deaths due to dengue shock syndrome were 50 times higher

than that of dengue fever [4,18,19]. If this virus is properly diagnosed and treated promptly, the death rate from dengue fever will fall from more than 20% to less than 1% [4]. Therefore, early prediction and case recognition are very important for controlling dengue fever. The number of dengue fever cases in Indonesia reached 143,000 by the end of 2022, with West Java, East Java and Central Java having the highest number of dengue fever cases. Nationally, the number of dengue cases is much lower than the estimated number of dengue cases in Indonesia [20].

In humans, one dengue serotype confers lifelong immunity against reinfection but provides only temporary and partial immunity against other serotypes[21]. Enhancement of antibody-dependent immunity also plays an important role in the incidence of dengue fever[22]. The first dengue outbreaks were reported in 1779 in Jakarta, Indonesia and Cairo, Egypt.[23,24] However, the only confirmed outbreak in North America, by DENV, was the Philadelphia plague in 1780[25]. The largest outbreak of dengue fever was seen in 2016 in the Americas, with more than 2.38 million cases. In this outbreak, the highest contribution was in Brazil, with 1.5 million cases[26]. When dengue became a global concern, currently almost 75% of the global population is affected by dengue, the majority of which are in the Asia-Pacific region[27]. Apart from that, there has been an increase in the proportion of dengue fever cases, especially in Thailand, Indonesia and Myanmar[28].

Because it is anthropophilic, the Aedes aegypti mosquito prefers human blood to animal blood[29]. Because many factors include amino acids, lactic acid, body heat, body odor, sweat, and other things that can attract mosquitoes, Aedes aegypti mosquitoes will land on old clothes hangers. Therefore, hanging clothes will increase the number of mosquitoes[30]. Suyasa's (2008) research findings show a correlation between the practice of hanging clothes and the prevalence of dengue fever vectors[31]. Similar findings were also reported by T. Widiyanto in his research in 2007 which found a relationship between the practice of hanging clothes and the incidence of dengue fever (OR=7.851) in Purwokerto respondents[32]. However, showering can stop the development of sweat odor. Bathing can reduce the smell of sweat, thereby reducing mosquito activity around humans. Human sweat is an important factor in the attraction of A. aegypti.

The aim of this research is to determine the risk variables that influence the incidence of dengue hemorrhagic fever in Indonesia, including the presence of larvae, the practice of hanging clothes, and the 3M movement. The uniqueness of this research is that researchers attempted to synthesize data from all research conducted between 2015 and 2023 to examine the relationship between variables that influence the incidence of dengue hemorrhagic fever.

METHOD

Meta analysis was carried out on data that had been extracted and synthesized from 21 research articles collected. The pooled prevalence ratio estimate value was obtained from analysis of this data. If the model used is a fixed effect model then the Mentel-Haenszel method is used, and if the model is a random effect then the DerSimonian-Laird approach is used. PICOS methodology, which involves combining two or more similar research findings to produce a combination of quantitative data with the same hypothesis, was used in the meta-analysis of this study [33,34].

Google Scholar, ResearchGate, and PlosONE were used as research data sources. "Environmental factors" and "behavior" are the main words of this research. The downloaded articles are articles that have abstracts and full text. The research articles found in this study were 193 journal articles. Then the articles were screened and sorted again using clear inclusion and exclusion criteria such as articles having 2x2 tables, articles discussing dengue fever, the environment and behavior in Indonesia, the number of articles in each variable was at least 10. The researcher used a cross sectional study design to screen at the next stage. Environmental and behavioral factors are selected variables that influence the incidence of dengue fever in Indonesia. Secondary data types from selected articles were used in this research. The incidence of dengue fever is the dependent variable, while environmental and behavioral factors are the independent variables of this research. The following is an image of the PRISMA flow diagram of this research.
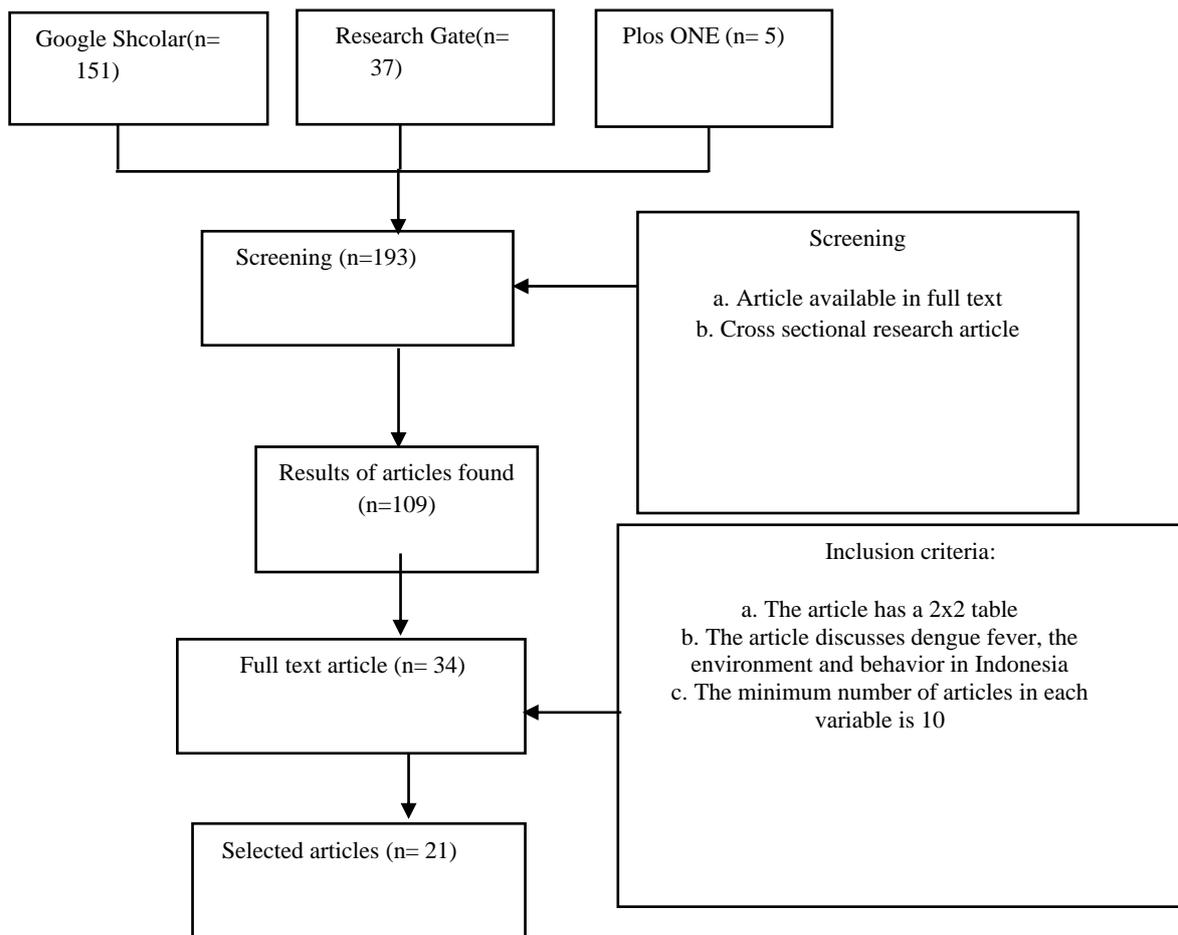
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┌─────────────────┐  ┌─────────────────┐  ┌─────────────────┐
│ Google Shcolar  │  │ Research Gate(n= │  │ Plos ONE (n= 5) │
│ (n= 151)        │  │ 37)              │  │                 │
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┌──────────────────────┐      ┌──────────────────────────────────┐
│ Screening (n=193)    │◄─────│ Screening                        │
│                      │      │                                  │
│                      │      │ a. Article available in full text│
│                      │      │ b. Cross sectional research      │
│                      │      │    article                       │
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┌──────────────────────┐
│ Results of articles  │
│ found (n=109)        │
└──────────────────────┘
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┌──────────────────────┐      ┌──────────────────────────────────┐
│ Full text article    │◄─────│ Inclusion criteria:              │
│ (n= 34)              │      │                                  │
│                      │      │ a. The article has a 2x2 table   │
│                      │      │ b. The article discusses dengue  │
│                      │      │    fever, the environment and    │
│                      │      │    behavior in Indonesia         │
│                      │      │ c. The minimum number of articles│
│                      │      │    in each variable is 10        │
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┌──────────────────────┐
│ Selected articles    │
│ (n= 21)              │
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Figure 1. Prism Flow Diagram of the influence of environmental and behavioral factors on dengue fever cases

Meta-analysis is often carried out in 5 steps, and the first involves the formulation of the study problem, followed by the collection of literature based on the expected objectives, as well as evaluation. The process then continues with analysis and interpretation of the literature obtained, followed by presentation in the form of articles [35].

The JASP application is used to process the collected data and then analyze it using classic meta-analysis. Data analysis goes through the following stages:

1. Data Selection

The year of publication, variables, design, and results of each study are all included in state-of-the-art tables or the same tables as data collected from other papers. A 2x2 table is taken from this data to be entered into Excel and then converted into Comma Sparated Values (CSV) in storage to be entered into the JASP application.

2. Data Analysis

To process meta analysis data using the JASP Version 0.16.3.0 application. fixed effect model or random effect is a type of analysis method. To determine the type of IUI method, it depends on the p value in the heterogeneity test table. The analysis results are displayed in the form of a forest plot graphicEgger Test /Bias Untuk melihat terdapat bias dalam penelitian ini digunakan Funnel plot dan uji Egger [36].

3. Sensitivity Test

To find out whether the data is stable to change, this test examines the differences between the fixed effect model and the random effect model in terms of the pool prevalence ratio value and the difference in the Confident Internal (CI) range.

RESULTS AND DISCUSSIONS

Based on Table 1. The one with the highest risk factor is the habit of hanging clothes with the pooled OR value as follows e0.87 = 2.387 (CI 95% 0.17- 0.57) so it can be concluded that the possibility of contracting dengue fever is 2.387 times higher in people. who hangs clothes. The possibility of contracting dengue fever is 2.075 times higher for people whose larvae are found around their house. Based on the findings of research conducted in the Semarang area, there is a large correlation between the prevalence of dengue fever and water reservoirs that accommodate mosquito larvae [37]. To implement the 3M plus movement, it is necessary to promote health about the importance of environmental cleanliness and change community behavior through eradicating mosquito larvae [38]. This

will stop the breeding cycle of Aedes aegypti mosquito larvae in the surrounding environment.

People's habit of hanging clothes is 6.29 times more likely to contract dengue fever compared to the habit of people who don't hang clothes [39]. When mosquitoes lay their eggs, they prefer wet and dark places. In rooms where more clothes are hung, there will be an increase in mosquito nests [40]. In this case, it is very important to know about preventing dengue fever, especially the habit of hanging clothes, in order to suppress the growth of the Aedes aegypti mosquito population and stop the spread of dengue fever in the surrounding environment, especially by eradicating mosquito nests. (PSN) in the home environment (inside and outside) using clothes that are no longer hanging.

Table 1. Results of Meta Analysis of the Presence of Larvae, Habit of Hanging Clothes, and 3M Movement with Dengue Hemorrhagic Fever Cases.

No	Research variable	N	Heterogenity (pvalue)	*Fixed/Random Effect Model*	
				OR	95% CI
1	Presence of Larvae	10	< 0,001	2,075	0,12-1,33
2	the Habit of Hanging Clothes	10	< 0,001	2,387	0,17 – 0,57
3	the 3M Movement	10	< 0,001	0,406	(-1,66)- (-0,15)

The findings show that the Random Effect (RE) Model value represents the estimated Odd Ratio (OR) value showing a 95% CI of 0.73 with a value range of 0.12-1.33. The forest plot data shown in Figure 1 has a combined OR value of e0.73 = 2.075, which indicates that there is a 2.075 times higher risk of dengue hemorrhagic fever if larvae are present.

According to Nurrochmawati and Dharmawan stated that the presence of live mosquito larvae allows dengue fever to occur[41]. The presence of A. aegypti larvae is significantly correlated with pH, temperature and humidity of the surrounding water and air [42]. Although dissolved oxygen and pH appear to strongly influence the microfauna and associated flora at nest sites, mosquito larval development is directly influenced by parameters such as temperature and salinity [43–47]. Previous research shows that the quality of the water in the breeding area, seen from the physical and chemical properties of the water, can have an impact on the presence of larvae [48]. Aedes aegypti mosquito eggs will hatch if the water has the right pH, dissolved oxygen

salinity and temperature [49]. One of the main determinants of the existence of life in water is water quality, which is determined based on measurements of various characteristics, especially physical and chemical [50–52]. The water temperature in the brooding area is 27.6^{0}C. The average maximum number of larvae detected in the breeding water at this temperature was still within the range where Ae. aegypti grows most effectively [53]. The water temperature where the Aedes aegypti mosquito breeds often ranges from 26.5^{0}C to 29.3^{0}C [49]. Salinity and dissolved oxygen, for example, have been shown to impact the development of Aedes aegypti larvae. It is known that the growth of Aedes aegypti larvae is strongly influenced by salinity (amount of dissolved salts in the environment) and DO (amount of dissolved oxygen) [54].

The Random Effect (RE) Model value represents the estimated Odd Ratio (OR) value showing a 95% CI of 0.87 with a value range of 0.17-1.57. The forest plot results in Figure 1 are pooled OR e$^{0.87}$ = 2,387, Therefore, it was determined that the danger of hanging clothes was 2,387 times higher than the number of

dengue hemorrhagic fever cases. This is in accordance with research [55] This shows that the incidence of dengue fever is correlated with hanging clothes, with a p value of 0.014 and an OR of 3. There are four types of surfaces that are breeding grounds for mosquitoes, such as metal, wood, clothes and cement [56]. Female mosquitoes are more often found on clothing, while male mosquitoes are more often seen landing on metal surfaces [31]. Hanging clothes also has an impact on the incidence of dengue fever [57].

The estimated Odd Ratio (OR) value is represented by the Random Effect (RE) Model value which has a CI 95% confidence interval of -0.90 and a range of -1.66 and -0.15. It can be concluded from the Forrest plot data in Figure 1 that the 3M movement has a protective factor of 0.406 against the incidence of Dengue Hemorrhagic Fever sufferers. The pooled OR value for the forest plot was $e^{-0.90} = 0.406$. Population density, screen ventilation, larvae, 3M behavior, hanging clothes, and use of mosquito repellent are additional factors that influence the occurrence of dengue fever [57].

Table 2. Heterogeneity test for careful variables

Meta-analysis heterogeneity test		Q	df	p
the presence of larvae in cases of Dengue Hemorrhagic Fever	Omnibus test of Model Coefficients	5.577	1	0.018
	Test of Residual Heterogeneity	133.099	9	<001
the habit of hanging clothes in cases of Dengue Hemorrhagic Fever	Omnibus test of Model Coefficients	5.896	1	0.015
	Test of Residual Heterogeneity	124.323	9	< .001
the habit of hanging clothes in cases of Dengue Hemorrhagic Fever	Omnibus test of Model Coefficients	5.488	1	0.019
	Test of Residual Heterogeneity	194.019	9	< .001

Based on Table 2, it is known that the p-value of the heterogeneity test for each test variable is less than 0.05 or p = 0.001.

Therefore, we used the Random Effect Model in this analysis because there are variations between studies.

Table 3. Egger's Test

Egger's Test	Z	P
Risk Factors for the Presence of Larvae in Cases of Dengue Hemorrhagic Fever	-0.059	0.953
Risk Factors for the Habit of Hanging Clothes in Cases of Dengue Hemorrhagic Fever	1.337	0.181
Risk Factors for the 3M Movement in Dengue Hemorrhagic Fever Cases	2.647	0.008

The findings show that the Egger's Test p value is > α (0.005), so the variable for the presence of larvae in Dengue Hemorrhagic Fever cases does not have publication bias. The findings also show that the Egger's Test p value is > α (0.005), so the habit of hanging clothes variable in Dengue Hemorrhagic Fever cases does not have publication bias. It is known that the p value of Egger's Test is > α (0.005), then the 3M Movement variable for Dengue Hemorrhagic Fever cases does not have publication bias.

CONCLUSION

The findings show that the habit of hanging clothes has a 2.386 higher risk as a cause of dengue hemorrhagic fever, with the pooled OR value as follows $e^{0.87} = 2.387$ (CI 95% 0.17-1.57). The presence of larvae has a risk of 2.075 for dengue fever with the following pooled value $e^{0.73} = 2.075$ (CI 95% 0.12-1.33). Meanwhile, the 3 M movement has a risk of 0.406 for the incidence of dengue fever with the following pooled value $e^{-0.90} = 0.406$ (CI 95% 1.66- 0.15). Based on these findings, it

was also concluded that there is an influence of the habit of hanging clothes, the presence of larvae and 3M movement on the incidence of dengue hemorrhagic fever. The habit of hanging clothes is the factor that has the highest risk value among the three research factors. With these findings, it can be recommended not to hang clothes and the alternative is to fold clothes and provide a place for dirty clothes that is disinfected so that it does not become a nest for mosquitoes. As for the presence of mosquito larvae, they can be eradicated by carrying out 3 M and routinely cleaning up puddles that may arise.

REFERENCES

1. Nonyong P, Ekalaksananan T, Phanthanawiboon S, Aromseree S, Phadungsombat J, Nakayama Ee, Et Al. Dengue Virus In Humans And Mosquitoes And Their Molecular Characteristics In Northeastern Thailand 2016-2018. Plos One [Internet]. 2021;16(9 September 2021):1–19. http://dx.doi.org/10.1371/journal.pone.0257460

2. Wang Wh, Urbina An, Chang Mr, Assavalapsakul W, Lu Pl, Chen Yh, Et Al. Dengue Hemorrhagic Fever – A Systemic Literature Review Of Current Perspectives On Pathogenesis, Prevention And Control. J Microbiol Immunol Infect [Internet]. 2020;53(6):963–78. https://doi.org/10.1016/j.jmii.2020.03.007

3. World Health Organization (Who) And Tdr. Dengue Guidelines For Diagnosis, Treatment, Prevention And Control. New Editio. Who Library Cataloguing-In-Publication Data. Printed: Who Library Cataloguing-In-Publication Data; 2009. 1–144.

4. World Health Organization. Dengue Hemorrhagic Fever: Diagnosis, Treatment And Control. Second Edi. The American Journal Of Tropical Medicine And Hygiene. Geneva; 1997. 1–83.

5. Bhatt S, W. Gething P, Brady, Oliver, Messina, Jane, Et Al. The Global Distribution And Burden Of Dengue. Nature. 2013;496(7446):504–7.

6. Stanaway JD, Shepard DS, Undurraga Ea, Halasa Ya, Coffeng Le, Brady Oj, Et Al. The Global Burden Of Dengue: An Analysis From The Global Burden Of Disease Study 2013. Lancet Infect Dis. 2016;16(6):712–23.

7. Soriano JB, Abajobir AA, Abate KH, Abera SF, Agrawal A, Ahmed MB, Aichour AN, Aichour I, Aichour MT, Alam K, Alam N. Global, regional, and national deaths, prevalence, disability-adjusted life years, and years lived with disability for chronic obstructive pulmonary disease and asthma, 1990–2015: a systematic analysis for the Global Burden of Disease Study 2015. The Lancet Respiratory Medicine. 2017 Sep 1;5(9):691-706.

8. Whiteford HA, Degenhardt L, Rehm J, Baxter AJ, Ferrari AJ, Erskine HE, Charlson FJ, Norman RE, Flaxman AD, Johns N, Burstein R. Global burden of disease attributable to mental and substance use disorders: findings from the Global Burden of Disease Study 2010. The lancet. 2013 Nov 9;382(9904):1575-86.http://dx.doi.org/10.1016/s0140-6736(13)61611-6

9. Flasche S, Jit M, Rodríguez-Barraquer I, Coudeville L, Recker M, Koelle K, Milne G, Hladish TJ, Perkins TA, Cummings DA, Dorigatti I. The long-term safety, public health impact, and cost-effectiveness of routine vaccination with a recombinant, live-attenuated dengue vaccine (Dengvaxia): a model comparison study. PLoS medicine. 2016 Nov 29;13(11):e1002181.

10. España G, Yao Y, Anderson KB, Fitzpatrick MC, Smith DL, Morrison AC, Wilder-Smith A, Scott TW, Perkins TA. Model-based assessment of public health impact and cost-effectiveness of dengue vaccination following screening for prior exposure. PLoS neglected tropical diseases. 2019 Jul 1;13(7):e0007482.

11. España G, Leidner AJ, Waterman Sh, Perkins TA. Cost-Effectiveness Of Dengue Vaccination In Puerto Rico. Plos Negl Trop Dis. 2021;15(7):1–15.

12. Sridhar S, Luedtke A, Langevin E, Zhu M, Bonaparte M, Machabert T,

Savarino S, Zambrano B, Moureau A, Khromava A, Moodie Z. Effect of dengue serostatus on dengue vaccine safety and efficacy. New England Journal of Medicine. 2018 Jul 26;379(4):327-40.

13. Yeh CY, Chen PL, Chuang KT, Shu YC, Chien YW, Perng GC, Ko WC, Ko NY. Symptoms associated with adverse dengue fever prognoses at the time of reporting in the 2015 dengue outbreak in Taiwan. PLoS neglected tropical diseases. 2017 Dec 6;11(12):e0006091.

14. Carras M, Maillard O, Cousty J, Gérardin P, Boukerrou M, Raffray L, Mavingui P, Poubeau P, Cabie A, Bertolotti A. Associated risk factors of severe dengue in Reunion Island: A prospective cohort study. PLOS Neglected Tropical Diseases. 2023 Apr 17;17(4):e0011260.

15. Gibson G, Souza-Santos R, Pedro AS, Honório NA, Sá Carvalho M. Occurrence of severe dengue in Rio de Janeiro: an ecological study. Revista da Sociedade Brasileira de Medicina Tropical. 2014 Nov;47:684-91.

16. Macedo GA, de Araújo JM, Schatzmayr HG, Costa FA, de Filippis AM, Santos FB, Nogueira RM. Virological surveillance for early warning of dengue epidemics in the State of Rio de Janeiro, Brazil. Transactions of the Royal Society of Tropical Medicine and Hygiene. 2013 Mar 1;107(3):141-6.

17. Kapuria D, Takyar VK, Etzion O, Surana P, O'Keefe JH, Koh C. Association of hepatic steatosis with subclinical atherosclerosis: systematic review and meta-analysis. Hepatology communications. 2018 Aug;2(8):877-87.

18. Anders KL, Nguyet NM, Chau NV, Hung NT, Thuy TT, Farrar J, Wills B, Hien TT, Simmons CP. Epidemiological factors associated with dengue shock syndrome and mortality in hospitalized dengue patients in Ho Chi Minh City, Vietnam. The American journal of tropical medicine and hygiene. 2011 Jan 1;84(1):127.

19. Halstead SB, Lan NT, Myint TT, Shwe TN, Nisalak A, Kalyanarooj S, Nimmannitya S, Soegijanto S, Vaughn DW, Endy TP. Dengue hemorrhagic fever in infants: research opportunities ignored. Emerging infectious diseases. 2002 Dec;8(12):1474.

20. Kemenkes RI. Laporan Tahunan 2022 Demam Berdarah. Unicef. Jakarta; 2022. 1–35 P.

21. Wahala WMPB, De Silva AM. The Human Antibody Response To Dengue Virus Infection. Viruses. 2011;3(12):2374–95.

22. Rothman AL. Immunity To Dengue Virus: A Tale Of Original Antigenic Sin And Tropical Cytokine Storms. Nat Rev Immunol. 2011;11(8):532–43.

23. Wu W, Bai Z, Zhou H, Tu Z, Fang M, Tang B, Liu J, Liu L, Liu J, Chen W. Molecular epidemiology of dengue viruses in southern China from 1978 to 2006. Virology journal. 2011 Dec;8:1-9.

24. Luo L, Liang H Ying, Jing Q Long, He P, Yuan J, Di B, Et Al. Molecular Characterization Of The Envelope Gene Of Dengue Virus Type 3 Newly Isolated In Guangzhou, China, During 2009-2010. Int J Infect Dis [Internet]. 2013;17(7):E498–504. http://dx.doi.org/10.1016/j.ijid.2012.12.017

25. Zahoor MK, Rasul A, Zahoor MA, Sarfraz I, Zulhussnain M, Rasool R, Majeed HN, Jabeen F, Ranian K. Dengue fever: a general perspective. Dengue Fever: a Resilient Threat in the Face of Innovation. 2019 Jan 30;1.

26. WHO. Epidemiological Dengue 2019. WHO [Internet]. 2019.

27. World Health Organization. Global Strategy For Dengue Prevention And Control. France: WHO Library Cataloguing-In-Publication Data; 2020.

28. Asidik AH, Rokhmayanti R, Supraptiningsih S, Puratmaja Y. Epidemiology of Dengue in Jetis Public Health Centre, Yogyakarta 2013-2016. Epidemiology and Society Health Review (ESHR). 2020;2(2):69-76.

29. Kurniawan W. Pengaruh Pelatihan Pengendalian Vektor Demam Berdarah Terhadap Maya Index Pada Siswa Sekolah Dasar Di Majalengka. J Ilmu Dan Teknol Kesehat. 2020;11(1):1–8.

30. Baskoro T, Satoto T, Widartono Bs.

Spatial Analysis On Vulnerability To Dengue Hemorrhagic Fever In Kotabaru Subdistrict, Jambi Municipality, Jambi Province. J Trop Med. 2014;2(1):45–56.

31. Suyasa IG, Putra NA, Aryanta IWR. Hubungan Faktor Lingkungan Dan Perilaku Masyarakat Dengan Keberadaan Vektor Demam Berdarah Dengue (DBD) Di Wilayah Kerja Puskesmas I Denpasar Selatan. Ecotrophic. 2007;3(1):1–6.

32. Widiyanto T. Terhadap Kejadian Demam Berdarah Dengue (DBD) Di Kota Purwokerto Jawa -Tengah. Program Pasca Sarjana Universitas Diponegoro Semarang. Universitas Diponegoro; 2007.

33. Menanti L, Azizah R, Latif MT, Leonita A, Sumantri A, Jauharoh SN. Analisis Perilaku Keluarga Dengan Kejadian Infeksi Saluran Pernapasan Akut (ISPA) Pada Balita Di Indonesia. J Kesehat Fak Kesehat Univ Dian Nuswantoro. 2022;21(2):282–92.

34. Anjaswanti RN, Azizah R, Leonita A. Studi Meta-Analisis: Faktor Risiko Kejadian Pneumonia Pada Balita Di Indonesia Tahun 2016-2021. J Community Ment Heal Public Policy. 2022;4(2):56–70.

35. Card NA. Applied Meta-Analysis For Social Science Research. Little Td, Editor. New York London: The Guilford Press; 2011.

36. Rose DH, Harbour WS, Johnston CS, Daley SG, Abarbanell L. Universal Design For Learning In Postsecondary Education: Reflections On Principles And Their Application. J Postsecond Educ Disabil. 2006;19(2):135–51.

37. Sucipto Pt, Raharjo M, Nurjazuli. Dynamical Degrees Of (Pseudo)-Automorphisms Fixing Cubic Hypersurfaces. J Kesehat Lingkung Indones. 2015;14(2):51–6.

38. Anggraini S. Hubungan Keberadaan Jentik Dengan Kejadian DBD Di Kelurahan Kedurus Surabaya. J Kesehat Lingkung [Internet]. 2018;10(3):252–8.

39. Yunita J, Mitra M, Susmaneli H. Pengaruh Perilaku Masyarakat Dan Kondisi Lingkungan Terhadap Kejadian Demam Berdarah Dengue. J Kesehat Komunitas. 2012;1(4):193–8.

40. Sari R, Anifatmawati A. Menurunkan Kejadian Demam Berdarah Dengue Dengan Pengetahuan Dan Pelaksanaan Pencegahan. J Kesehat Metro Sai Wawai. 2017;10(2):67.

41. Nurrochmawati I, Dharmawa R, Pawito. Biological, Physical, Social, And Environmental Factors Associated With Dengue Hemorrhagic Fever In Nganjuk, East Java. J Epidemiol Public Heal. 2017;02(02):94–106.

42. Medeiros-Sousa AR, de Oliveira-Christe R, Camargo AA, Scinachi CA, Milani GM, Urbinatti PR, Natal D, Ceretti-Junior W, Marrelli MT. Influence of water's physical and chemical parameters on mosquito (Diptera: Culicidae) assemblages in larval habitats in urban parks of Sao Paulo, Brazil. Acta tropica. 2020 May 1;205:105394.

43. Clark TM, Vieira MA, Huegel KL, Flury D, Carper M. Strategies for regulation of hemolymph pH in acidic and alkaline water by the larval mosquito Aedes aegypti (L.)(Diptera; Culicidae). Journal of Experimental Biology. 2007 Dec 15;210(24):4359-67.

44. Clark TM, Flis BJ, Remold SK. pH tolerances and regulatory abilities of freshwater and euryhaline Aedine mosquito larvae. Journal of Experimental Biology. 2004 Jun 1;207(13):2297-304.

45. Clark TM, Flis BJ, Remold SK. Differences in the effects of salinity on larval growth and developmental programs of a freshwater and a euryhaline mosquito species (Insecta: Diptera, Culicidae). Journal of Experimental Biology. 2004 Jun 1;207(13):2289-95.

46. Reinhold JM, Lazzari CR, Lahondère C. Effects Of The Environmental Temperature On Aedes Aegypti And Aedes Albopictus Mosquitoes: A Review. Insects. 2018;9(4):1–17.

47. Eisen L, Moore Cg. Aedes (Stegomyia) Aegypti In The Continental United States: A Vector At The Cool Margin Of Its Geographic Range. J Med Entomol. 2013;50(3):467–78.

48. Saleh F, Kitau J, Konradsen F,

Alifrangis M, Lin CH, Juma S, Mchenga SS, Saadaty T, Schiøler KL. Habitat characteristics for immature stages of Aedes aegypti in Zanzibar city, Tanzania. Journal of the American Mosquito Control Association. 2018 Sep 1;34(3):190-200.

49. Saleh F, Kitau J, Konradsen F, Kampango A, Abassi R, Schiøler KL. Epidemic risk of arboviral diseases: Determining the habitats, spatial-temporal distribution, and abundance of immature Aedes aegypti in the Urban and Rural areas of Zanzibar, Tanzania. PLoS neglected tropical diseases. 2020 Dec 7;14(12):e0008949.

50. Nikookar SH, Fazeli-Dinan M, Azari-Hamidian S, Mousavinasab SN, Aarabi M, Ziapour SP, Esfandyari Y, Enayati A. Correlation between mosquito larval density and their habitat physicochemical characteristics in Mazandaran Province, northern Iran. PLoS neglected tropical diseases. 2017 Aug 18;11(8):e0005835.

51. Hery L, Guidez A, Durand AA, Delannay C, Normandeau-Guimond J, Reynaud Y, Issaly J, Goindin D, Legrave G, Gustave J, Raffestin S. Natural variation in physicochemical profiles and bacterial communities associated with Aedes aegypti breeding sites and larvae on Guadeloupe and French Guiana. Microbial ecology. 2021 Jan;81:93-109.

52. Alkhayat FA, Ahmad AH, Rahim J, Dieng H, Ismail BA, Imran M, Sheikh UA, Shahzad MS, Abid AD, Munawar K. Charaterization of mosquito larval habitats in Qatar. Saudi journal of biological sciences. 2020 Sep 1;27(9):2358-65.

53. Hidayah N, Rahmawati D. The Differences Analysis Of Temperature, Salinity, And Dissolved Oxygen Of Aedes Aegypti Breeding Place Water In Endemic And Non-Endemic Areas. Berk Kedokt. 2019;15(2):89.

54. Hidayah N, Rahmawati D. The Water pH Levels in Breeding Places Associated with The Presence of Larva Aedes Aegypti in Endemic and Non-Endemic Areas of Dengue Hemorrhagic Fever (DHF). InICER-PH 2018: Proceedings of the 3rd International Conference on Environmental Risks and Public Health, ICER-PH 2018, 26-27, October 2018.

55. Masrizal, Sari NP. Analisis Kasus DBD Berdasarkan Unsur Iklim Dan Kepadatan Penduduk Melalui Pendekatan Gis Di Tanah Datar. J Kesehat Masy Andalas. 2016;10(2):166–71.

56. Widjaja J. Keberadaan Kontainer Sebagai Faktor Risiko Penularan Demam Berdarah Dengue Di Kota Palu , Sulawesi Tengah The Existence Of Water Container As Risk Factors The Transmission Of Dengue Hemorrhagic Fever (DHF) In Palu Central Sulawesi Province. Aspirator. 2006;3(2):82–8.

57. Ishak H, Aisyah AS, Mallongi A, Astuti RD. Risk factors and fogging effectiveness of dengue hemorrhagic fever incidence in the Pontap Public Health Center area in Palopo City, Indonesia. Enfermeria clinica. 2020 Jun 1;30:294-7.