DETERMINANTS OF PHYSICAL ENVIROMENTAL CONDITIONS OF THE HOUSE ON THE RISK OF DENGUE FIVER INCIDENTS

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Abstract

Dengue hemorrhagic fever (DHF) remains a major public health problem in tropical countries, including Indonesia. The high incidence of DHF is closely linked to physical environmental conditions in homes that support the breeding of Aedes aegypti, the vector that transmits the disease. Various factors, such as water storage containers, ventilation, lighting, humidity, drainage, environmental cleanliness, vegetation, and household sanitation conditions, play a role in either increasing or decreasing the risk of DF. This study aims to identify the determinants of the physical environmental conditions of homes that most significantly influence the risk of DF based on a literature review. The study employed a Literature Review method using Narrative Synthesis and Thematic Synthesis approaches. Articles were searched in the PubMed, ScienceDirect, OpenAlex, Springer Nature Link, Neliti, and Garuda databases using the keywords "Dengue" AND "Household Environment" OR "Risk Factors." Of the 65 articles identified, 25 met the inclusion criteria and were analyzed. The results of the study indicate that the presence of open water storage containers is the most dominant factor associated with an increased risk of dengue fever. Additionally, poor drainage, standing water, inadequate home ventilation and lighting, high humidity, poor sanitation, poor environmental hygiene, and vegetation around the home also contribute to the increased presence of Aedes aegypti and the risk of dengue transmission. Conversely, physical housing conditions that meet health standards have been shown to reduce the risk of dengue fever outbreaks. Therefore, improving physical housing conditions through the management of water storage containers, improved sanitation, better ventilation and drainage, and community empowerment are key strategies in dengue fever prevention and control efforts.

Keyword: *Dengue; Household Environment; Risk Factors; Housing Condition; Aedes aegypti*

INTRODUCTION

Dengue hemorrhagic fever (DHF) remains a serious public health problem in tropical and subtropical regions, including Indonesia. According to the World Health Organization (2023), there are more than 390 million cases of DF each year, with about 70% occurring in Southeast Asia. The disease is transmitted through the bite of the Aedes aegypti mosquito, which breeds in residential environments, particularly in clean water storage containers. Therefore, the physical conditions of the home play a crucial role in determining the risk of DF transmission.

In Indonesia, dengue fever was first reported in 1968 and has since spread to all provinces. According to data from the Ministry of Health of the Republic of Indonesia (2024), as of the 41st week of 2024, there were 203,921 reported cases of dengue fever, resulting in 1,210 deaths. These high incidence rates indicate that dengue control depends not only on vector control efforts but is also influenced by physical housing conditions that do not meet health standards.

Various studies have shown that physical environmental factors in the home are associated with the risk of dengue fever. Iryanti et al. (2024) and Rahman et al. (2023) reported that insufficient lighting, poor ventilation, high humidity, and the presence of open water containers increase the risk of Aedes aegypti breeding. Furthermore, Ginting (2017) states that homes with inadequate ventilation have a 6.2 times higher risk of dengue fever compared to homes that meet health standards.

Other factors such as drainage systems, standing water, environmental hygiene, and housing conditions also contribute to an increased risk of dengue fever. A study by Septia Lisa et al. (2022) showed that poor drainage and standing water increase the risk of dengue fever, while Rosser et al. (2025) reported that proper water management and drainage can reduce the risk of infection. On the other hand, Peña-García et al. (2023), Evans et al. (2019), and Ha et al. (2021) found that housing conditions, high humidity, and inadequate ventilation and lighting support the proliferation of Aedes aegypti.

Although various studies have examined the relationship between the physical environmental conditions of homes and the incidence of dengue fever, the findings remain scattered across various environmental factors and thus have not yet provided a comprehensive picture of the factors that most significantly influence the incidence of dengue fever. Therefore, this sticle aims to identify and analyze the determinants of the physical environmental conditions of homes on the risk of dengue fever incidence through a literature review. The results of this study are expected to serve as a basis for developing environment-based intervention recommendations as part of efforts to prevent and control dengue fever.

RESEARCH METHODS

This study employed a literature review method using a narrative synthesis approach combined with thematic synthesis to identify and analyze the determinants of the physical environment of homes in relation to the risk of dengue fever (DF). The Narrative Synthesis approach was used to systematically integrate research findings, while Thematic Synthesis was used to identify key themes emerging from various studies, thereby providing a more comprehensive understanding of the physical environmental factors in homes associated with DF cases.

A literature search was conducted using six databases-PubMed, ScienceDirect, OpenAlex, Springer Nature Link, Neliti, and Garuda-using the keywords "Dengue" AND "Household Environment" OR "Risk Factors." Articles were selected based on the following inclusi criteria: (1) they discussed the relationship between physical household environmental factors and the incidence of dengue hemorrhagic fever (DHF); (2) they were original research articles; (3) they were published between 2016 and 2025; (4) they were available in full text: and (5) they were written in Indonesian or English. Articles that were irrelevant to the topic, non-scientific, duplicates, or not available in full text were excluded from the selection process. The search yielded 25 articles that met the inclusion criteria for analysis. Next, data were extracted based on the articles' characteristics, including authors, year of publication, research location, study design, sample size, physical environmental variables of the homes studied, and the main findings of the studies. A descriptive analysis was conducted using Narrative Synthesis by comparing, grouping, and interpreting the findings from each article. Subsequently, Thematic Synthesis was performed to identify themes, patterns, similarities, and differences in the research results, thereby providing an overview of the most dominant physical environmental factors in the home associated with the risk of dengue fever.

RESEARCH RESULTS

Of the twelve articles reviewed, it was found that the majority indicated a significant association between the physical environmental conditions of homes and the incidence of dengue fever. Homes with open water storage have a higher risk of harboring Aedes aegypti larvae. In addition, the presence of standing water due to poor drainage systems further increases the likelihood of transmission. The most dominant factor influencing dengue fever incidence in most of the articles was open water storage.

Table 1. Results of the following PRISMA steps

No	Nama Penulis, Tahun	Judul Artikel	Metode Penelitian	Variabel Utama	Hasil Utama
1.	(Ngugi et al., 2020)	Risk factors for Aedes aegypti household pupal persistence in longitudinal entomological household surveys in urban and rural Kenya.	This study is a longitudinal observational study (repeated entomological surveys of the same households).	Vegetation, open eaves, water containers	Vegetation and open eaves enhance pupal persistence.
2.	(Paul et al., 2018)	Risk factors for the presence of dengue vector mosquitoes, and determinants of their prevalence and larval site selection in Dhaka, Bangladesh.	This study is a cross-sectional, multi-year entomological survey.	Water feature, vegetation, shaded areas	Rainwater containers and shaded locations were at high risk for Aedes larvae
3.	(Kenneson et al., 2017)	Social-ecological factors and preventive actions decrease the risk of dengue infection at the household-level: Results from a prospective dengue surveillance study in Machala, Ecuador.	This research is a prospective study based on household surveillance (prospective observational).	Abandoned property, shaded patio, water supply	Shady patios and disrupted water supplies increase the risk of dengue fever.
4.	(Swain et al., 2020)	*Risk factors for dengue outbreaks in Odisha, India: A case–control study*.	This type of research is an observational case-control study.	Standing water, open containers, drainage	Stagnant water and open water containers increase the risk of Dengue Hemorrhagic Fever.
5.	(Martin et al., 2021)	*Household and climate factors influence Aedes aegypti presence in the arid city of Huaquillas, Ecuador.*	This study is an observational analytic (cross-sectional) study.	Water supply, sanitation, ventilation	Irregular water supply increases the risk.

6.	*(Da Cruz Ferreira et al., 2017)*	*Meteorological variables and mosquito monitoring are good predictors for infestation trends of Aedes aegypti.*	This study is an observational analytic study with a cross-sectional design based on entomological surveillance combined with household environmental data.	Water containers, stagnant water, yard cleanliness.	Open water containers & significant pools of water.
7.	*(Madewell et al., 2019)*	*Associations between Household Environmental Factors and Immature Mosquito Abundance in Quetzaltenango, Guatemala*	An analytical observational study with a cross-sectional design based on a household entomological survey.	Distance of the house, number of water containers, location of containers	Houses located close to the road and possessing a greater number of water containers exhibited a higher abundance of *Aedes aegypti* larvae and pupae.
8.	*(Souza et al., 2023)*	*Density of Aedes aegypti in a Low-income Brazilian Urban Community*	Longitudinal observational study using a household environment survey.	Water containers, vegetation, organic matter, container location	Open water containers containing organic matter and surrounded by vegetation are associated with the presence of Aedes aegypti larvae.
9.	*(Baskoro et al., 2017)*	*Environmental Factors of the Home Affect the Density of Aedes aegypti*	An analytical observational study with a cross-sectional design.	Ventilation, lighting, humidity, vegetation, landfill, drainage.	Ventilation, lighting, humidity, vegetation, the number of water storage containers, and drainage are significantly associated with Aedes aegypti density.
10.	*(Mantilla-Granados et al., 2025)*	*Environmental and anthropic factors influencing Aedes aegypti and Aedes albopictus (Diptera: Culicidae), with emphasis on natural infection and*	Observational entomological research involving urban environmental surveys in residential areas.	Drainage, water pooling, house structure, vegetation	Poor drainage, stagnant water, structural characteristics of houses, and vegetation surrounding residences are

		dissemination: Implications for an emerging vector in Colombia			associated with the increased distribution of Aedes aegypti in urban environments.
11.	*(Vásquez-Trujillo et al., 2021)*	*House-Level Risk Factors for Aedes aegypti Infestation in the Urban Center of Castilla la Nueva, Meta State, Colombia*	An analytical observational study with a cross-sectional design using a household entomological survey.	Water storage facilities, open water containers, drainage systems, pools of stagnant water	The number of water storage sites, the presence of open water containers, stagnant water, and poor drainage are significantly associated with increased Aedes aegypti infestation.
12.	*(Akagankou et al., 2025)*	*Widespread Distribution of Aedes aegypti Larvae, a Potential Risk of Arbovirus Transmission in the Grand Lomé Health Region, Togo, West Africa*	An observational entomological study involving field surveys using ovitraps to identify the distribution of Aedes aegypti larvae.	Season, administrative region	Aedes aegypti larval density is higher during the rainy season than the dry season, with a higher distribution of larvae in the Golfe area compared to Agoè-Nyivé.
13.	(Chahaya et al., 2023)	*Analysis of Household Environmental Factors and the Presence of Aedes aegypti Larvae (A Study in Tebing Tinggi Urban Village).*	This study is an analytical observational study with a cross-sectional design.	Number of waste disposal sites, water containers, and pools of stagnant water	Having more than three waste disposal sites and open containers increases the risk.
14.	(Sari et al., 2017)	*The Relationship Between the Physical Home Environment and the Incidence of Dengue Hemorrhagic Fever in Semarang*	This study is an observational analytic study with a case-control design.	Ventilation, lighting, humidity	Low light & significant high humidity.
15.	(Triwahyuni et al., 2020)	*The Relationship Between Household Environmental Conditions and the Presence of Aedes aegypti Larvae*	This study is observational, employing an analytical cross-sectional approach.	Standing water, ventilation,	Stagnant water is significantly associated with the presence of larvae.

				ornamental plants	
16.	(Mawaddah et al., 2022)	*Analysis of the Relationship Between Environmental Sanitation Conditions, Behavior, and the Presence of Aedes aegypti Larvae in Sungai Jawi Luar Urban Village, Pontianak City.*	This study is an observational analytic study with a cross-sectional approach.	Landfill, wastewater drainage system, trash receptacles	Poorly managed landfills and wastewater drainage systems increase risk.
17.	(Maharani et al., 2024)	*The Relationship Between Environmental Sanitation and the Presence of *Aedes* Mosquito Larvae in the Working Area of the Umbulharjo I Community Health Center, Yogyakarta City.*	This study is an analytical observational study with a cross-sectional approach.	Landfill, ventilation, lighting	Landfills and poor lighting are significant factors.
18.	(Handoyo et al., 2015)	*The Relationship of Sociodemographic Factors and the Physical Environment with the Incidence of Dengue Hemorrhagic Fever (DHF) among Coastal Communities in Tarakan City (A Case Study in the Buffer Zone of the Class II Port Health Office of Tarakan).*	This study is an analytical observational study with a cross-sectional survey approach.	Larvae, housing density, lighting	The presence of larvae increases the risk of Dengue Hemorrhagic Fever (DHF).
19.	(Win Erwina et al., 2025)	*Analisis Determinan Kejadian Demam Berdarah Dengue di Wilayah Kerja UPT BLUD Puskesmas Kaliorang Kutai Timur*	Penelitian observasional analitik dengan desain case–control.	Breeding place, resting place, kepadatan penduduk	Keberadaan breeding place, resting place, dan kepadatan penduduk berhubungan signifikan dengan kejadian DBD. Rumah yang memiliki breeding place dan resting place berisiko lebih tinggi mengalami DBD.
20.	(Catur Putra et al., 2019)	*The Relationship Between Environmental Conditions and the Presence of *Aedes aegypti* Larvae in Wooden Furniture Home Industries in Ngasem Village,*	An analytical observational study with a cross-sectional design.	Water storage containers, pools of stagnant water,	Water storage containers, pools of stagnant water, and environmental conditions are significantly

		Batealit District, Jepara Regency, in 2017		environmental conditions	associated with the presence of Aedes aegypti larvae.
21.	(Irawan, 2024)	*Overview of the Physical Environment and 3M Practices in the Homes of Dengue Hemorrhagic Fever (DHF) Patients in Wonosari Jaya Urban Village, Wania District*	Descriptive quantitative research.	Indoor temperature, humidity, screened ventilation, occupancy density, breeding sites	Most homes of Dengue Hemorrhagic Fever (DHF) patients had temperatures above 25°C, humidity levels of 40–60%, and adequate ventilation and occupancy density; however, breeding sites were still found in 50% of the homes.
22.	(Sarwita et al., 2018)	*Analysis of the Relationship Between Physical Environmental Factors and the Abundance of *Aedes aegypti* Mosquitoes in Bandung City*	An ecological study with a cross-sectional approach.	Ventilation area, occupancy density, temperature, humidity, roof type, gutters, water storage containers	Water storage containers testing positive for larvae were significantly associated with the number of Aedes aegypti mosquitoes, whereas other physical environmental factors did not show a significant association.
23	(Daary & Haryanto, 2021)	*The Relationship Between Aedes aegypti Mosquito Density in Homes and the Incidence of Dengue Hemorrhagic Fever (DHF) in Tegal Alur Urban Village, Kalideres District, West Jakarta*	An analytical observational quantitative study with a cross-sectional design.	Use of air conditioning, presence of larvae in water storage containers	The use of air conditioning is significantly associated with the incidence of Dengue Hemorrhagic Fever (DHF), whereas the presence of larvae in water storage containers is not significantly associated.
24.	(Kusuma Mamonto et al., 2025)	*The Relationship Between Physical Environmental Factors and the Incidence of Dengue Hemorrhagic Fever (DHF) in the Working Area of the Motoboi Kecil*	An observational study with a case-control design.	Room temperature, humidity, lighting,	Room temperature, lighting, and the presence of larvae in water storage containers are significantly associated with the incidence of

		Community Health Center, South Kotamobagu District		presence of larvae	Dengue Hemorrhagic Fever (DHF), whereas humidity does not show a significant association.
25.	(Jannah et al., 2021)	*The Relationship Between the Physical Environment and the Presence of Aedes sp. Larvae in Balleanging Urban Village, Balocci District, Pangkep Regency*	An analytical observational quantitative study with a cross-sectional design.	Air temperature, air humidity, light intensity	Air humidity and light intensity are significantly associated with the presence of Aedes sp. larvae, whereas air temperature does not show a significant relationship.

The table above presents the twelve articles analyzed in this literature review, including the study locations, the physical housing conditions examined, and the main findings related to the risk of dengue fever. Most studies showed a significant association between physical housing conditions-particularly open water storage containers, poor drainage systems, inadequate lighting, and high humidity-and an increased risk of dengue fever.

DISCUSSION

The results of the literature review indicate that water storage containers are the most significant physical environmental factor in homes associated with the risk of dengue fever (DF). Most studies show that open water containers and poorly managed water storage containers serve as the primary breeding sites for Aedes aegypti. These findings are supported by Ngugi et al. (2020), Swain et al. (2020), Da Cruz Ferreira et al. (2017), Paul et al. (2018), Mawaddah et al. (2022), Chahaya et al. (2023), Maharani et al. (2024), and Martin et al.(2021). These results are consistent with the WHO (2009), which states that various water storage containers are the primary breeding sites for Aedes aegypti larvae.

In addition, drainage and standing water also contribute to an increased risk of dengue fever. Poor drainage systems lead to the formation of standing water, which serves as a potential habitat for mosquitoes to lay eggs and breed. These findings are consistent with the research by Swain et al. (2020), Triwahyuni et al. (2020), Mawaddah et al. (2022), and Martin et al. (2021), and are supported by Delita et al. (2022), who explain that standing water is an important breeding site for Aedes aegypti.

Other factors that contribute to the incidence of dengue fever include environmental cleanliness, ventilation, lighting, vegetation, sanitation, and humidity. An unclean environment with a lot of solid waste has the potential to provide water-holding containers for mosquitoes. Inadequate ventilation, low lighting, and high humidity create microclimatic conditions that support the survival of Aedes aegypti. In addition, dense vegetation provides resting places, while poor environmental sanitation increases the likelihood of mosquito breeding habitats forming. These findings are consistent with the research by Sari et al. (2017), Ngugi et al. (2020), Kenneson et al. (2017), Martin et al. (2021), as well as WHO theories (2009; 2018).
Overall, the results of the synthesis indicate that the physical environmental conditions of a home play a significant role in determining the risk of dengue fever. Water storage containers are the most dominant factor, followed by drainage and standing water, environmental cleanliness, ventilation and lighting, vegetation, sanitation, and air humidity. Therefore, dengue fever prevention efforts should focus on managing water storage containers, improving drainage and sanitation, and enhancing environmental cleanliness to reduce breeding habitats for Aedes aegypti.

CONCLUSION

Based on the results of a literature review of 25 articles, it can be concluded that the physical environmental conditions of a home play a significant role in the risk of Dengue Hemorrhagic Fever (DHF). Water storage containers are the most dominant factor because they are most consistently associated with the presence of Aedes aegypti larvae and an increased risk of DHF. In addition, drainage and standing water, environmental cleanliness and waste management, home ventilation and lighting, vegetation around the home, environmental sanitation, and air humidity also contribute to an increased risk of DF. Therefore, comprehensive efforts to prevent DF are necessary through the management of the physical environment of homes, control of mosquito breeding sites, improvements in sanitation and drainage, and increased community participation in maintaining environmental cleanliness.

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