IJTMGH International Journal of Travel Medicine and Global Health

Int J Travel Med Glob Health. 2025 Sep;13(3):129-134 doi 10.30491/ijtmgh.2024.487943.1441
http://ijtmgh.com

Review Article Open Access

Aedes Mosquito and Dengue Fever: A Dangerous Connection in Global Health, A review article

Zahra Moghadam[1], Bita Avarki[1], Zahra Falah Parvizi[1], Parinaz Rabiee[1], Shabnam Bahrami*[1]

[1] Department of Biology, Shahr-e-Qods Branch, Islamic Azad University, Tehran, Iran.

***Corresponding Author:** Shabnam Bahrami, Ph. D in Molecular Cell Biology, Department of Molecular Cell Biology and Genetics, Shahr-e-Qods Branch, Islamic Azad University, Tehran, Iran. Email: shbahrami68@gmail.com.

Received 2024-10-09; **Accepted** 2025-07-06; **Online Published** 2025-09-01

Abstract

Dengue fever is a viral disease primarily transmitted by Aedes mosquitoes, particularly Aedes aegypti and Aedes albopictus. It is endemic in tropical and subtropical regions, notably Southeast Asia and Latin America, affecting millions of people annually. The disease presents with symptoms such as high fever, severe headaches, and joint pain, and can lead to severe complications like dengue hemorrhagic fever and dengue shock syndrome. The increasing global travel to these endemic areas poses a significant risk for travelers, who may contract the virus and inadvertently introduce it to non-endemic regions. As climate change expands the habitats of Aedes mosquitoes, the potential for dengue outbreaks in new areas rises. Understanding the characteristics of dengue fever, the life cycle of its vectors, and effective prevention strategies is crucial for mitigating its impact on global health. A comprehensive literature search was conducted using the PubMed, Embase, and Web of Science databases to identify relevant studies related to Dengue Fever, Aedes Mosquitoes, Travel-Related Diseases, and Diagnosis. The search was limited to articles published until 2024. This article aims to provide a comprehensive overview of these aspects to enhance awareness and promote preventive measures among travelers.

Keywords: Dengue Fever, Aedes Mosquitoes, Travel-Related Diseases, Diagnosis.

Citation: Moghadam Z, Avarki B, Falah Parvizi Z, Rabiee P, Bahrami. Aedes Mosquito and Dengue Fever: A Dangerous Connection in Global Health, A review article. Int J Travel Med Glob Health, 2025;13(3):129-134. doi: 10.30491/ijtmgh.2024.487943.1441

Introduction

Dengue fever is a major public health issue caused by any of the four serotypes of the dengue virus (DENV-1, DENV-2, DENV-3, and DENV-4).[1] It is primarily spread to humans through bites from infected female Aedes mosquitoes, especially Aedes aegypti and Aedes albopictus.[2] This mosquito-borne illness is prevalent in tropical and subtropical regions, impacting nearly one-third of the global population and resulting in millions of infections each year.[3] Over the past few decades, the incidence of dengue has dramatically increased, with reports indicating a 30-fold rise in cases over the last fifty years.[4] Epidemics typically align with seasonal climate variations, particularly after rainy periods, leading to thousands of reported cases during outbreaks.[5]

Dengue fever can present itself in various forms, from mild and asymptomatic cases to severe manifestations such as dengue hemorrhagic fever (DHF) and dengue shock syndrome (DSS), which can be life-threatening.[6] The management of dengue is complicated by the existence of multiple serotypes; while infection with one serotype grants lifelong immunity against that specific strain, it also leaves individuals at risk for severe illness if infected by other serotypes later on.[7]

Despite progress in medical research, including vaccine development, effective treatment options remain scarce. Current management approaches focus on supportive care and fluid replacement therapy since there is no specific antiviral treatment available for dengue. The critical monitoring period for patients generally occurs between 48 to 72 hours after symptoms begin, as this is when the risk of severe complications significantly escalates.[8]

The rising rates of dengue infections are linked to several factors, including rapid urban growth, increased international travel, ineffective mosquito control strategies, and climate change. Consequently, dengue has become endemic in over 128 countries, mainly in developing nations where healthcare systems are often overwhelmed during outbreaks. There is an urgent need for enhanced vector control strategies—ranging from the physical elimination of breeding sites to biological methods utilizing bacteria such as *Bacillus thuringiensis* to help reduce transmission rates.[9]

Aedes aegypti is a mosquito species that holds significant public health importance due to its role in transmitting various arboviruses including dengue, chikungunya, and Zika. The emergence of the Zika virus in Brazil in 2015 underscored the growing risk of co-infection and the rapid dissemination of these viruses facilitated by Aedes mosquitoes.[10] The high efficiency of Aedes aegypti as a vector, combined with its preference for human hosts and adaptability to urban settings, intensifies the public health challenges posed by these diseases.

The biological lifecycle of Aedes aegypti includes distinct stages: eggs, larvae (which go through four instars), pupae, and adults. The eggs are particularly hardy and can survive desiccation for up to a year, presenting a significant challenge for controlling mosquito populations. The protective features of the egg chorion assist in gas exchange while minimizing water loss, contributing to their longevity.[11]

Method

A comprehensive literature search was conducted using the PubMed, Embase, and Web of Science databases to identify relevant studies related to Dengue Fever, Aedes Mosquitoes, Travel-Related Diseases, and Diagnosis. The search was limited to articles published until 2024. The following keywords were utilized in various combinations: "Dengue Fever," "Aedes Mosquitoes," "Travel-Related Diseases," and "Diagnosis." Boolean operators (AND, OR) were employed to refine the search results and ensure a thorough retrieval of pertinent literature. Inclusion criteria for the selected studies comprised peer-reviewed articles, clinical trials, and reviews that focused on the epidemiology, transmission dynamics, diagnostic methods, or treatment approaches associated with Dengue Fever. Studies that did not provide relevant data or were not published in English were excluded from the analysis. The search results were systematically screened based on titles and abstracts, followed by a full-text review of potentially eligible articles to ensure their relevance to the research objectives. Data extraction was performed to summarize key findings related to the impact of Aedes mosquitoes on Dengue transmission and associated travel-related health risks.

Life Cycle of Aedes Mosquitoes

The life cycle of Aedes mosquitoes consists of four distinct stages: egg, larva, pupa, and adult. The process begins when a female Aedes mosquito lays her eggs on the inner walls of containers that hold stagnant water.[12] These eggs are resilient and can survive dry conditions for several months, hatching when submerged in water. Once the eggs hatch, the larvae emerge as tiny, wiggle-like creatures that live in water. They go through four instar stages, growing larger with each molt. During this time, they feed on organic matter and microorganisms present in the water. After the larval stage, the mosquitoes enter the pupal stage. Pupae are also aquatic and are often described as "tumbling" because they move in a distinctive manner when disturbed. This stage lasts about 1 to 2 days before the adult mosquito emerges. Finally, the adult Aedes mosquito is fully formed and ready to reproduce. Males do not bite humans; they feed on nectar and plant juices, while females require a blood meal to develop their eggs. After mating, females seek out suitable water sources to lay their eggs, thus continuing the cycle. Understanding this life cycle is crucial for implementing effective control measures to reduce the population of Aedes mosquitoes and prevent the transmission of diseases such as dengue fever. [13] The life stages of Aedes mosquitoes are depicted in Image 1.

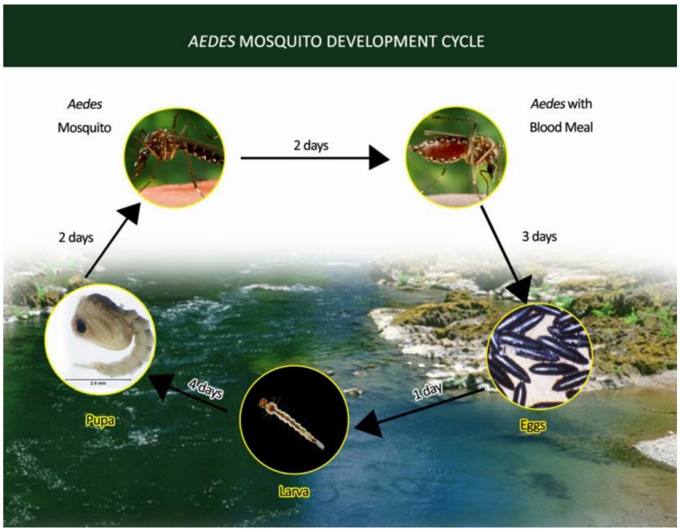

Figure 1. illustrating the four distinct phases: egg, larva, pupa, and adult. This cycle begins with the female laying eggs in stagnant water, which can survive dry conditions for months. Upon hatching, larvae emerge and feed in the water, progressing through several instar stages before transforming into pupae. Finally, adult mosquitoes emerge from the pupae and are ready to reproduce. [14]

Transmission of Dengue Virus

The dengue virus is primarily spread by the Aedes mosquito, especially the species Aedes aegypti.[15] These mosquitoes are typically found in regions between 35 degrees north and 35 degrees' south latitude and at elevations below 1,000 meters.[16] They are known for their daytime feeding habits, making them significant vectors for transmitting diseases. A single bite from an infected mosquito can result in dengue infection in humans. Interestingly, humans can also pass the dengue virus back to mosquitoes. When a female mosquito feeds on an infected individual, the virus enters the mosquito's body. Initially, it resides in the abdominal cells of the mosquito. After approximately 8 to 10 days, the virus moves to the salivary glands, where it becomes incorporated into the saliva produced by the mosquito.[17] Consequently, when this mosquito bites another human, it injects saliva containing the dengue virus, thereby infecting the new host. Aedes aegypti mosquitoes are particularly effective at transmitting dengue due to their close association with human environments and their preference for feeding on humans instead of animals. Additionally, they lay their eggs in artificial water sources, which facilitates their reproduction.[18]

Beyond mosquito bites, dengue can also be transmitted through contaminated blood and organ donations. If an infected person donates blood or an organ, there is a risk that the recipient may contract dengue fever. In certain countries like Singapore, rates of dengue transmission via blood transfusions have been recorded at 1.6 to 6 cases per 10,000 transfusions. Vertical transmission from mother to child during pregnancy or childbirth is another possibility that poses additional risks for newborns.[19] In summary, Aedes aegypti plays a crucial role in the transmission of dengue fever through its interactions with humans and its adaptability to urban settings. Understanding these transmission dynamics is essential for developing effective prevention and control strategies against this significant public health threat.

Mechanism of Dengue Virus Infection

The dengue virus is primarily transmitted through the bites of Aedes mosquitoes, especially Aedes aegypti. When an infected mosquito bites a human, its saliva enters the person's bloodstream. If the mosquito carries the dengue virus, it will also be present in the saliva. This facilitates the transmission of the virus into the human host. Once inside, the virus attaches to and infiltrates white blood cells, which are crucial for the body's defense against infections. As these white blood cells circulate throughout the body, the virus replicates, generating numerous copies of itself. In response to this viral replication, white blood cells release proteins known as cytokines, such as interleukin, interferon, and tumor necrosis factor. These cytokines contribute to symptoms commonly associated with dengue fever, including fever, cold-like symptoms, and intense pain.[20]

In cases of severe infection, the virus replicates more rapidly within the host's body. This increased viral load heightens the risk of infecting additional organs, including the liver and bone marrow. Consequently, fluids from the bloodstream can leak through the walls of small blood vessels into body cavities, resulting in decreased circulation within blood vessels. This leads to a significant drop in blood pressure, which hampers the heart's ability to pump sufficient blood to vital organs. Moreover, the bone marrow's capacity to produce adequate platelets for proper blood clotting is compromised. Hemorrhaging becomes a major complication of dengue and is one of the most serious issues associated with this disease. In summary, understanding how Aedes mosquitoes transmit dengue fever through their interactions with humans is crucial for developing effective prevention and control strategies against this significant public health threat.[21]

Diagnosis of Dengue Fever

Dengue fever is typically diagnosed by healthcare professionals through a physical examination and by comparing the patient's symptoms to those associated with the disease. The accuracy of diagnosing dengue using this method is notably high in regions where the disease is endemic. However, in the initial stages of infection, distinguishing dengue from other viral illnesses can be quite challenging. If a patient present with fever along with two additional symptoms such as nausea, vomiting, skin sensitivity, generalized pain, a decrease in white blood cell count, or a positive tourniquet test, there is a strong likelihood of dengue infection, particularly in areas where it is common. Warning signs often emerge prior to an increase in the severity of the disease.[22]

In situations where laboratory testing is unavailable, the tourniquet test may be utilized. During this procedure, a healthcare provider applies a blood pressure cuff to the patient's arm for five minutes and counts any red spots that appear on the skin. A higher number of red spots indicates a greater probability of dengue infection. Differentiating dengue from chikungunya can be difficult due to their similar symptoms and overlapping geographic distributions. Additionally, dengue can present symptoms akin to those of other diseases such as malaria, leptospirosis, typhoid fever, and meningococcal disease. Before diagnosing dengue, specialists typically ensure that the patient does not have any of these alternative illnesses.[23]

The first laboratory finding in patients with dengue is usually a decrease in white blood cell count. Other indicators may include reduced platelet counts and metabolic acidosis. In more severe cases of infection, further changes may be evident in blood tests. Acute dengue leads to fluid leakage from the bloodstream, resulting in hemoconcentration (a condition where plasma volume decreases while red blood cell concentration increases) and lowered serum albumin levels. Acute dengue may also cause pleural effusion (fluid accumulation around the lungs) and ascites (fluid accumulation in the abdominal cavity). If these effusions are significant enough, they can be detected during a physical examination. Ultrasound imaging can assist in identifying fluid accumulation within the body, facilitating early diagnosis of dengue shock syndrome. However, access to ultrasound equipment is often limited in many endemic regions.[24]

Dengue Vector Control Strategies

Controlling dengue vector populations is crucial for mitigating the transmission of dengue fever. Various methods can be employed, including the use of chemical insecticides, biological control methods, and physical strategies.[25]

Chemical insecticides play a significant role in vector control. Commonly used insect repellents, such as DEET (N,N-diethyl-meta-toluamide) and picaridin, can effectively reduce mosquito bites when applied to the skin and clothing. Additionally, environmental spraying of insecticides in residential areas and public spaces can help decrease mosquito populations. This spraying should be conducted periodically to maintain its effectiveness. Liquid and aerosol insecticides can also be utilized indoors, particularly in homes and healthcare facilities, to minimize the risk of mosquito bites.[26]

Biological control methods offer sustainable alternatives for managing mosquito populations. One effective approach involves using larvivorous fish species, such as Gambusia, which can consume mosquito larvae in natural and artificial water bodies. This method has been recognized as a sustainable strategy for reducing mosquito populations in high-risk areas. Another promising biological method involves the use of bacteria like *Bacillus thuringiensis israelensis* , which can effectively kill mosquito larvae without harming other aquatic organisms. Physical strategies are also essential in controlling dengue vectors. One of the most critical actions is the removal or covering of stagnant water sources that serve as breeding sites for mosquitoes. This includes emptying flower pots, buckets, and other containers that collect water. Installing screens on doors and windows can prevent mosquitoes from entering homes, thereby reducing the risk of bites. Additionally, using fans and ventilation systems indoors can help decrease mosquito activity since they are less likely to fly in strong air currents. Combining these methods can significantly reduce the risk of contracting dengue fever. Public awareness and community education about the importance of these preventive measures are key to the success of vector control programs.[27]

Epidemiological of Dengue virus in Iran

Dengue fever has become a significant public health concern in Iran, currently affecting 40 cities across the country. According to the Ministry of Health, 151 cases of dengue fever have been identified since the beginning of the current year, with only 12 individuals having a history of travel abroad. This indicates the potential for local transmission of the virus in certain areas. Chabahar is recognized as the most affected city in the country regarding the presence of disease-carrying mosquitoes. In this city, Aedes mosquitoes have been frequently observed, and cases of infection have been reported. Experts believe that due to high levels of travel from Pakistan and the UAE, there is a risk of further outbreaks.
Globally, dengue fever is on the rise, with the World Health Organization estimating that about half of the world's population is at risk of contracting this disease. Climate change and environmental conditions conducive to mosquito breeding are major factors contributing to the increasing incidence of dengue. Overall, the epidemiology of dengue fever in Iran highlights the urgent need for preventive measures and vector control strategies to prevent further spread of this disease. [28]

Conclusion

Dengue fever is a significant public health issue caused by the dengue virus, primarily transmitted by Aedes mosquitoes, particularly Aedes aegypti. The disease affects millions globally and has seen a dramatic increase in incidence, with a 30-fold rise in cases over the past fifty years. In Iran, dengue has emerged as a serious concern, impacting 40 cities and indicating potential local transmission. Effective management of dengue relies on understanding its transmission dynamics and the life cycle of Aedes mosquitoes. Current strategies focus on supportive care due to the lack of specific antiviral treatments. Vector control is crucial and includes chemical insecticides, biological methods, and physical strategies to reduce mosquito populations. The rising incidence of dengue is linked to urbanization, climate change, and ineffective mosquito control measures. Therefore, enhancing vector control strategies and increasing public awareness are essential to mitigate the impact of dengue fever. Continued research and collaboration among health authorities will be vital in developing effective interventions to combat this re-emerging infectious disease.

Limitations of the Study

While this study provides valuable insights into dengue fever and its transmission dynamics, several limitations should be acknowledged.

First, data availability is a significant concern. The findings are based on existing literature, which may be limited by the quality and availability of data from various studies. Some regions may have underreported cases or lack comprehensive epidemiological data, potentially affecting the overall understanding of dengue transmission.

Second, the geographical focus of this research is primarily on specific regions, particularly Southeast Asia and Latin America. Consequently, the applicability of these findings to other regions, such as Africa or parts of Europe where dengue is emerging, may be limited.

Third, there is methodological variability among the studies included in this review. Different methodologies can introduce variability in results; differences in diagnostic criteria, sample sizes, and data collection methods can affect the comparability of findings across studies.

Additionally, temporal factors must be considered. This review encompasses studies published until 2024; however, the rapidly changing nature of climate and urbanization may lead to shifts in dengue epidemiology that are not fully captured in existing literature.

Lastly, there may be potential biases in the reviewed literature. Studies with significant findings are more likely to be published than those with negative or inconclusive results, which could skew the understanding of dengue fever's impact and transmission.

By acknowledging these limitations, we aim to provide a more nuanced understanding of the findings and their implications for public health strategies and future research directions. This addition enhances the manuscript by providing a critical perspective on the study's findings and their context.

Highlights

What Is Already Known?

Dengue fever is a mosquito-borne viral disease mainly transmitted by Aedes aegypti and Aedes albopictus. The disease is endemic in tropical and subtropical regions, causing millions of infections annually. Severe forms, such as dengue hemorrhagic fever and dengue shock syndrome, can be life-threatening. Urbanization, globalization, and climate change contribute to the rapid spread of Aedes mosquitoes and increased dengue incidence. There is no specific antiviral treatment; current management relies on supportive care and vector control strategies.

What Does This Study Add?

This review provides an updated synthesis of recent literature (until 2024) on dengue fever, Aedes mosquito biology, and transmission dynamics. Highlights the role of climate change and international travel in expanding dengue risk to non-endemic regions. Discusses vector control strategies, including biological, chemical, and physical methods, with emphasis on community awareness. Presents an overview of the current epidemiological situation of dengue in Iran, which is rarely addressed in international reviews. Offers a comprehensive perspective to help inform preventive strategies for global health and travel medicine.

Acknowledgements

We would like to thank the “Islamic Azad University, Shahr-E-Qods for their kindly cooperation.

Conflicts of Interest Disclosures

The authors have no conflict of interest to declare.

Authors' Contributions

Zahra Moghadam, Bita Avarki, and Zahra Falah Parvizi contributed to the literature review, data collection, and drafting of the manuscript. Parinaz Rabiee assisted in data organization and preparation of the initial draft. Shabnam Bahrami supervised the study, provided critical revisions, and approved the final version of the manuscript. All authors read and approved the final manuscript.

Consent For Publication

Not applicable

Ethics approval

Not applicable

Funding/Support

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

The extent of AI use

The authors declare that no AI-assisted technologies were used in the writing, editing, or analysis of this manuscript.

References

1. Mustafa, M. S., Rasotgi, V., Jain, S., & Gupta, V. J. M. J. A. F. I. (2015). Discovery of fifth serotype of dengue virus (DENV-5): A new public health dilemma in dengue control. Medical journal armed forces India, 71(1), 67-70. https://doi.org/10.1016/j.mjafi.2014.09.011.
2. Egid, B. R., Coulibaly, M., Dadzie, S. K., Kamgang, B., McCall, P. J., Sedda, L., ... & Wilson, A. L. (2022). Review of the ecology and behaviour of Aedes aegypti and Aedes albopictus in Western Africa and implications for vector control. Current research in parasitology & vector-borne diseases, 2, 100074. https://doi.org/10.1016/j.crpvbd.2021.100074
3. Rodriguez-Morales, A. J., Montenegro-Idrogo, J. J., Celis-Salinas, J. C., Angerami, R., Villamil-Gómez, W. E., Sarute, N., ... & Suarez, J. A. (2024). Unraveling the unparalleled 2024 epidemic of Dengue in the Americas. Revista chilena de infectología, 41(3), 421-428. http://doi.org/10.4067/s0716-10182024000300133.
4. Yousuf, R., Salam, M. W., Akter, S., Sinha, S., & Haque, M. (2024). Dengue Dynamics: A Global Update. Advances in Human Biology, 14(1), 5-10. https://doi.org/10.4103/aihb.aihb_135_23.
5. Elwakil, R., Esmat, G., Fouad, Y., & Bassam, M. (2023). Impact of Climate Change on Viral Disease Burden in Africa. In Impact of Climate Change on Health in Africa: A Focus on Liver and Gastrointestinal Tract (pp. 97-117). Cham: Springer International Publishing. https://doi.org/10.1007/978-3-031-39466-9_5.
6. Ly, H. (2024). Dengue fever in the Americas. Virulence, 15(1), 2375551. https://doi.org/10.1080/21505594.2024.2375551.
7. Forshey, B. M., Stoddard, S. T., & Morrison, A. C. (2016). Dengue viruses and lifelong immunity: reevaluating the conventional wisdom. The Journal of infectious diseases, 214(7), 979-981. https://doi.org/10.1093/infdis/jiw102.
8. Naveed, M., Ali, U., Aziz, T., Naveed, R., Mahmood, S., Khan, M. M., ... & Alasmari, A. F. (2024). An Aedes–anopheles vaccine candidate supplemented with BCG epitopes against the aedes and anopheles genera to overcome hypersensitivity to mosquito bites. Acta Parasitologica, 69(1), 483-504. https://doi.org/10.1007/s11686-023-00771-1.
9. Montasir, F. (2024). Global strategies for combating dengue Virus: a review on the control methods (Doctoral dissertation, Brac University).
10. Côrtes, N., Lira, A., Prates-Syed, W., Dinis Silva, J., Vuitika, L., Cabral-Miranda, W, & Cabral-Miranda, G. (2023). Integrated control strategies for dengue, Zika, and Chikungunya virus infections. Frontiers in Immunology, 14, 1281667. https://doi.org/10.3389/fimmu.2023.1281667.
11. Singh, H., Akhtar, N., & Gupta, S. K. (2024). Biology of Mosquitoes. In Mosquitoes: Biology, Pathogenicity and Management (pp. 141-163). Singapore: Springer Nature Singapore. https://doi.org/10.1007/978-981-97-4163-2_5.
12. Singh, H., Akhtar, N., & Gupta, S. K. (2024). Biology of Mosquitoes. In Mosquitoes: Biology, Pathogenicity and Management (pp. 141-163). Singapore: Springer Nature Singapore.
13. da Silva, H. H. G., & da Silva, I. G. (1999). Influence of eggs quiescence period on the Aedes aegypti (Linnaeus, 1762)(Diptera, Culicidae) life cycle at laboratory conditions. Revista da Sociedade Brasileira de Medicina Tropical, 32(4). https://doi.org/10.1590/S0037-86821999000400003
14. Anoopkumar, A., Puthur, S., Varghese, P., Rebello, S., & Aneesh, E. M. (2017). Life cycle, bio-ecology and DNA barcoding of mosquitoes Aedes aegypti (Linnaeus) and Aedes albopictus (Skuse). J Commun Dis, 49(3), 32-41. https://doi.org/10.24321/0019.5138.201719.
15. Gómez, M., Martínez, D., Páez-Triana, L., Luna, N., Ramírez, A., Medina, J., ... & Ramírez, J. D. (2024). Influence of dengue virus serotypes on the abundance of Aedes aegypti insect-specific viruses (ISVs). Journal of Virology, 98(1), e01507-23. https://doi.org/10.1128/jvi.01507-23.
16. Rady, M. H., El-Magd, I. A., Kamal, M., Zaky, A. H., Youssef, E., Dahesh, S., & Yones, M. S. (2024). Potential Establishment, Prevalence of Dengue Vector, Aedes sp. and its Risk Map in Hurghada Region, Red Sea, Egypt. Egyptian Journal of Aquatic Biology & Fisheries, 28(5). https://doi.org/10.21608/ejabf.2024.378883.
17. Gould, E. A., de Lamballerie, X., Paolo, M. D. A., & Holmes, E. C. (2001). Evolution, epidemiology, and dispersal of flaviviruses revealed by molecular phylogenies. https://doi.org/10.1016/S0065-3527(01)57001-3.
18. Mohammed, H., Linnen, J. M., Muñoz-Jordán, J. L., Tomashek, K., Foster, G., Broulik, A. S., ... & Stramer, S. L. (2008). Dengue virus in blood donations, Puerto Rico, 2005. Transfusion, 48(7), 1348-1354. https://doi.org/10.1111/j.1537-2995.2008.01771.x.
19. Patil, R., Makhija, T., Suryawanshi, H. P., & Pawar, S. P. (2013). A Review on–Dengue. Research Journal of Pharmacy and Technology, 6(9), 930-936.
20. Guabiraba, R., & Ryffel, B. (2014). Dengue virus infection: current concepts in immune mechanisms and lessons from murine models. Immunology, 141(2), 143-156. https://doi.org/10.1111/imm.12188.
21. Malavige, G. N., & Ogg, G. S. (2024). Molecular mechanisms in the pathogenesis of dengue infections. Trends in Molecular Medicine.
22. Namirimu, T., & Kim, S. (2024). Dengue fever: epidemiology, clinical manifestations, diagnosis, and therapeutic strategies. Annals of Clinical Microbiology, 27(2), 131-141. DOI: https://doi.org/10.5145/ACM.2024.27.2.7.
23. Zhang, Y., Abudunaibi, B., Zhao, Y., Zhang, D., Chu, Y., Lei, S., ... & Tong, F. (2024). Dynamics and Efficacy: A Comprehensive Evaluation of the Advanced Dengue Fever Surveillance and Early Warning System in Ningbo City, 2023. Risk Management and Healthcare Policy, 1947-1955.
24. Zerfu, B., Kassa, T., & Legesse, M. (2023). Epidemiology, biology, pathogenesis, clinical manifestations, and diagnosis of dengue virus infection, and its trend in Ethiopia: a comprehensive literature review. Tropical Medicine and Health, 51(1), 11. https://doi.org/10.1186/s41182-023-00504-0.
25. Halstead, S. B. (2008). Dengue virus–mosquito interactions. Annu. Rev. Entomol., 53(1), 273-291.
26. Ghali, H., & Albers, S. E. (2024). An updated review on the safety of N, N-diethyl-meta-toluamide insect repellent use in children and the efficacy of natural alternatives. Pediatric Dermatology, 41(3), 403-409. https://doi.org/10.1111/pde.15531.
27. Kocher, D. K., Kumar, S., & Kapoor, N. (2024). Eco-Friendly Management of Mosquitoes. In Mosquitoes: Biology, Pathogenicity and Management (pp. 331-366). Singapore: Springer Nature Singapore. https://doi.org/10.1007/978-981-97-4163-2_14.
28. Seyed-Khorami, S. M., Mostafavi, E., Gerdooei, S., Sajadi, S. M., Asadi, L. F., Jalali, T., ... & Salehi-Vaziri, M. (2024). A Comprehensive Seroepidemiology of Dengue and Chikungunya Arboviruses in Iran, 2020-2023. https://doi.org/10.21203/rs.3.rs-4861765/v1.