International Journal of Advance Social Sciences and Education (IJASSE)
Vol. 4, No. 5, 2026: 569-582

Dengue and its Relationship with the Determinants of Health at Centro de Salud Abdón Calderón

Lopez Peña Yadir[1]*, Aragundi Quiroz Alisson Fernanda[2], Arteaga Briones Hilary Kaina[3], Muñoz Mancheno Karen Anabel[4], Villalva Aragón Ghislayne Danaé[5]
Universidad San Gregorio de Portoviejo
Corresponding Author: Yadir Lopez Peña, ylopezp@sangregorio.edu.ec

A R T I C L E I N F O
Keywords: Dengue, Health Determinants, Prevention, Community, Epidemiology

Received: 19, August
Revised: 20, September
Accepted: 30, October

©2026 Yadir, Fernanda, Kaina, Anabel, Danaé: This is an open-access article distributed under the terms of the Creative Commons Attribution 4.0 International.

A B S T R A C T
This study aimed to analyse dengue incidence and its relationship with health determinants at Community Health Center Abdon Calderon during April - September 2026. A descriptive cross-sectional design was used, with a convenience sample of 54 residents and a structured questionnaire. Sociodemographic, behavioural, and epidemiological variables were considered. Responses were analysed descriptively in Microsoft Excel. Twenty participants reported previous dengue. Preventive practices and service access varied: 51 cleaned and covered water containers, 8 participated in prevention campaigns, and 22 received information from health personnel. An educational tri-fold leaflet was developed. The findings describe household conditions and preventive practices and support community health education, without establishing statistical associations between determinants and dengue incidence.

DOI: https://doi.org/10.59890/ijasse.v4i5.32
ISSN-E: 2988-2133
https://journalijasse.my.id/index.php/ijasse

INTRODUCTION

Dengue is one of the main public health problems worldwide because of its high incidence, rapid spread, and impact on morbidity and the response capacity of health systems. It is a viral disease transmitted mainly by Aedes aegypti and Aedes albopictus (Yukiko, 2011). Vector presence and proliferation are closely related to environmental, social, economic, and behavioural factors (OMS, 2024). Reported cases increased from approximately 500 000 in 2000 to 5,2 million in 2019, while simultaneous outbreaks in different regions during 2023 demonstrated the expansion of dengue into new areas (OMS, 2023).

In Ecuador, climatic, environmental, social and economic conditions favour vector reproduction and dispersal. Rainfall, inadequate water storage, lack of basic services, poor waste management and certain occupational activities increase transmission risk. Approximately 70 % of the national territory has favourable conditions for dengue, exposing an estimated 8.220.000 people (Estrada Zamora et al., 2024). Socioeconomic circumstances and knowledge of prevention also influence population vulnerability.

Manabi has climatic, environmental, and demographic conditions that favour vector presence, and dengue remains a priority problem for health services and communities (OPS, 2025). During epidemiological weeks 1 to 16 of 2024, the province recorded 3.785 confirmed cases (MSP, 2024). In 2025, it reported 382 confirmed cases up to epidemiological week 5 and 1.615 up to week 13 (MSP, 2025). These records demonstrate persistent and recurrent transmission in the province.

Up to epidemiological week 17 of 2026, Community Health Center Abdon Calderon reported 28 patients with dengue without warning signs, comprising 14 men and 14 women. These local records provide a reason to examine the conditions that may favour transmission within the facility's catchment area. Environmental conditions, access to basic services, socioeconomic characteristics, population habits, and knowledge of preventive measures provide a basis for examining dengue alongside the determinants of health.

The general objective was to analyse the incidence of Dengue and its relationship with the determinants of health at Community Health Center Abdon Calderon during April-September 2026. The specific objectives were to conduct a literature review of dengue and the determinants of health, administer a survey to determine the population's level of knowledge about these topics, and develop an educational tri-fold leaflet to strengthen knowledge and promote dengue prevention measures in the community.

LITERATURE REVIEW

In Latin America, endemic dengue is related to social determinants that favour transmission. Urban population growth facilitates Aedes aegypti reproduction, while internal and external migration contribute to the introduction and spread of dengue in new regions, particularly when people come from areas with a high incidence (Lisbeth Cantarero Zeledón et al., 2025). In Ecuador, Guayas, Los Ríos, Manabi, Esmeraldas, El Oro and Amazonian

provinces remain areas of high transmission, with tropical conditions favourable to vector reproduction (Wilson Cañizares et al., 2023).

Dengue has varied clinical presentations and may progress to severe stages requiring hospital management (Gabriela E. Mendoza et al., 2025). Classification by severity facilitates decisions about observation and treatment (Consejo de Salubridad General, 2026). In Ecuador, dengue without warning signs represents approximately 85-86% of cases, dengue with warning signs 13-14%, and severe dengue less than 1% (MSP, 2026). The disease has febrile, critical, and recovery phases. Monitoring warning signs and other clinical parameters is crucial for recognising progression to the critical phase (OPS, 2016). There is no specific treatment apart from supportive measures and hydration (Rajapakse S et al., 2012); aspirin and ibuprofen should be avoided because they may increase bleeding risk (OMS, 2025).

Human biology affects infection and disease progression. DENV replicates mainly in dendritic cells and infects macrophages, monocytes and lymphocytes (Bhattacharjee, 2021). Its four serotypes, DENV-1, DENV-2, DENV-3 and DENV-4, are genetically related but antigenically distinct. Infection with one serotype provides prolonged homotypic and short-term heterotypic protection (Yung C et al., 2015). Host immunity and genetics, the epidemiological setting, and viral characteristics may contribute to protection or increased disease; a higher viral load may be associated with severe forms (Hershan, 2023).

Environmental determinants affect vector presence, distribution, and reproduction. Temperature influences the vector's life cycle and capacity to transmit the virus; humidity conditions survival, and rainfall changes breeding-site availability. Warm weather, rainy periods, and accumulated water favour mosquito presence and increased cases in Latin America (Yuliana del Carmen Cedeño Gómez et al., 2026). In Ecuador, heavy rainy seasons, precarious housing, water containers, basic services, healthcare access and occupational activities are linked to the disease's endemic-epidemic behaviour (Estrada Zamora et al., 2024).

Housing and lifestyle conditions also shape exposure. Lack of drinking water, inadequate sanitation, stagnant water, and inadequate waste disposal are related to greater transmission risk (Lisbeth Cantarero Zeledón et al., 2025). Preventive practices include covering water containers, eliminating accumulated water, cleaning gutters and drains, using protective clothing and repellent, and fitting mosquito screens to windows (Diumenjo, 2023). Health services contribute through vector control, epidemiological and entomological surveillance, and communication about transmission and prevention (MSP, 2020). The study uses these biological, environmental, behavioural, and service-related determinants as its conceptual framework (Figure 1). Its descriptive approach does not include statistical hypothesis testing.

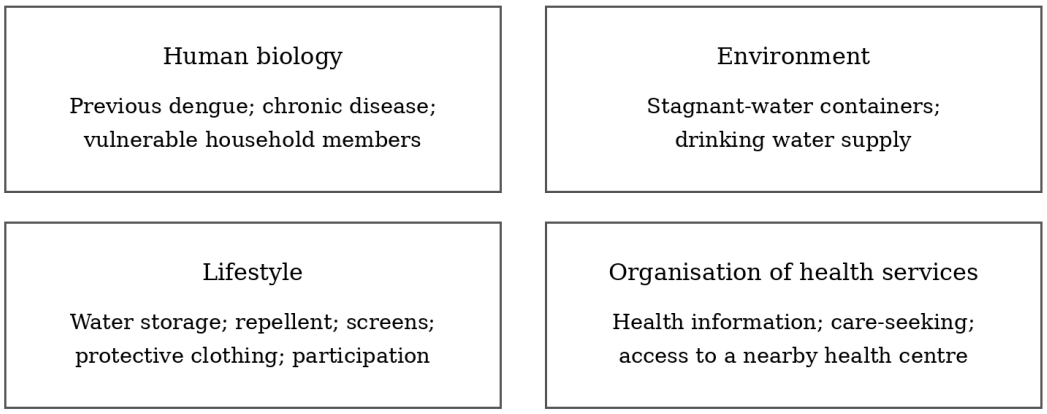


Figure 1. Conceptual Framework

METHODOLOGY

The study is descriptive and adopts a cross-sectional design to analyse the determinants of health at Community Health Center Abdon Calderon during the period from 2021 to 2026. It examines population knowledge of dengue transmission, symptoms, prevention, and warning signs. The literature review considered 25 scientific articles: 20 corresponded to the established research period, and 5 fell outside it but were included because of their academic relevance and contribution to the scientific background and theoretical foundations of the study.

The target population consists of 15.852 inhabitants (7.735 Men and 8.117 Women). A convenience sample of 54 people was selected to ensure access to specific cases. Inclusion criteria were age over 18 years, residence in the study area, and agreement to participate. People who did not complete the questionnaire or did not wish to participate were excluded.

Data collection used a structured questionnaire developed by the authors from scientific information and health organisation recommendations on dengue. It was administered through visits following the informed consent protocol described in the document. Sociodemographic variables (age, sex, educational level), behavioural variables (breeding-site elimination practices and repellent use), and epidemiological parameters (history of infection and number of cases in the area) were considered. Knowledge was to be assessed from survey responses and classified as low, medium, or high according to the number of correct responses.

Materials included tri-fold leaflets, computers, telephones and printers, with 4 female survey interviewers. The methodological plan included 5 hours of training on ethical conduct and questionnaire administration. Data were entered into Microsoft Excel. Responses to each question were analysed descriptively, distinguishing between “Yes” and “No”, and presented in tables and figures.

RESULTS AND DISCUSSION

Table 1. History of Dengue

Have you had dengue before?	Frequency
Yes	20
No	34
Total	54

Source: Survey

It was identified that 20 participants (37,0%) reported a history of dengue, while 34 (63,0%) did not report having had the disease. This demonstrates that, although the population without a history predominates, a considerable proportion has had previous exposure to dengue.

Table 2. Chronic Disease

Do you have any chronic disease such as diabetes or hypertension?	Frequency
Yes	13
No	41
Total	54

Source: Survey

Chronic diseases were present in 24,1% of participants (13 people), compared with 75,9% (41 people) who did not report these conditions. A population without a history of chronic diseases therefore predominated, a favourable aspect of the characteristics of the sample studied.

Table 3. Vulnerable Population in the Household

Are there people under 5 or over 65 years of age in your household?	Frequency
Yes	32
No	22
Total	54

Source: Survey

Regarding the presence of a vulnerable population, 32 participants stated that they lived with children under five or adults over 65 years of age, while 22 indicated otherwise. This finding is relevant because more than half of the households have members who require special attention in relation to vector-borne diseases.

Table 4. Presence of Fever

Have you had a fever in the last 15 days?	Frequency
Yes	6
No	48
Total	54

Source: Survey

Recent fever was reported by 6 people (11,1%), while 48 (88,9%) did not present this sign. Although its frequency was low, identifying it is important from an epidemiological perspective because fever is a frequent clinical manifestation in presentations compatible with dengue.

Table 5. Containers with Stagnant Water

Are there containers with stagnant water around your home?	Frequency
Yes	13
No	41
Total	54

Source: Survey

It was found that 13 people kept containers with stagnant water around their homes, while 41 stated that they did not have them. Despite the predominance of a favourable condition, the existence of these containers represents a potential environmental factor for vector reproduction.

Table 6. Drinking Water Supply

Does your home have a continuous supply of drinking water?	Frequency
Yes	33
No	21
Total	54

Source: Survey

Of the 54 people surveyed, 33 people indicated that they had a continuous supply of drinking water, while 21 people stated that they did not have this service permanently. This situation may favour water storage in homes, so it is important to keep containers properly covered to prevent the formation of vector mosquito breeding sites.

Table 7. Elimination of Breeding Sites

Are breeding-site elimination activities carried out in your community?	Frequency
Yes	35
No	19
Total	54

Source: Survey

It was found that 35 participants (64,8%) stated that breeding-site elimination activities were carried out in their community, while 19 (35,2%) indicated otherwise. This reflects that most of the population recognises the existence of community actions directed at vector control, although a group remains without this preventive activity.

Table 8. Use of Physical Barriers in the Home

Does your home have mesh or mosquito screens on doors and windows?	Frequency
Yes	26
No	28
Total	54

Source: Survey

Of all respondents, 26 people (48,1%) indicated that they had mesh or mosquito screens on the doors and windows of their homes, compared with 28 (51,9%) who did not have this physical barrier. These results show an almost even distribution, demonstrating that a considerable proportion of the population remains exposed to vector entry into the home.

Table 9. Use of Repellent

Do you frequently use mosquito repellent?	Frequency
Yes	25
No	29
Total	54

Source: Survey

It was identified that 25 participants (46,3%) frequently use mosquito repellent, while 29 (53,7%) do not use it regularly. This demonstrates limited adoption of this individual preventive measure, which represents an aspect to be strengthened within health promotion strategies.

Table 10. Water Storage

Do you clean and cover the containers in which you store water?	Frequency
Yes	51
No	3
Total	54

Source: Survey

It was found that 51 people (94,4%) clean and cover the containers in which they store water, compared with only 3 (5,6%) who do not follow this practice. This result demonstrates favourable preventive behaviour that is widespread in the population studied, contributing to reduced availability of vector breeding sites.

Table 11. Use of Protective Clothing

Do you wear clothing that covers your arms and legs in areas where mosquitoes are present?	Frequency
Yes	24
No	30
Total	54

Source: Survey

Regarding clothing that covers the arms and legs in areas where mosquitoes are present, 24 participants (44,4%) stated that they wore it, while 30 (55,6%) did not adopt this measure. This demonstrates that an important proportion of the population does not use this form of physical protection against the vector.

Table 12. Participation in Dengue Prevention Campaigns

Do you participate in community dengue prevention campaigns?	Frequency
Yes	8
No	46
Total	54

Source: Survey

Regarding participation in community dengue prevention campaigns, only 8 people (14,8%) stated that they participated, compared with 46 (85,2%) who did not. These results demonstrate low community involvement in prevention activities, which constitutes a priority aspect to be strengthened.

Table 13. Information Received from Health Personnel

Have you received information about dengue prevention from health personnel?	Frequency
Yes	22
No	32
Total	54

Source: Survey

It was identified that 22 participants (40,7%) had received information about dengue prevention from health personnel, while 32 (59,3%) had not received it. This reflects limited coverage of institutional educational activities directed at the community.

Table 14. Behaviour when Dengue is Suspected

Would you attend a health centre if you developed dengue symptoms?	Frequency
Yes	45
No	9
Total	54

Source: Survey

Most respondents, 45 people (83,3%), stated that they would attend a health centre if they developed dengue symptoms, compared with 9 (16,7%) who would not. This finding demonstrates a favourable attitude in the population towards seeking timely medical care.

Table 15. Access to Health Centre Services

Do you have access to a health centre near your home?	Frequency
Yes	49
No	5
Total	54

Source: Survey

It was determined that 49 participants (90,7%) had access to a health centre near their home, while 5 (9,3%) did not have this access. This demonstrates predominantly adequate health service coverage in the study area, although a group with access difficulties remains.

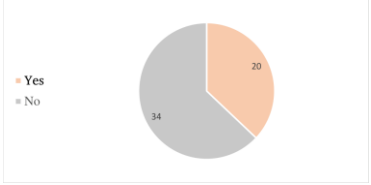


Figure 2. History of dengue

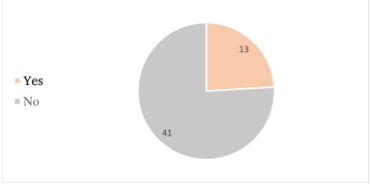


Figure 3. Chronic disease

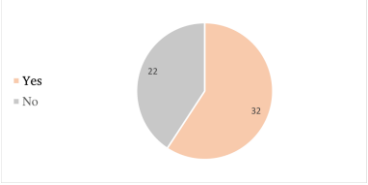


Figure 4. Vulnerable population in the household

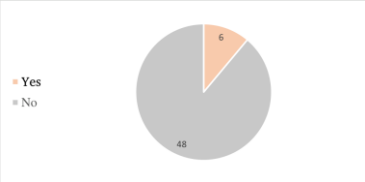


Figure 5. Presence of fever

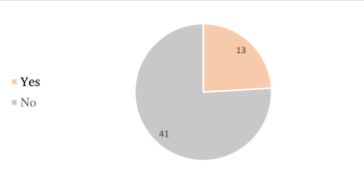


Figure 6. Containers with stagnant water

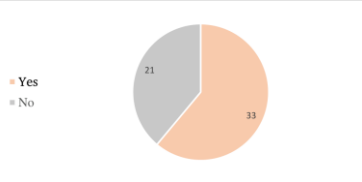


Figure 7. Drinking water supply

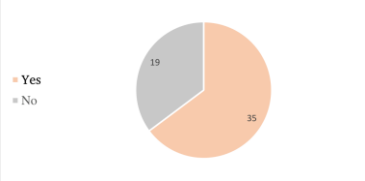


Figure 8. Elimination of breeding sites

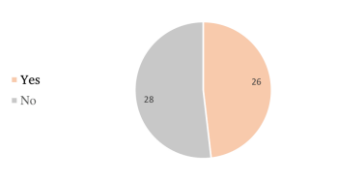


Figure 9. Use of physical barriers in the home

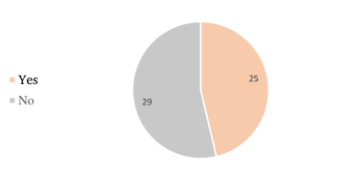


Figure 10. Use of repellent

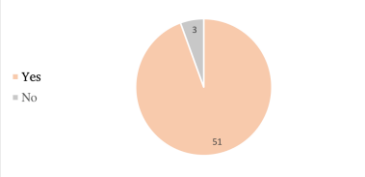


Figure 11. Water storage

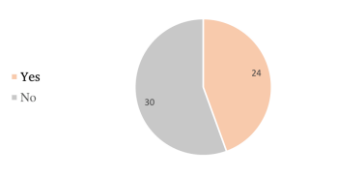


Figure 12. Use of protective clothing

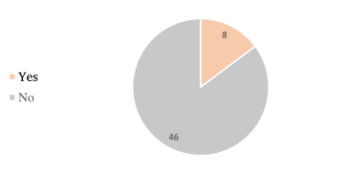


Figure 13. Participation in dengue prevention campaigns

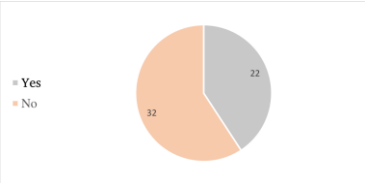


Figure 14. Information received from health personnel

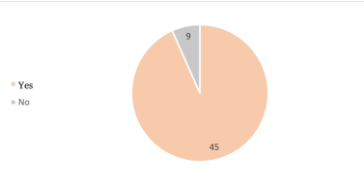


Figure 15. Behaviour when dengue is suspected

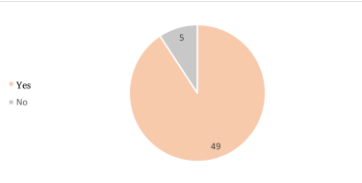


Figure 16. Access to health centre services

The survey describes household conditions, preventive practices and access to health services among residents of the catchment area of Community Health Center Abdon Calderon. Its findings can be considered alongside the environmental, social and behavioural determinants described in the literature. They do not establish a statistical relationship between these determinants and dengue incidence, because the results are presented as descriptive responses rather than association tests. The contribution of the survey is therefore a local description of conditions that may be relevant to prevention and community health education.

Previous dengue was reported by a considerable proportion of respondents, although people without a reported history predominated. This is consistent with considering dengue a local concern in a province where surveillance records show persistent and recurrent transmission (MSP, 2024; MSP, 2025). However, a reported history of dengue does not establish when infection occurred or provide a measure of incidence during the study period.

Recent fever also requires cautious interpretation: it is a common clinical manifestation in presentations compatible with dengue, but the questionnaire responses alone do not establish a dengue diagnosis.

The coexistence of favourable and less favourable household conditions is relevant to the environmental determinants considered in the study. Most respondents did not report stagnant-water containers around their homes, yet these containers remained present in some households. A substantial group also lacked a continuous drinking water supply. The literature relates inadequate water storage, deficient basic services, and precarious housing conditions to dengue transmission risk (Estrada Zamora et al., 2024; Lisbeth Cantarero Zeledón et al., 2025). The survey describes the presence of these conditions but does not determine whether they account for the reported dengue histories.

Cleaning and covering water storage containers were widespread in the sample. This reported practice corresponds to the preventive measures described by Diumenjo (2023), which include covering tanks and reservoirs and removing accumulated water. Nevertheless, favourable responses about water storage coexist with less frequent use of repellent, protective clothing, and screens on doors and windows. The findings indicate that preventive practices are unevenly adopted. They do not show whether respondents apply each measure consistently or whether the measures have reduced infection in the surveyed households.

The presence of young children and older adults in more than half of the households gives the local description a further practical dimension. These households include members who require special attention in relation to vector-borne diseases, as described in the results. Likewise, although chronic diseases were not reported by most respondents, they were present in part of the sample. These characteristics should be considered when interpreting the surveyed population, without treating them as demonstrated predictors of dengue severity or transmission, since the study did not examine those relationships.

Community activities and individual participation differed. Most respondents recognised breeding-site elimination activities in their community, whereas participation in dengue prevention campaigns was limited. Recognition of an activity does not necessarily mean participation in it. The results therefore distinguish the reported presence of community actions from personal involvement. The importance of community participation is consistent with the approach described for dengue control in Ecuador, which combines surveillance, breeding-site elimination and health education (Estrada Zamora et al., 2024). The survey does not establish why some residents do not participate or whether reported activities cover all households equally.

Access to a nearby health centre and willingness to seek medical care when dengue symptoms occur were generally favourable. In contrast, information received from health personnel was reported less often. These responses describe different aspects of the organisation of health services: geographical access and stated care-seeking intentions coexist with limited

reported educational coverage. MSP (2020) describes communication about dengue, its transmission and prevention as an important part of control activities. The survey findings support considering this educational dimension alongside access to clinical care, while recognising that stated intentions do not confirm subsequent attendance or actual service use.

The educational tri-fold leaflet was developed in response to the project's objectives and addressed breeding-site elimination, physical protection, warning signs and timely care-seeking. Its content follows the preventive and clinical topics discussed in the literature (Diumenjo, 2023; OPS, 2016). It may serve as a resource for community health education, as stated in the conclusions. The study did not present a follow-up assessment of knowledge or preventive practices after its use, so the material's effectiveness cannot be established from the available results.

CONCLUSIONS AND RECOMMENDATION

A literature review of dengue and the determinants of health was conducted, which made it possible to determine that dengue constitutes an important public health problem and that its transmission is related not only to the presence of the vector, but also to environmental, social, economic and behavioural determinants. Factors such as water storage, housing conditions, sanitation, prevention habits and access to health services influence the risk of disease transmission.

A survey was administered to 54 inhabitants, allowing identification of different conditions and practices related to dengue in the population studied. Favourable aspects were observed, such as adequate cleaning and covering of water storage containers, as well as a positive attitude towards seeking medical care when dengue symptoms are present; however, aspects requiring strengthening were also found, mainly low population participation in prevention campaigns and the limited information received from health personnel.

An educational tri-fold leaflet was developed as a promotion and prevention strategy aimed at strengthening knowledge about dengue, emphasising the elimination of breeding sites, physical protection measures against mosquitoes, recognition of warning signs and the importance of seeking health services promptly. In this way, the material constitutes an educational resource that may help encourage preventive practices and greater community participation in dengue control.

FURTHER STUDY

The convenience sample of 54 residents limits the extent to which the findings can be generalised to the entire catchment population. The cross-sectional design describes responses at one point and does not establish the temporal sequence between health determinants and dengue. Practices, previous illness and service use were reported by respondents; the results do not provide independent verification of these responses or laboratory confirmation of infection.

Although the methodology considered sociodemographic variables and classification of knowledge as low, medium, or high, the presented results consist of dichotomous responses and do not report those knowledge categories or comparisons between population groups. The study also does not present an incidence calculation or statistical association tests. These limitations restrict conclusions about the relationship stated in the general objective.

Further research could use a broader sampling approach, specify the data collection period, assess knowledge with defined scoring criteria, and examine associations between household conditions, preventive practices, and confirmed dengue. Follow-up assessment could also examine changes in knowledge and practices after use of the educational leaflet.

ACKNOWLEDGMENT

The authors thank Dr. Yadir López Peña for his supervision of the Knowledge Integration Project at Universidad San Gregorio de Portoviejo.

REFERENCES

Bhattacharjee, S. K. (03 de 09 de 2021). Virus del dengue: epidemiología, biología y etiología de la enfermedad. Obtenido de

CDC. (27 de 11 de 2024). Guías para clasificar el dengue. Obtenido de https://www.cdc.gov/dengue/es/hcp/clinical-signs/clasificacion.html

Consejo de Salubridad General. (2026). Protocolo Nacional de Atención Médica (PRONAM). Obtenido de https://pronamsalud.csg.gob.mx/pronam-dengue.pdf

Dengue.com. (2025). Origen e historia del virus del dengue. Obtenido de https://www.dengue.com/origin-and-history-dengue-virus

Diumenjo, V. (20 de 04 de 2023). Dengue: todo lo que necesitamos saber para prevenir y consultar. Obtenido de

Estrada Zamora et al. (2024). Características epidemiológicas del dengue en el Ecuador – año 2022. Revisión bibliográfica. Obtenido de

Estrada Zamora et al. (2024). Características epidemiológicas del dengue en el Ecuador – año 2022. Revisión bibliográfica. Obtenido de

Gabriela E. Mendoza et al. (31 de 01 de 2025). Determinantes sociales de la salud asociados al dengue en América del Sur: revisión sistemática. Obtenido de https://dialnet.unirioja.es/servlet/articulo?codigo=10014183

Hershan, A. A. (19 de 11 de 2023). Virus del dengue: biología molecular y avances recientes en estrategias de control, prevención, manejo y terapéutica. Obtenido de

Lisbeth Cantarero Zeledón et al. (20 de 06 de 2025). Determinantes Sociales en la incidencia de dengue en América Latina. Obtenido de https://www.camjol.info/index.php/RCSEM/article/download/20632/25516?inline=1

MSP. (2020). Ecuador en alerta para prevenir el contagio del dengue. Obtenido de https://www.salud.gob.ec/estrategia-nacional-de-control-del-dengue/

MSP. (2024). SUBSECRETARÍA DE VIGILANCIA, PREVENCIÓN Y CONTROL DE LA SALUD DIRECCIÓN NACIONAL DE VIGILANCIA EPIDEMIOLÓGICA ENFERMEDADES TRANSMITIDAS POR VECTORES Ecuador 2024 SE1 a SE16. Obtenido de

MSP. (2025). SUBSECRETARÍA DE VIGILANCIA, PREVENCIÓN Y CONTROL DE LA SALUD DIRECCIÓN NACIONAL DE VIGILANCIA EPIDEMIOLÓGICA ENFERMEDADES TRANSMITIDAS POR VECTORES DENGUE. Obtenido de https://www.salud.gob.ec/wp-content/uploads/2025/04/Eventos-vectoriales-DNVE-SE-13.pdf

MSP. (2026). ETV_Gaceta_10. Obtenido de https://www.salud.gob.ec/wp-content/uploads/2026/03/ETV_Gaceta_10.pdf

OMS. (21 de Diciembre de 2023). Dengue – Situación mundial. Obtenido de

OMS. (23 de abril de 2024). Dengue y dengue grave. Obtenido de https://www.who.int/es/news-room/fact-sheets/detail/dengue-and-severe-dengue

OMS. (21 de 08 de 2025). Dengue. Obtenido de https://www.who.int/news-room/fact-sheets/detail/dengue-and-severe-dengue

OPS. (2016). Dengue: guías para la atención de enfermos en la Región de las Américas. 2.ed. Obtenido de

OPS. (2025). Dengue. Obtenido de https://www.paho.org/es/temas/dengue

OPS. (2026). Determinantes sociales de la salud. Obtenido de https://www.paho.org/es/temas/determinantes-sociales-salud

Rajapakse S et al. (2012). Treatment of dengue fever. Infection and drug resistance. Obtenido de https://doi.org/10.2147/IDR.S22613

Wilson Cañizares et al. (2023). Comportamiento epidemiológico del dengue en Ecuador desde su reemergencia. Periodo 1980-2020. Obtenido de https://revistahcam.iess.gob.ec/index.php/cambios/article/download/834/827?inline=1

Yukiko, H. (2011). Dengue Vectors and their Spatial Distribution. Tropical medicine and health. Obtenido de https://doi.org/10.2149/tmh.2011-S04

Yuliana del Carmen Cedeño Gómez et al. (29 de 03 de 2026). Determinantes Ambientales y Sociales como Factores de Riesgo para el Dengue en Latinoamérica. Obtenido de https://doi.org/10.61616/rvdc.v7i1.1286

Yung C et al. (06 de 05 de 2015). Dengue serotype-specific differences in clinical manifestation, laboratory parameters and risk of severe disease in adults, singapore. Obtenido de The American journal of tropical medicine and hygiene: https://doi.org/10.4269/ajtmh.14-0628