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REVIEW

Epidemiological review of Dengue in Ecuador, its main findings and impact on public health

Revisión epidemiológica del Dengue en Ecuador, sus principales hallazgos e impacto en la salud pública

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ABSTRACT

Introduction: dengue is a viral disease transmitted by Aedes mosquitoes, endemic in Ecuador and other tropical countries. Its incidence has increased due to factors such as uncontrolled urbanization, population mobility, climate change and deficiencies in vector control. In Ecuador, the four serotypes of the virus circulate, which increases the risk of severe forms and mortality.
Method: this study analyzes the recent epidemiological situation, the determining factors in the proliferation of the vector and the prevention and control strategies implemented by the Ministry of Public Health (MSP) through a review of scientific literature, official reports and previous studies.
Results: an alarming increase in cases is evident, influenced by socioeconomic, climatic and health conditions. Epidemiological surveillance is insufficient, and vector control faces operational limitations. In addition, climate change favors the expansion of the mosquito, increasing the risk of more frequent and severe outbreaks.
Conclusions: to mitigate the burden of dengue in Ecuador, it is necessary to strengthen epidemiological surveillance, implement sustainable vector control strategies and promote community education. Genetic monitoring of the virus and the integration of climate change into public health policies are essential for an effective response. The adoption of multidisciplinary approaches and inter-institutional cooperation will be key to reducing the incidence and impact of dengue in the country.

Keywords: Epidemiological Alert; Dengue; Vector Control; Public Health; Ecuador.

RESUMEN

Introducción: el dengue es una enfermedad viral transmitida por mosquitos Aedes, endémica en Ecuador y otros países tropicales. Su incidencia ha aumentado debido a factores como urbanización descontrolada, movilidad poblacional, cambio climático y deficiencias en el control vectorial. En Ecuador, circulan los cuatro serotipos del virus, lo que incrementa el riesgo de formas graves y mortalidad.
Método: este estudio analiza la situación epidemiológica reciente, los factores determinantes en la proliferación del vector y las estrategias de prevención y control implementadas por el Ministerio de Salud Pública (MSP) Mediante una revisión de literatura científica, reportes oficiales y estudios previos.
Resultados: se evidencia un alarmante incremento de casos, influenciado por condiciones socioeconómicas, climáticas y sanitarias. La vigilancia epidemiológica es insuficiente, y el control vectorial enfrenta limitaciones operativas. Además, el cambio climático favorece la expansión del mosquito, aumentando el riesgo de brotes más frecuentes y severos.
Conclusiones: para mitigar la carga del dengue en Ecuador, se requiere fortalecer la vigilancia epidemiológica, implementar estrategias sostenibles de control vectorial y fomentar la educación comunitaria. El monitoreo genético del virus y la integración del cambio climático en las políticas de salud pública son esenciales para una respuesta efectiva. La adopción de enfoques multidisciplinarios y la cooperación interinstitucional serán clave para reducir la incidencia y el impacto del dengue en el país.

Palabras clave: Alerta Epidemiológica; Dengue; Control Vectorial; Salud Pública; Ecuador.

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INTRODUCTION

Dengue is a hyperendemic arboviral infection in tropical and subtropical climates caused by the bite of female Aedes Aegypti and Aedes albopictus mosquitoes infected with the DENV virus.[1,2] It is considered an urban disease because transmission is usually recorded in areas with high population density; however, with increased trade and population growth, similar rates occur in rural areas, often through cases introduced through border movements.[3]

The disease can occur several times in a person, depending on the circulating serotype. Suppose a person is infected by one of the serotypes, permanent immunity is produced for that serotype, and cross immunity for the other serotypes only for a short period. In that case, becoming infected with the different serotypes is possible.[1]

Clinical manifestations can range from asymptomatic infection to severe infection with multiorgan failure. Dengue hemorrhagic fever (DHF) is a subcategory of dengue infection characterized by selective, transient, and dynamic plasma leakage, requiring careful monitoring and meticulous fluid resuscitation with prolonged and unusual manifestations affecting any organ, including the heart, liver, kidneys, and brain[2] and can be fatal without proper clinical management, especially when infection with different serotypes is present, because when a person is infected first by one of the serotypes and after some time by a different one, this causes an increase of antibodies for the first serotype and the non-production of antibodies for the second one, causing an exaggerated immune reaction for a virus that is not in the body and on the other hand increases the amount of virus of the serotype that is not being attacked, which encourages the development of the severity of the symptoms.[1]

In the 1950s, 1960s, and by 1972, the vector had been eradicated in 21 countries in the Region of the Americas. However, in recent years, there has been an increase in cases that may be due to population density, different serotypes of the virus, increased virulence and pathogenicity, host immunity and vector distribution in new areas of the world, forcing health systems to reinforce management models to strengthen national programs to reduce morbidity, mortality and the social and economic burden caused by the dengue epidemic.[4]

Globally, reported cases of dengue fever by the World Health Organization (WHO) have increased from 505 430 in 2000 to 5,2 million in 2019; however, most cases are considered to be manageable without medical help, which is why the actual number of cases is supposed to be higher than reported.[5]

Four serotypes are circulating in the Region of the Americas (DENV-1, DENV-2, DENV-3, and DENV-4). During 2018, 560,586 cases were reported throughout the region, with an incidence of 57,3 per 100,000 population, of which 3 535 cases (0,63 %) were classified as severe dengue.[1]

Several countries, including Belize, Colombia, Costa Rica, Dominican Republic, Ecuador, Dominica, Honduras, Mexico, Panama, Peru, and the Dominican Republic, have reported two to three times more cases than the previous year. This increase could be related to the deterioration of health systems, ineffective vector control programs, economic globalization, increased international travel, deforestation, and climate change. These factors have contributed to an exponential growth in the incidence of dengue in the Americas, representing a significant public health problem.[6]

According to data from the Health Information Platform for the Americas (PLISA) and PAHO on dengue, the region is witnessing a significant increase in the total number of cases and an apparent rise in the proportion of severe cases and deaths, particularly in the Andean region. This trend in the total number of cases suggests an escalation in the severity of outbreaks.[7]

The year 2023 saw the highest number of dengue cases ever recorded, affecting more than 80 countries in all WHO regions. Since the beginning of that year, continued transmission of the disease, together with an unexpected increase in cases, led to a record of more than 6,5 million reported infections and more than 7300 deaths linked to the disease, with an estimated 390 million infections each year, of which 96 million are clinically manifested, and it is currently endemic in more than 100 countries in the African, Americas, Southeast Asia, Eastern Mediterranean and Western Pacific regions and spreading to Europe and South America.[8,9]

In 2024, between epidemiological weeks 1 and 50, a total of 12 945 446 suspected cases of dengue were reported (cumulative incidence of 128 372 cases per 100 000 population). This figure represents an increase of 189 % compared to the same period in 2023 and 365 % compared to the average for the last 5 years. Of the 12 945 446 cases of dengue reported in the Americas, 6 888 698 cases were laboratory-confirmed, and 22 452 were classified as severe dengue. A total of 8 186 deaths from dengue were recorded, for a case fatality rate of 0,063 %, of which Ecuador had a total of 1 088 cases.[10]

In Ecuador, dengue represents a priority public health problem among vector-borne diseases due to the large number of cases that occur each year. The impact of this disease depends on the distribution and population density of mosquito vectors, as well as the circulating viral serotype. The four serotypes of dengue virus are present in the country: DEN-1, DEN-2, DEN-3, and DEN-4, and one reason why DENV transmission has remained endemic in regions such as Ecuador is that there is a continuous replacement of serotypes and lineages, to which cross immunity is only partial.[1,3]

In regions where dengue remains endemic throughout the year, epidemic peaks usually coincide with the rainy season. The continuity of virus transmission is determined by various socioeconomic, climatic, and ecological factors, especially those that favor an increase in the density of mosquito vectors in areas where the virus is active. These factors include prolonged storage of water in poorly covered or uncovered containers; the accumulation of waste that retains rainwater, such as disused tires, plastic containers and cans; the absence of screens on windows and doors to prevent mosquitoes from entering homes; and the lack of use of mosquito nets during rest periods, especially between dusk and dawn, among others.[1]

Dengue represents a priority public health problem for the health system, where it occurs most frequently in the south of the country, even in people with improved health conditions.[11] In this context, countermeasures are urgently needed to prevent human exposure to infected Aedes mosquitoes and prevent the disease, once exposed, recognizing the importance of reorganizing health services, optimizing care for dengue patients, training clinical and support staff in early identification of cases and warning signs,

along with the implementation of well-established clinical care pathways, to significantly mitigate the impact of dengue in terms of morbidity and mortality.[12,13]

In addition, the Pan American Health Organization (PAHO) and the World Health Organization (WHO) stress the importance of strengthening epidemiological surveillance, clinical management, and laboratory confirmation, improving monitoring systems, and promoting prevention campaigns to reduce the incidence of dengue.[14] Community education is essential in creating awareness for people's correct interpretation and implementation of prevention measures.[15]

Against this background, this study reviews the recent epidemiological situation in the country, the determining factors in the proliferation of the vector, the prevention and control strategies implemented by the Ministry of Public Health (MPH), and the challenges for its mitigation. The methodology includes a review of scientific literature, official reports, and previous studies on the epidemiology of dengue in Ecuador.

METHOD

Type of study

For the present literature review on the epidemiological situation of dengue in Ecuador, determinants in the proliferation of the vector, prevention and control strategies, its impact on public health in Ecuador, and future challenges using a qualitative approach based on the collection, analysis, and synthesis of scientific and official information.

Sources of information

Scientific databases such as PubMed, Scielo, Redalyc, Google Scholar and Scopus will be consulted, as well as official documents issued by national and international organizations, such as the Ministry of Public Health of Ecuador (MSP), the World Health Organization (WHO) and the Pan American Health Organization (PAHO).

Inclusion criteria

- Publications between 2020 and 2024 to ensure that data is up to date.
- Studies related to epidemiology, public health impact and dengue control strategies in Ecuador.
- Peer-reviewed articles, official agency reports and publicly available academic theses.

Inclusion exclusion

- Studies outside the Ecuadorian context.
- Studies with epidemiological characterizations biased to age or to a specific population.
- Publications with outdated information with data up to 2019 or without scientific support.
- Articles with evident methodological biases or with restricted access.

Search strategy

Combinations of keywords in Spanish and English were used, such as: "dengue Ecuador", "dengue epidemiological alert Ecuador", "impact of dengue on public health Ecuador", "dengue epidemiology Ecuador", "dengue prevention Ecuador", "Aedes aegypti mosquito Ecuador", among others. Boolean operators (AND, OR, NOT) will be applied to refine the search.

Analysis and synthesis of information

The information gathered will be organized in a bibliographic review matrix, considering the following aspects:

- Source and year of publication.
- Objectives and methodology of the studies reviewed.
- Main findings on the epidemiological situation of dengue in Ecuador.
- Control and prevention measures.
- Impact on public health and future challenges.

The analysis will be carried out by means of a thematic synthesis, grouping the information into relevant categories for a better interpretation of the data.

Limitations of the study

It is recognized that the availability of information may be restricted by access to certain pay items and the lack of updated data in some official sources.

RESULTS AND DISCUSSION

Based on the studies analyzed, the incidence and factors associated with dengue have been identified, and the effectiveness of prevention and control measures has been evaluated to provide updated data on the epidemiological situation in Ecuador. There has been an alarming increase in cases in recent years, reaching more than 42 000 in 2024, and a report of 3 400 cases in the first two months of 2025. Several studies have identified risk factors such as precarious socioeconomic conditions, climate change, and vector control failures, and have described the circulation of serotypes DENV-1 and DENV-2, with possible entry through Esmeraldas and links to strains from neighboring countries. Prevention strategies include mosquito

control, community education, epidemiological monitoring, and health system strengthening. However, challenges remain, such as the lack of effectiveness of control measures and the need for a coordinated response at the national level. A multisectoral and sustained approach is required to mitigate the impact of dengue and improve the response to outbreaks.

The literature review from 2020 to February 2025 shows that dengue continues to represent a public health problem in Ecuador, with an increasing trend in the number of cases reported in recent years. The studies reviewed show that the disease's control depends on a combination of epidemiological surveillance strategies, vector control measures, and community education. However, despite these efforts, data reported by various sources indicate a significant increase in dengue cases and mortality in recent years.[21,25]

One of the key findings is the relationship between socioeconomic conditions and the spread of dengue. Estrada-Zamora et al.[18] identified poor sanitation, inadequate water supply, and low schooling as essential determinants of dengue incidence in Ecuador.[18] These results are consistent with those reported by Zavala-Hoppe et al.[22] who point out that the lack of basic services and the accumulation of garbage facilitate the proliferation of the *Aedes aegypti* mosquito.

Genetic analysis of the virus has been crucial for understanding the transmission dynamics of dengue. Márquez et al.[3] determined that DENV-1 and DENV-2 have circulated in Ecuador between 2019 and 2021, entering through the province of Esmeraldas, attributing this to trade and population migration.[3] Along the same lines, Carrazco-Montalvo et al.[20] identified the viral evolution of DENV-2 in *Aedes aegypti* mosquitoes, highlighting the connection of Ecuadorian strains with genomes from Venezuela and Colombia. These findings underscore the need for continuous genetic monitoring to anticipate the emergence of new variants.[20] The reappearance of a serotype that did not circulate in the last decade, such as DENV-3, together with the increase in the susceptible population, not only increases the probability of severe cases of dengue, but could also cause epidemics that overload health services, exceeding their response capacity.[14]

Regarding prevention and control measures, the reviewed studies suggest the importance of vector control, epidemiological surveillance, and community participation.[16,17] However, despite the implementation of these strategies, Acosta-España et al.[19] concluded that vector-borne disease control has failed in Ecuador, given that no significant reduction in dengue was observed between 2015 and 2022 and the substantial increase, with a total of 3 400 cases so far in 2025.[19,26] This situation suggests the need to optimize and strengthen existing control programs.

Climate change has also been identified as a key factor in the spread of dengue. The National Institute of Public Health Research[24] highlights that changing climatic conditions favor the expansion of the *Aedes aegypti* and *Aedes albopictus* mosquitoes. This phenomenon poses an additional challenge for health authorities, who must adapt prevention and control strategies to changing climatic scenarios.

Finally, the response of the Ministry of Public Health of Ecuador[27,26] and PAHO[4] emphasizes the importance of strengthening surveillance systems, improving vector control programs, and implementing sustainable community education campaigns. It highlights the need for a coordinated effort between regional governments and communities to mitigate the public health impact of dengue.

Table 1. Literature review matrix

Source and year of publication	Methodology and objectives	Main findings	Prevention and control measures	Public health impact and future challenges
Muñoz-Arteaga et al.[16]	Bibliographic review, With the objective of knowing and identifying the performance of control methods	An association has been identified between environmental controls and certain vector-borne metaxenic diseases, such as dengue, chikungunya, yellow fever, and malaria, among others. This is equivalent to 20 % of the total incidence of diseases worldwide in industrialized countries that can be attributed to environmental factors.	Vector control to detect imported cases of dengue and chikungunya. Vector control. Physical and chemical control of larvae. Protect doors and windows of homes with screens to prevent mosquitoes from entering. In endemic areas, vector density should be monitored to maintain safe levels. Maintain surveillance and control of vectors in epidemics, disasters and climatic changes.	Evaluate the measures that have been effective and those that need to be reformed to obtain better results, emphasizing the measures aimed at controlling dengue fever, taking into account that due to its geographic location it is in a predisposing situation for this type of disease.
Bohórquez A et. al.[17]	of metaxenic diseases in Ecuador.	In the epidemiological week 01/09/2020, the incidence was 23,47, of which 16 were severe cases, resulting in 5 deaths, giving us a total of 3 549 cases of dengue fever.	Primary prevention through home visits to identify mosquito breeding sites, their elimination and prevention by identifying risks and susceptibility. Secondary prevention for early diagnosis and treatment. Tertiary prevention to manage the complications presented by the patient and at the same time perform isolation to prevent spread.	Community education because the population does not have the necessary knowledge of preventive measures or strategies to avoid the spread of the vector.
Márquez, S. et al.[3]	Qualitative bibliographic review with the objective of knowing the incidence of classical Dengue fever during the winter season.	Phylogenetic analysis of 27 samples from Ecuador and other South American countries confirmed that DENV-1 circulated between May 2019 and March 2020 and DENV-2 between December 2020 and July 2021. Combining locality and isolation dates, it was determined that DENV entered Ecuador through the northern province of Esmeraldas.		The study underscores the need for coordinated efforts to monitor and control DENV strains across national borders and through ministries of health to intensify surveillance in remote underserved regions especially along national borders.
Estrada-Zamora et al.[18]	Original article that was based on the study of DENV nucleotide sequence collected during 2019-2021 to understand the role of the dynamics of rural transmission of DENV in northwestern Ecuador.	It was determined that the main factors involved in the spread and incidence of dengue in Ecuador are the socioeconomic conditions in the coastal and Amazon regions, the climate in a given season, tourism, low schooling, poor sanitation, and inadequate water supply.		
Acosta-España et al.[19]	Bibliographic review with the purpose of obtaining epidemiological data on dengue during epidemiological weeks 1 to 48 of the year 2022.	The burden of dengue was 31 616 cases. Between 2015 and 2022, the highest dengue hospitalization rate per 10 5 inhabitants was observed in Sucumbios province (697,2). Trend analysis of the data revealed a slight increase in dengue.		The results suggest that the control of vector-borne diseases has failed in Ecuador, because at the country level there was no significant trend towards a decrease in dengue fever during the years studied, highlighting the need to optimize sustainable vector control programs and continuous monitoring of disease incidence and control measures.

Carrazco-Montalvo, et al.[20]	National cross-sectional study from 2015 to 2022 of the National Institute of Statistics and Census of Ecuador with data were filtered specific for each disease (ICD-10).	The possibility of isolating a complete DENV genome directly from 30 mosquitoes was demonstrated. A close relationship with the genomes of Venezuela and Colombia was identified. This could be due to the commercial exchange and human migration that exist in these countries, increasing the probability of the emergence of new variants.		Identification of circulating serotypes and genotypes is required to understand the genetic variability of the virus and to anticipate possible severe outbreaks, which will allow the adaptation of specific prevention and control strategies for the serotypes present in a particular geographic area.
Ortíz-Prado et al.[21]	To report the complete genome sequence 96 of DENV-2 virus detected in a group of Aedes aegypti mosquitoes, its genotype and viral evolution in Ecuador.	When comparing the first 15 weeks of 2023 to the same period in 2024, a significant average increase of 600 % in the number of new cases was observed. Epidemiologically, Ecuador showed similar average increases of about 250-280 % from 2023 to 2024 in the first 15 epidemiological weeks. By 2023, the mortality rate in the Andean countries (Bolivia, Colombia, Ecuador, and Peru) reached 8,8 %, with more than 9 414 severe dengue cases, representing 0,6 % of the total cases. By 2024, 11 400 severe dengue cases were recorded in the Andean region, with a mortality rate of 5,7 %, slightly lower than in the previous year. Still, the proportion of severe dengue cases remained at 0,6 %.		It is essential to strengthen surveillance systems, improve vector control programs, and implement effective public health campaigns. Immediate and coordinated action by regional governments and health authorities is essential to mitigate the growing dengue crisis and safeguard public health in the region.
Zavala-Hope[22]	Perception review article with the objective of raising awareness and encouraging regional governments to take immediate but lasting steps to change the paradigm in which they currently operate.	In Ecuador, studies from 2019 and 2022 highlight that the lack of basic services, such as drinking water and sewage, and the presence of empty lots and garbage facilitate the proliferation of mosquito breeding sites.	Active community participation for the elimination of mosquito breeding sites. Insecticide spraying. Adapt to local resources, with a focus on cleaning containers with standing water and applying specific control methods as key to reducing the incidence of this disease and improving public health in various regions.	It is crucial that education, promotion and information campaigns be continuous and focused on the elimination of mosquito breeding sites, even outside epidemic periods.
Ministery Public Health[23]	Descriptive narrative documentary design with the objective of learning about dengue prevention and control strategies used in urban communities.	According to data from active epidemiological surveillance during the first eleven weeks of the year, the Ministry of Public Health (MSP) reports a significant increase in the number of dengue cases in the country. There are 11 492 confirmed cases of dengue fever, far exceeding the previous years' figures.	Training of health personnel to strengthen the identification and management of dengue cases. Vector control to eliminate mosquito breeding sites. Sampling of confirmed patients for serotyping and genotyping studies. Development of community mingas for the elimination of mosquito breeding sites. Use of repellent.	Raise awareness among the population against self-medication when the signs and symptoms of the disease are present.
INSPI[24]	National Health Authority Report	Climate change poses global challenges, both environmental and public health. One of these challenges is the increased spread of vector-borne diseases, such as dengue fever, facilitated by the expansion of Aedes aegypti and Aedes albopictus mosquitoes.		Implementation of strategy for early detection and rapid response to control dengue and understand how climate change affects vector survival and expansion.

OPS[25]	Report to the Health Authority	As of July 2024, Ecuador has registered a total of 42 765 cases and 48 deaths to date.	Monitoring of territorial and altitudinal distribution of vectors under climate change scenarios.	Promote an integrated approach to prevention and control. Strengthen health services in terms of their capacity for differential diagnosis and clinical management. Evaluate and strengthen surveillance capacity and integrated vector control. Establish and strengthen the technical capacity of the Network of Arbovirus Diagnostic Laboratories in the Region of the Americas (RELDA).
Public Health Ecuador[1]	Report of vector gazettes containing Dengue information.	During 2023, 27 838 confirmed cases of dengue were reported in Ecuador, of which 24 089 (86,53 %) were dengue without warning signs, 3637 cases (13,06 %) were dengue with warning signs, and 112 cases (0,40 %) were severe dengue, with circulating serotypes DENV-1 and DENV-2. During 2023, 27 838 confirmed cases of dengue were reported in Ecuador, of which 24 089 (86,53 %) were dengue without warning signs, 3637 cases (13,06 %) were dengue with warning signs, and 112 cases (0,40 %) were severe dengue, with circulating serotypes DENV-1 and DENV-2.	1) clinical management training, 2) vector control, 3) communication and education, 4) epidemiological surveillance, and 4) laboratory surveillance. Vector control. Epidemiological surveillance, with constant entomological studies that include monitoring the distribution and density of *Aedes aegypti* and *Ae. albopictus*, mosquito resistance to insecticides and viral serotypes circulating in the vectors. Communication campaigns on what dengue is, how it is transmitted and what the population can do at home, work, school or any other place to avoid its transmission.	

CONCLUSIONS

Although various strategies have been implemented to control dengue fever in Ecuador, the disease continues to be a significant threat to public health, as epidemiological data show an increase in its incidence.

The combination of climatic, socioeconomic, and ecological factors requires a comprehensive response involving health authorities, local governments, and the community.

In this context, improving epidemiological surveillance strategies, strengthening vector control, and promoting community education are essential to reducing the burden of dengue in the country. Genetic monitoring of the virus and integrating climate change into public health policies are also essential for an effective response. Adopting multidisciplinary approaches and interagency cooperation will be key to reducing the incidence and impact of dengue in the country.

FINANCING

None.

CONFLICT OF INTEREST

None.

AUTHORSHIP CONTRIBUTION

Conceptualization: Evelin Alexandra Zúñiga Sosa.
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