

TYPE 2 DIABETES MELLITUS AS A RISK FACTOR FOR DENGUE MORTALITY IN THE YEARS 2020-2024 IN THE OOAD SOUTH VERACRUZ

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Abstract:

Background: In recent years, dengue fever has become a public health issue due to its high global prevalence. In Mexico, it has been shown that socioeconomic status plays a role in the disease; furthermore, patients with comorbidities such as type 2 diabetes mellitus is a risk factor for dengue mortality in the OOAD Veracruz Sur during the years 2020-2024.

Objective: To determinate the risk of mortality from dengue in patients with type 2 diabetes mellitus during the years 2020-2024 in the OOAD Veracruz Sur.

Materials and Methods: A case-control study with a 1:3 ratio (93 cases and 279 controls) was conducted, utilizing patient records from SISMOR (Mortality System) regarding dengue cases within the Veracruz South OOAD. The data were analyzed using descriptive statistics for sociodemographic variables; risk was assessed by calculating the odds ratio (OR) and 95% confidence interval (CI), with statistical significance defined as $p \leq 0.05$.

Results: The study analyzed 93 cases (13.4% male). The Overall mean age was 59 years. Based on the study objectives, a higher dengue mortality rate was identified in 2020 (2.01 per 100,000 inhabitants). Additionally, laboratory markers such as SGOT high, SGPT high, and hyperalbuminemia showed elevated levels, accompanied by abdominal pain as a clinical feature. Risk analysis regarding the association between type 2 diabetes mellitus and dengue mortality yielded an OR of 1.018 (95% CI:0.604-1.716) with a p-value of 0.947.

Conclusions: Dengue remains one of the most significant vector-borne diseases in Mexico, particularly in the state of Veracruz, where climatic, geographic, and epidemiological conditions foster the virus's continuous circulation and persistence of seasonal outbreaks. The region covered by the Veracruz South Deconcentrated Administrative Operation Body (OOAD) is endemic for disease; therefore, analyzing mortality risk factors is a crucial tool for strengthening epidemiological surveillance, optimizing medical care, and contributing to the reduction of mortality.

Key words: Dengue, mortality

Introduction:

Dengue is one of the vector-borne diseases with the greatest global impact on public health. In recent decades, dengue incidence, has shown a sustained increase linked to factors such as urbanization, population mobility, climate change, and limitations in vector control, resulting in a continuous and significant burden of morbidity and mortality across many Latin American countries.

In Mexico, dengue is considered a priority public health issue due to its wide geographical distribution and the constant occurrence of epidemic outbreaks. The state of Veracruz is regarded as a region with high disease transmissibility, driven by its climatic, environmental, and demographic conditions with the southern region of the state being particularly notable for harboring conditions that favor vector persistence and virus circulation, thereby leading to a high number of reported cases annually.

Dengue mortality is largely preventable through timely case detection, appropriate clinical monitoring, and prompt management of complications. Various factors can influence poor patient outcomes, including sociodemographic conditions, the quality of health services, and pre-existing comorbidities. Identifying factors such as comorbidities is crucial for strengthening epidemiological surveillance strategies, optimizing medical care, and reducing adverse outcomes that could otherwise lead to death.

Consequently, analyzing the factors associated with dengue mortality provides a better understanding of the determinants influencing the progression to severe forms of the disease and the occurrence of fatalities. Furthermore, it offers scientific evidence to support public health decision-making, targeted interventions, and the design of more effective prevention and control programs.

Materials and Methods:

Type of study:

Retrospective case-control study during January 2020 to December 2024.

Study population:

This study included patients who met the operational definition of dengue across its various classifications, as well as all patients entered in to the Veracruz Sur mortality system between 2020 to 2024.

Data collected:

Selection criteria:

Cases

Inclusion criteria:

*Male and female clinical expedients, aged from 1 to 90 years, who are registered on the SINAVE ETV platform for dengue fever and who are confirmed to be sick by NS1 or IgM, who are registered for hospitalization between 2020 and December 2024 in all hospital units of the OOAD Veracruz on that SISMOR (Mortality System) it was established as the cause of the death, the diagnosis of dengue in addition to several variables (dengue with alarm signs, dengue with alarm signs or severe dengue).

Exclusion criteria:

*Clinical expedients of patients with dengue diagnosis without confirmatory study.

Elimination criteria:

*Incomplete clinical expedient.

Controls:

Inclusion criteria:

*Medical expedient of men and women aged 1 to 90 years, who are registered in the SINAVE ETV platform for dengue, with confirmation NS1 or IgM, and a record of hospitalization between January 2020 and December 2024 at any of hospital units within the OOAD Veracruz Sur.

Exclusion criteria:

*Patient records with diagnosis of dengue but without a confirmatory test.

Elimination criteria:

*Incomplete medical expedient.

Ethical considerations:

All procedures comply with the provisions of the General Health Law Regulations- specifically the Regulations on Health Research (Titles I through VI and Title IX, 1987) and Technical Standard No. 313 regarding the submission of research projects and technical reports in healthcare institutions.

Results:

A case-control study was conducted in the Veracruz South OOAD to determine the risk of mortality from dengue in patients with type 2 diabetes mellitus. A sample of 372 records was obtained comprising 93 cases (25%) and 279 controls (75%) yielding a 1:3 ratio. Various sociodemographic, clinical, and laboratory variables were analyzed. The overall mean age was 59 years (SD ± 15.939). Among the cases, men accounted for 13.4% (50 cases), a proportion higher than that of women; a similar pattern was observed among the controls, where men accounted for 185 (49.7%) (Table 1).

Table 1. Frequency and percentage by sex.

Sex n=	Cases (93)		Controls (279)	
	Total	%	Total	%
Female	43	11.6	94	25.3
Male	50	13.4	185	49.7

Higher frequency of men among cases and controls: 50 (13.4%) and 185 (49.7%), respectively

Clinical and laboratory characteristics were obtained from the database; regarding the variable of thrombocytopenia, it was more prevalent in the control group (103; 27.7%) compared to the case group (65; 17.5%). Type 2 diabetes mellitus was more common among controls (200; 53.8%) than among cases (67; 18%). Regarding liver function tests, elevated AST levels were observed in 60 cases (16.1%) compared to 31 controls (8.3%); similarly, a higher count of elevated ALT levels was found in cases (60; 16.1%) compared to controls (31; 8.3%). Hyperalbuminemia was more frequent in cases (60; 16.1%) than in controls (35; 9.4%).

Hemoconcentration was more common in controls (143; 38.4%) than in cases (53; 14.2%). Leukopenia was more frequent in controls (139; 37.5%) than in cases (62; 16.7%). Among clinical signs, mucosal bleeding occurred in 30 controls (8.1%) and 11 cases (3%); abdominal pain was more common in cases (68; 18.3%) than in controls (65; 17.5%); and persistent vomiting was more frequent in controls (20; 5.4%) than in cases (13; 3.5%) (Table 2).

Table 2. Mortality rate per year.

Year	Deaths	Population	Rate per 100,000 habitants
2020	23	1,143,817	2.0108
2021	23	1,170,564	1.9649
2022	13	1,200,852	1.0826
2023	20	1,212,348	1.6497
2024	14	1,190,864	1.1756

A higher mortality incidence was observed in the years 2020 (2.01), 2021 (1.96), and 2023 (1.64).

Additionally, laboratory markers such as SGOT, SGPT, and hyperalbuminemia showed elevated levels, accompanied by abdominal pain as a clinical feature.

Annual mortality rates were calculated based on SISMOR records from the Veracruz South OOAD for the study period (January 2020 to December 2024), revealing the highest mortality rates for this arboviral disease in 2020 (2.01), followed by 2021 (1.96) and 2023 (1.64) (Table 3).

Table 3. Clinical and laboratory characteristics.

Variables n=	Cases (93)		Controls (279)	
	Total	Percent %	Total	Percent %
Thrombocytopenia	65	17.5	103	27.7
Diabetes	67	18	200	53.8
SGOT high	60	6.1	31	8.3
SGPT high	60	16.1	31	8.3
Hyperalbuminemia	60	16.1	35	9.4
Hemoconcentration	53	14.2	143	38.4
Leukopenia	62	16.7	139	37.5
Mucosal bleeding	11	3	30	8.1
Abdominal pain	68	18.3	65	17.5
Persistent vomiting	13	3.5	20	5.4

A higher distribution of cases was observed for the following variables: elevated SGOT 60 (16.1%), elevated SGPT 60 (16.1%), hyperalbuminemia 60 (16.1%), and abdominal pain 68 (18.3%), in contrast, the control group showed a predominance of thrombocytopenia 103 (27.7%), diabetes 200 (53.8%), hemoconcentration 143 (38.4%), leukopenia 139 (37.5%), mucosal bleeding 30 (8.1%), and persistent vomiting 20 (5.4%).

An analysis of dengue mortality by sex was conducted, revealing higher mortality among men 50 (13.4%) compared to women 3 (11.6%). (Table 4)

Table 4. Risk of type 2 diabetes mellitus for dengue mortality.

Variables	Cases (93)	Controls (279)	OR	IC (95%)	p
Diabetes					
Yes	67	200	1.018	0.604-1.716	0.947
No	26	79			

An OR of 1.018 for type 2 diabetes mellitus in dengue was obtained.

It was determined that the age group most affected by this arboviral disease was the 70–79 age group, with 33 cases (8.9%), followed by the 60–69 age group with 22 cases (5.9%), resulting in an overall mean age of 59 years (**Table 5**).

Table 5. Dengue mortality by age group.

Age group	Frequency	Percentage %
1 to 9 years old	3	0.8
10 to 19 years old	1	0.3
20 to 29 years old	2	0.5
30 to 39 years old	4	1.1
40 to 49 years old	4	1.1
50 to 59 years old	11	3.0
60 to 69 years old	22	5.9
70 to 79 years old	33	8.9
80 to 89 years old	12	3.2
90 to 99 years old	1	0.3

A higher incidence of mortality was observed in the 70-79 age group, with 33 cases (8.9%).

An odds ratio (OR) was calculated to determine the risk of dengue-related mortality in patients with type 2 diabetes mellitus; an OR of 1.018 was obtained (95% CI: 0.604–1.716; p-value: 0.947). Similar frequencies were observed between cases and controls, indicating that type 2 diabetes mellitus is not a risk factor for mortality (**Table 6**).

Table6. Risk of type 2 diabetes mellitus for dengue mortality.

Variables	Casos (93)	Controles (279)	OR	IC (95%)	p
Diabetes					
Yes	67	200	1.018	0.604-1.716	0.947
No	26	79			

An OR of 1.018 for type 2 diabetes mellitus in dengue was obtained.

Clinical and laboratory variables were analyzed to determine their status as risk factors. Thrombocytopenia yielded an OR of 3.967 (95% CI: 2.393–6.575; $p < 0.001$), indicating it is a risk factor for dengue mortality.

Liver function tests identified as elevated included aspartate aminotransferase (SGOT), alanine aminotransferase (SGTP), and albumin (hyperalbuminemia). SGOT and SGTP shared an OR of 14.545 (95% CI: 8.263–25.606; $p < 0.001$), representing a 14.5-fold higher odds of death; thus, they were concluded to be risk factors. Hyperalbuminemia yielded an OR of 12.675 (95% CI: 7.290–22.038; $p < 0.001$), leading to the conclusion that elevation of this parameter is a risk factor.

Hemoconcentration yielded an OR of 1.260 (95% CI: 0.785–2.022; $p = 0.337$), indicating that this variable is not a risk factor for mortality.

Leukopenia yielded an OR of 2.082 (95% CI: 1.269–3.415; $p = 0.003$), identifying it as a risk factor for dengue mortality. Among the clinical variables, mucosal bleeding showed an OR of 1.113 (95% CI: 0.534–2.321; $p = 0.082$), indicating that it is not a risk factor.

Abdominal pain showed an OR of 8.955 (95% CI: 5.240–15.304; $p < 0.001$); unlike mucosal bleeding, abdominal pain was identified as a risk factor, associated with an 8.955-fold higher risk of mortality.

Persistent vomiting showed an OR of 2.104 (95% CI: 1.002–4.419; $p = 0.045$), indicating that this clinical sign is a risk factor for dengue mortality. (**Table 7**)

Table7. Odds ratio analysis for laboratory and clinical variables.

Variables		Cases (93)	Controls (279)	OR	IC (95%)	p
Thrombocytopenia						
	Yes	65	103	3.967	2.393-6.575	<0.001
	No	28	176			
SGOT high						
	Yes	60	31	14,545	8.263-25.606	<0.001
	No	33	248			
SGPT high						
	Yes	60	31	14,545	8.263-25.606	<0.001
	No	33	248			
Hyperalbuminemia						
	Yes	60	35	12.675	7.290-22.038	<0.001
	No	33	244			
Hemoconcentration						
	Yes	53	143	1.260	0.785-2.022	<0.337
	No	40	136			
Leukopenia						
	Yes	62	139	2.082	1.269-3.415	0.003
	No	30	140			
Mucosal bleeding						
	Yes	11	30	1.113	0.534-2.321	0.082
	No	82	249			
Abdominal pain						
	Yes	68	65	8.955	5.240-15.304	<0.001
	No	25	214			
Persisting vomiting						
	Yes	13	20	2.104	1.002-4.419	0.045
	No	80	80			

A notable odds ratio (OR) was observed for laboratory variables such as SGOT / SGPT, followed by hyperalbuminemia. A prominent clinical variable associated with elevated risk was abdominal pain.

DISCUSSION

A 2017 meta-analysis by Guo et al. covering countries such as India, China, and Brazil and a subsequent 2022 systematic review and meta-analysis by Chagas et al. examined the global epidemiology of dengue outbreaks (based on a sample of 360). They found a combined mean age of 30.1 years among infected individuals and a mortality rate of 1.3%; type 2 diabetes mellitus (T2DM) was identified as a major risk factor for dengue mortality, with an odds ratio (OR) of 2.5 ($p=0.05$). These findings differ from those observed in the population of the current study, where the OR for T2DM was 1.18 ($p=0.947$).³⁰

In a 2021 meta-analysis conducted across various dengue-endemic countries (including Brazil, Mexico, and Colombia), Tsheten et al. aimed to identify clinical predictors associated with progression to severe dengue (based on a sample of 87). They concluded that T2DM was a significant risk factor for developing severe dengue; diabetic patients faced nearly three times the risk of progressing to severe forms of the disease compared to non-diabetic patients (OR: 2.88; 95% CI: 1.72–4.81). This contrasts with the OR found in the present study, which indicated that the presence of T2DM is not a risk factor for dengue mortality within this specific administrative health unit (OOAD).³³

In a retrospective observational study conducted by Chen Chih-Yuan et al. in Kaohsiung, Taiwan, and published in 2015 (supported by Lu et al. in their 2024 meta-analysis) which aimed to investigate the relationship between type 2 diabetes mellitus and the severity of thrombocytopenia in patients with dengue infection (sample size: 500) a p -value of 0.004 was obtained. This indicated that older patients tended to exhibit more severe thrombocytopenia than younger patients; regarding this clinical variable, it was concluded that patients with type 2 diabetes mellitus had significantly lower platelet counts. Similarly, in the Veracruz Sur region, thrombocytopenia yielded an Odds Ratio (OR) of 3.967 with a p -value <0.001 , indicating that patients faced a 3.9-fold higher risk of death associated with this hematological alteration, thereby establishing it as a risk factor for dengue mortality.³¹

The Odds Ratio calculation demonstrated that, in the Veracruz Sur region, type 2 diabetes mellitus is not a risk factor for dengue mortality; however, high OR values were observed for elevated SGOT high (OR: 14.545) and SGPT high (OR: 14.545) levels, hyperalbuminemia (OR: 12.675), and thrombocytopenia (OR: 3.967), highlighting the importance of clinical warning signs and hematological alterations in the fatal progression of dengue.

Therefore, the Mexican Social Security Institute must adopt an approach emphasizing prevention and training for operational health personnel including physicians, nurses, and trainees since the area is at high risk for this arboviral disease, necessitating appropriate and timely management of these patients and the factors associated with disease complications.

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267 **Conclusion:**

268 Dengue remains one of the most significant vector-borne diseases in Mexico, particularly in the
269 state of Veracruz, where climatic, geographic, and epidemiological conditions foster the virus's
270 continuous circulation and the persistence of seasonal outbreaks. The region covered by the
271 Veracruz South Deconcentrated Administrative Operation Body (OOAD) is endemic for this
272 disease; therefore, analyzing risk factors associated with dengue mortality is a crucial tool for
273 strengthening epidemiological surveillance, optimizing medical care, and helping to reduce
274 mortality rates.

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276 This study did not identify type 2 diabetes mellitus as a risk factor for dengue mortality. This
277 finding may be linked to the way variables were obtained specifically, the failure to account for
278 the severity of the clinical presentation or whether the diabetes was controlled or
279 uncontrolled which could have influenced the expected outcome.

280
281 One of the strengths of the Mexican Social Security Institute (IMSS) is its extensive healthcare
282 workforce; consequently, continuous training regarding this endemic arboviral disease is crucial
283 to ensure the optimal identification of clinical risk factors, such as abdominal pain. Furthermore,
284 the Institute possesses adequate facilities for laboratory testing, which bolsters the early detection
285 of hematological abnormalities associated with a risk of dengue-related mortality.

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287 From an epidemiological perspective, the findings of this study provide relevant evidence to
288 address areas for improvements specifically regarding dengue prevention, surveillance, and
289 control strategies within the OOAD Veracruz Sur administrative division. Early detection of risk
290 factors for dengue mortality can contribute to improved risk stratification, optimized timely
291 patient referral, and the implementation of interventions aimed at reducing complications and
292 fatalities related to this disease. Similarly, the lack of training for healthcare personnel regarding
293 dengue and its mortality-related risk factors represents a weakness; therefore, the implementation
294 of new information and training measures is recommended. This type of arboviral disease
295 remains a public health threat, as Veracruz is an endemic region; consequently, strengthening
296 optimal care and the identification of risk factors serves as a preventive measure against
297 complications and mortality.

298 Finally, the alternative hypothesis was rejected and the null hypothesis was accepted,
299 establishing that the presence of type 2 diabetes mellitus in the Southern Veracruz region is not a
300 risk factor for dengue-related mortality.

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