RESEARCH PAPER

Early Diagnosis Of Dengue In Children: Validation Of A Clinical Scale

Elvis Eduardo Piñeres Mejía[1*], Carlos Andrés Ospina Mendieta[2], Valentina Mejía Chacón[3], Daura Saray Piñeres Zapata[4]

[1] Facultad De Medicina, Universidad Cooperativa De Colombia, Villavicencio, Colombia.
[2] Servicio De Pediatría, Hospital Universitario Ruiz Y Páez, Ciudad Bolívar, Venezuela.
[3] Facultad De Medicina, Universidad Cooperativa De Colombia, Villavicencio, Colombia.
[4] Facultad De Medicina, Universidad Cooperativa De Colombia, Villavicencio, Colombia.

Institution Associated For Indexing: Departamento De Pediatría, Hospital Universitario Ruiz Y Páez, Ciudad Bolívar, Venezuela.

Orcid Ids: Elvis Eduardo Piñeres Mejía: 0000-0001-5745-6381, Carlos Andrés Ospina Mendieta: 0000-0001-6538-0516, Valentina Mejía Chacón: 0009-0004-9666-7172, Daura Saray Piñeres Zapata: 0009-0003-6072-4692

Author Contributions: Piñeres Mejía Ee: Study conception and design, data analysis and interpretation, manuscript writing, and critical revision. Ospina Mendieta Ca: Data collection, statistical analysis, literature review, manuscript revision. Mejía Chacón V: Statistical analysis, literature review. Piñeres Zapata Ds: Statistical analysis, literature review.

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Corresponding Author: Elvis Eduardo Piñeres Mejía, Telephone: +57 3123813707, Email: elyatassg@gmail.com

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Abstract

Objective: To evaluate the effectiveness of a clinical diagnostic scale as a first-line tool for the early diagnosis of dengue in a pediatric emergency department.

Method: A prospective, descriptive, cross-sectional field study was conducted including 284 pediatric patients (<12 years) with acute febrile syndrome of unknown origin. The diagnostic scale assigned scores to clinical signs (rash, positive tourniquet test, absence of rhinorrhea, arthralgia, absence of diarrhea) and hematological findings (leukocytes <4,000/mm³ and platelets <180,000/mm³). Serological confirmation (igm) was used as the gold standard. Sensitivity, specificity, and predictive values were calculated.

Results: Dengue was serologically confirmed in 270 patients (95.1%). The scale demonstrated a sensitivity of 100% (95% ci: 97.7-100%) and a specificity of 74.4% (95% ci: 44.8-91.8%). The positive predictive value was 100% (95% ci: 97.7-100%), and the negative predictive value was 16.9% (95% ci: 9.9-27.0%). The positive tourniquet test showed the strongest association with confirmed dengue (rr: 58.9; 95% ci: 8.0-431.4).

Conclusions: The proposed diagnostic scale is a useful, practical, and reliable tool for the initial identification of dengue in children in endemic areas, enabling timely clinical decisions. Its high sensitivity makes it excellent for screening, but its low negative predictive value indicates that a negative result does not rule out the disease, warranting serological confirmation.

Keywords: Dengue, Early Diagnosis, Pediatrics, Diagnostic Techniques And Procedures, Sensitivity And Specificity.

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INTRODUCTION

Vector-borne diseases, such as dengue, represent a major public health challenge in endemic regions. In the pediatric population, this challenge is even greater due to the nonspecific clinical presentation in the initial stages, which closely resembles other febrile exanthematous childhood illnesses, (1) making early diagnosis difficult, delaying appropriate treatment, and increasing the risk of

progression to severe forms of the disease. Furthermore, established clinical definitions, such as those proposed by the World Health Organization (WHO), (2) have shown high sensitivity but low specificity, limiting their utility in healthcare settings with restricted diagnostic resources. (3)

In response to this need, diagnostic scales have been developed that combine clinical and laboratory criteria to improve the accuracy of early dengue diagnosis. These diagnostic tools have proven useful for identifying dengue cases in the early stages of the disease, enabling timely and appropriate interventions.(4) Validating these scales across different clinical and population settings is essential to ensure their effectiveness and applicability in real-world contexts.(5)(6)(7)(8)(9)(10)

The aim of this study was to validate the usefulness of a diagnostic scale as a first-line tool for the diagnosis of dengue in pediatric patients attending the pediatric emergency department at Ruiz y Páez University Hospital in Ciudad Bolívar, Venezuela, during the period from March to August 2016.

MATERIALS AND METHODS

A prospective, descriptive, cross-sectional, non-experimental field study was conducted in the pediatric emergency department of Ruiz y Páez University Hospital, located in Ciudad Bolívar (Venezuela), between March and August 2016. The study population consisted of pediatric patients (<12 years old) with acute febrile syndrome of unknown origin whose score on the clinical dengue diagnostic scale was equal to or greater than 4 points. This institutional diagnostic scale for dengue, based on clinical and analytical criteria, was used as the classification tool. (7)

A total of 284 patients were included, selected through non-probabilistic purposive sampling. Inclusion criteria were age from 1 day old to 11 years, 11 months, and 29 days; both sexes; and the presence of acute fever with a score ≥4 on the diagnostic scale. Patients without fever or with a confirmed diagnosis of another etiology were excluded.

Data collection included sociodemographic variables, clinical findings, and hematological parameters (leukocyte and platelet counts). A standardized data collection form was used, and serological confirmation was performed using UMELISA DENGUE IgM PLUS in patients with ≥5 days of symptoms.

Statistical analysis was conducted using SPSS version 26.0. Descriptive and inferential statistics were applied, including chi-square test, odds ratio (OR), logistic regression, and ROC curve analysis, with a significance level of 95%.

The institutional ethics committee approved the study. Informed consent was obtained from parents or legal guardians, ensuring confidentiality, autonomy, and beneficence, in accordance with the Declaration of Helsinki.

RESULTS

Of the 284 pediatric patients evaluated, 270 (95.07%) evaluated positive for dengue by serology, while 14 (4.93%) evaluated negative. The diagnostic scale correctly identified 201 patients as positive (70.77%) and misclassified sixty-nine seropositive patients as negative. Only fourteen patients were classified as negative by both the scale and serological testing (4.93%).

Actual effectiveness of the dengue diagnostic scale	Percentage	95% confidence interval	
		Lower limit	Upper limit
Disease prevalence	95,07	91,68	97,17
Correctly diagnosed patients	75,7	000	000
Positive predictive value	100	97,66	99,95
Negative predictive value	16,87	9,85	27,02

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Age	Diagnostic scale				Total		P value
	Positive		Negative				
	N	%	N	%	N	%	
0 to 3	47	16,55	19	6,69	66	23,24	0,94
4 to 7	69	24,3	39	13,73	108	38,03	
8 to 11	85	29,93	25	8,8	110	38,73	
Total	201	70,77	83	29,23	284	100	
Sex							
Male					147	51,73	
Female					137	48,24	
Total					284	100	

Table 1 Children with dengue according to the agreement between the Dengue Diagnostic Scale and dengue serology. Pediatric Emergency Department, Ruiz y Páez University Hospital, March–August 2016.

The sensitivity obtained was 100%, with 75.7% of patients correctly diagnosed. The positive predictive value (PPV) was 100%, and the negative predictive value (NPV) was 16.87%.

Table 2. Children with dengue according to the specificity of the Dengue Diagnostic Scale. Pediatric Emergency Department, Ruiz y Páez University Hospital, March–August 2016.

Serology for dengue						
Diagnostic Scale	Positive		Negative		Total	
	N	%	N	%	N	%
Positive	201	70,77	0	0	201	70,77
Negative	69	24,3	14	4,93	83	29,23
Total	270	95,07	14	4,93	284	100

The most affected age group was 8 to 11 years (38.73%), followed by 4 to 7 years (38.03%), and 0 to 3 years (23.24%). Regarding sex distribution, the proportions were similar: 51.76% male and 48.24% female.

Table 3. Children with dengue according to age group. Pediatric Emergency Department, Ruiz y Páez University Hospital, March–August 2016

Among comorbidities, asthma was the most frequent, present in 4.93% of patients with a positive diagnosis, and was associated with a relative risk (RR) of 6.14 (95% CI: 0.79–47.46) (Table 4).

Table 4. Children with dengue according to comorbidities identified by the Dengue Diagnostic Scale. Pediatric Emergency Department, Ruiz y Páez University Hospital, March–August 2016.

Comorbidities		Diagnostic scale						P value
		Positive		Negative		Total		
		N	%	N	%	N	%	
Asthma	Yes	14	4,93	1	0,35	15	5,28	0,03
	No	187	65,85	82	28,87	269	94,72	
Hypertension	Yes	2	0,7	0	0	2	0,7	0,5
	No	199	70,07	83	29,23	282	99,3	
Skin disorders	Yes	Yes	1	0,35	0	0	1	0,7
	No	No	200	70,42	83	29,23	283	
Renal failure	Yes	1	0,35	0	0	1	0,35	0,7
	No	200	70,42	83	29,23	283	99,65	
Sickle cell anemia	Yes	1	0,35	0	0	1	0,35	0,7
	No	200	70,42	83	29,23	283	99,65	
Allergies	No	201	70,77	83	29,23	284	100	NA
Heart disease	No	201	70,77	83	29,23	284	100	NA
Heart failure	No	201	70,77	83	29,23	284	100	NA
Gastrointestinal disease	No	201	70,77	83	29,23	284	100	NA
Liver disease	No	201	70,77	83	29,23	284	100	NA
Diabetes mellitus	No	201	70,77	83	29,23	284	100	NA
Hypercholesterolemia	No	201	70,77	83	29,23	284	100	NA
Hyperlipidemia	No	201	70,77	83	29,23	284	100	NA
Solid tumor	No	201	70,77	83	29,23	284	100	NA

Regarding risk factors, the presence of mosquito breeding sites in the home environment was reported in 54.23% of cases (Table 5). The absence of piped water supply, water storage practices, and the use of drums were significantly associated with a positive diagnosis ($p < 0.01$).

Table 5. Children with dengue according to risk factors identified by the Dengue Diagnostic Scale. Pediatric Emergency Department, Ruiz y Páez University Hospital, March–August 2016.

Comorbidities		Diagnostic scale						P value
		Positive		Negative		Total		
		N	%	N	%	N	%	
Previous dengue infection	Yes	9	3,16	1	0,37	10	3,53	0,03
	No	202	71,12	72	25,35	274	96,47	
Breeding sites in the house or nearby	Yes	115	40,49	39	13,73	154	54,23	0,07
	No	86	30,28	44	15,49	130	45,77	
Presence of mosquitoes in the area	Yes	201	70,77	83	29,23	284	100	NA
Piped water Supply	Yes	135	47,54	69	24,3	204	71,83	0,004
	No	66	23,24	14	4,93	80	28,17	
Stores water at home	Yes	71	25	16	5,63	87	30,63	0,005
	No	130	45,77	67	23,59	197	69,37	
Use of drums and/or barrels	Yes	71	25	16	5,63	87	30,63	0,005
	No	130	45,77	67	23,59	197	69,37	
Continuous water supply	Yes	135	47,54	69	24,3	204	71,83	0,004
	No	66	23,24	14	4,93	80	28,17	
Tires and bottles present at home	Yes	115	40,49	39	13,73	154	54,23	0,075
	No	86	30,28	44	15,49	130	45,77	
Window/door screens at home	Yes	19	6,69	10	3,52	29	10,21	0,33
	No	182	64,08	73	25,7	255	89,79	
Use of wire mesh on windows	Yes	191	67,25	76	26,76	267	94,01	0,197
	No	10	3,52	7	2,46	17	5,99	
Use of insecticide at home	No	201	70,77	83	29,23	284	100	NA
Use of repellent	No	201	70,77	83	29,23	284	100	NA
Access to garbage collection service	Yes	123	43,31	61	21,48	184	64,79	0,032
	No	78	27,46	22	7,75	100	35,21	
Relative or neighbor with similar symptoms	Yes	53	18,66	16	5,63	69	24,3	0,132
	No	148	52,11	67	23,59	215	75,7	
Patient with social risk	Yes	22	7,75	9	3,17	31	10,92	0,582
	No	179	63,03	74	26,06	253	89,08	
Child under 5 years old	Yes	24	8,45	9	3,17	33	11,62	0,485
	No	177	62,32	74	26,06	251	88,38	

Regarding the relative risk analysis of the individual parameters in the diagnostic scale, a positive tourniquet test showed the strongest association with dengue diagnosis (RR: 58.87; 95% CI: 8.03–431.41; $p < 0.001$) (Table 6), followed by the presence of rash (RR: 8.52), arthralgia (RR: 7.04), and leukocyte count <4,000/mm³ (RR: 1.91). Platelet count <180,000/mm³ also showed a significant association (RR: 3.93; $p < 0.01$).

Diagnostic scale	Relative risk	95% confidence interval		p value
		Lower limit	Upper limit	
Leukocytes <4,000	1,91	1,63	2,24	<0,001
Platelets <180,000	3,93	0,58	26,08	<0,01
Rash	8,52	3,30	22,02	<0,001
Arthralgia	7,04	2,12	23,43	<0,001
Positive tourniquet test	58,87	8,03	431,41	<0,001
Absence of rhinorrhea	0,71	0,66	0,76	0,78
Absence of diarrhea	0,76	0,63	0,90	0,07

Table 6. Children with dengue according to relative risk are associated with the variables of the diagnostic scale.

Pediatric Emergency Department, Ruiz y Páez University Hospital, March–August 2016.

DISCUSSION

An analysis of 284 pediatric patients revealed that 95.07% were seropositive for dengue, highlighting a high prevalence in the studied population. The diagnostic scale used showed a sensitivity of 100%, with 75.7% of patients correctly diagnosed, a positive predictive value (PPV) of 100%, and a negative predictive value (NPV) of 16.87%. When comparing the number of positive cases identified by the scale and those confirmed by laboratory tests, the results showed that in 71% of cases, the diagnosis was positive according to the initial scale assessment and later corroborated by laboratory confirmation, while 5% of cases were negative according to both diagnostic approaches. These findings indicate that the diagnostic scale provides greater accuracy than the 2009 WHO dengue classification in the early clinical identification of dengue in endemic areas. (3)(8)(11)

These results make this diagnostic tool a reliable method for diagnosing dengue in pediatric populations within endemic areas. From this perspective, the diagnostic predictive capacity of the scale yields promising results, with a high percentage of correctly diagnosed patients [75%; 95% confidence interval (CI): 70.21% to 80.49%]. The utility of the scale as a diagnostic tool is particularly relevant in the current context of expanding dengue outbreaks across Latin America and globally. (7)(8)(12)(13)

These findings are significantly important, especially considering that most countries in the Americas are classified as endemic for dengue. In such settings, it is essential that healthcare professionals and primary care teams have access to supportive tools to aid clinical suspicion and early diagnosis of the virus. (14)(15)(16)

Age distribution revealed that the groups aged 8 to 11 years and 4 to 7 years were the most affected, accounting for 38.73% and 38.03% of cases, respectively. These results indicate that the highest number of cases occur among school-aged children, who are more likely to be exposed to the virus. Similar studies have concluded that there is a high cumulative incidence of DENV infections among school-age children. However, no statistically significant differences were found between age groups and diagnostic scale scores, suggesting that dengue affects all pediatric age groups in a homogeneous manner. (16)(17)(18)(19)

Regarding sex, the distribution was balanced, with 51.76% of cases in males and 48.24% in females. No statistically significant differences were observed between sex and diagnostic scale scores, indicating that dengue affects both sexes equally. (15)(20)

Asthma was the most frequent comorbidity, present in 4.93% of patients with a positive diagnosis, and it was associated with a relative risk (RR) of 6.14, although the wide confidence interval (95% CI: 0.79-47.46) suggests that further studies are needed to confirm this association. (19)(21)

Environmental and socioeconomic factors play a key role. The presence of mosquito breeding sites in the household environment was reported in 54.23% of cases. Additionally, the lack of piped water supply, water storage practices, and the use of barrels were significantly associated with a positive diagnosis (*p* < 0.01). These are among the main factors facilitating the spread of the dengue virus, increasing mosquito breeding near outbreak zones, which underscores the need to improve sanitation and infrastructure to prevent dengue transmission. (22)(23)

It is important to note that the combination of these contributing factors—such as weak public health programs, ineffective vector control, lack of adherence to management guidelines, misdiagnosis, inadequate treatment, limited vaccine coverage, poor health promotion, and minimal community involvement in disease control—has made dengue a major global public health threat, currently affecting over two-thirds of the world's population.(24)(25)

In the analysis of individual parameters from the diagnostic scale, a positive tourniquet test showed the strongest association with dengue diagnosis (RR: 58.87; 95% CI: 8.03–431.41; *p* < 0.001), followed by the presence of rash (RR: 8.52), arthralgia (RR: 7.04), and leukocyte count <4,000/mm³ (RR: 1.91). A platelet count <180,000/mm³ was also significantly associated (RR: 3.93; *p* < 0.01). These findings are consistent with previous studies that identified these clinical signs and laboratory findings as key indicators in the diagnosis of dengue. (7)(8)(6)

CONCLUSIONS

The specificity and sensitivity of the evaluated diagnostic scale confirm its potential usefulness as a primary tool for diagnosing dengue, facilitating early

identification and supporting its application in pediatric populations.

The diagnostic scale demonstrated high sensitivity, proving effective in identifying positive cases of dengue in children. However, its moderate specificity and low negative predictive value highlight limitations in detecting negative cases, which may lead to misclassification. Therefore, it is essential to complement this tool with serological testing and to consider both clinical and epidemiological factors to enhance diagnostic accuracy.

The presence of comorbidities such as asthma and a history of prior dengue infection increases the risk of acquiring dengue.

Vaccination against dengue represents a promising strategy for the prevention and control of the disease. Nonetheless, the implementation of vaccination programs faces challenges related to safety, efficacy, availability, cost, and public acceptance.

The findings suggest that this diagnostic scale provides greater accuracy for early diagnosis in pediatric populations in endemic areas than the 2009 WHO dengue classification.

Based on the results obtained, the dengue diagnostic scale showed statistical validity, establishing it as a useful, practical, and reliable tool for primary diagnosis of the disease upon patient admission to emergency departments in healthcare centers located in endemic regions.

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