



## Laboratory analysis of patients infected with the dengue virus

Análises laboratoriais de pacientes infectados pelo vírus da dengue

Análisis laboratoriales en pacientes infectados por el virus del dengue

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### ABSTRACT

**Objective:** To analyze the laboratory data of patients infected with the dengue virus (DENV) in order to identify characteristic patterns associated with the infection. **Methods:** A cross-sectional retrospective study was conducted, evaluating secondary laboratory data from 2,117 patients treated at the Laboratory of the Military Police of the State of Goiás (LCHPM) between 2020 and 2022. Data from 389 patients who tested positive for DENV infection through NS1, IgM, and IgG assays were included. The following laboratory parameters were assessed: total leukocyte count, neutrophils, lymphocytes, platelet count, and the platelet-to-lymphocyte ratio (PLR), neutrophil-to-lymphocyte ratio (NLR), and leukocyte-to-lymphocyte ratio (LLR). The study was approved by the Research Ethics Committee. **Results:** A total of 389 patients were diagnosed with dengue, showing significant alterations in platelet count ( $p < 0.0001$ ), leukocytes ( $p < 0.0001$ ), lymphocytes ( $p < 0.0001$ ), neutrophils ( $p < 0.0001$ ), and monocytes ( $p = 0.0044$ ), when compared with patients negative for infection. A marked increase in cases was observed in 2022, with a 330% rise between the fourth quarter of 2021 and the third quarter of 2022. **Conclusion:** The laboratory profile of the analyzed patients confirmed thrombocytopenia, leukocytosis, lymphopenia, monocytosis, elevated neutrophils, and hepatic alterations in infected patients, reinforcing the importance of laboratory and epidemiological analysis in the clinical management of dengue.

**Keywords:** Dengue, Diagnosis, NS1, Infection, Serological markers.

### RESUMO

**Objetivo:** Analisar os dados laboratoriais de pacientes infectados pelo vírus da dengue (DENV), a fim de identificar padrões característicos associados à infecção. **Métodos:** Estudo retrospectivo transversal que avaliou os dados laboratoriais secundários de 2.117 pacientes atendidos no laboratório da Polícia Militar do Estado de Goiás (LCHPM) de 2020 a 2022. Foram incluídos no estudo, os dados de 389 pacientes que tiveram os testes de NS1, IgM e IgG positivos para infecção por DENV. Os seguintes dados laboratoriais foram utilizados para avaliação nesse trabalho: parâmetros hematológicos de: leucócitos totais, neutrófilos, linfócitos e contagem de plaquetas e as razões de plaquetas/linfócitos (PLR), neutrófilos/linfócitos (NLR) e leucócitos/linfócitos (LLR). O estudo foi aprovado pelo Comitê de Ética em Pesquisa. **Resultados:** No total, 389 pacientes foram diagnosticados com dengue, apresentando alterações significativas nas plaquetas ( $p < 0,0001$ ), leucócitos ( $p < 0,0001$ ), linfócitos ( $p < 0,0001$ ), neutrófilos ( $p < 0,0001$ ) e monócitos ( $p = 0,0044$ ), quando comparados com os pacientes negativos para a infecção. Houve aumento expressivo de casos em

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2022, com crescimento de 330% entre o quarto trimestre de 2021 e o terceiro de 2022. **Conclusão:** O padrão laboratorial dos pacientes analisados confirmou trombocitopenia, leucocitose, linfopenia, monocitose, neutrófilos aumentados e alterações hepáticas nos pacientes infectados, reforçando a importância da análise laboratorial e epidemiológica na abordagem da dengue.

**Palavras-chave:** Dengue, Diagnóstico, NS1, Infecção, Marcadores sorológicos.

## RESUMEN

**Objetivo:** Analizar los datos de laboratorio de pacientes infectados por el virus del dengue (DENV) con el fin de identificar patrones hematológicos y hepáticos característicos asociados a la infección. **Métodos:** Se realizó un estudio retrospectivo transversal utilizando datos de laboratorio secundarios de 2.117 pacientes atendidos en el Laboratorio de la Policía Militar del Estado de Goiás (LCHPM) entre 2020 y 2022. De ellos, 389 pacientes resultaron positivos para infección por DENV mediante las pruebas NS1, IgM e IgG. Se evaluaron los siguientes parámetros de laboratorio: recuento total de leucocitos, neutrófilos, linfocitos, plaquetas y las razones plaquetas/linfocitos (PLR), neutrófilos/linfocitos (NLR) y leucocitos/linfocitos (LLR). El estudio fue aprobado por el Comité de Ética en Investigación. **Resultados:** De los 389 casos confirmados, se observaron alteraciones significativas en plaquetas ( $p < 0,0001$ ), leucocitos ( $p < 0,0001$ ), linfocitos ( $p < 0,0001$ ), neutrófilos ( $p < 0,0001$ ) y monocitos ( $p = 0,0044$ ), en comparación con los pacientes negativos. En 2022 se registró un aumento marcado de casos, con un crecimiento del 330% entre el cuarto trimestre de 2021 y el tercer trimestre de 2022. **Conclusión:** El perfil de laboratorio confirmó trombocitopenia, leucocitosis, linfopenia, monocitosis, neutrófilos elevados y alteraciones hepáticas en los pacientes infectados. Estos hallazgos refuerzan la importancia del análisis de laboratorio y epidemiológico en el manejo clínico y la vigilancia del dengue.

**Palabras clave:** Dengue, Diagnóstico, NS1, Infecção, Marcadores serológicos.

## INTRODUCTION

Arboviruses are highly prevalent viral diseases in Brazil and are recognized worldwide as a public health problem. This group of diseases is transmitted by vectors, such as *Aedes aegypti* and *Aedes albopictus*, and, in the case of Brazil, the main arboviruses with high epidemiological relevance are Dengue, Chikungunya and Zika virus. These diseases present extremely similar clinical pictures, which makes differential diagnosis between them difficult, thus highlighting the importance of complementary tests to determine a diagnosis (MANIERO VC, et al., 2016).

According to the Epidemiological Bulletin of the Ministry of Health, for the year 2022, the Central-West region had the highest incidence rate of dengue, with 2,086.9 cases/100,000 inhabitants, with 56,503 cases recorded in Goiânia, data reflected in the increase in cases in the region of this study. The virus that causes dengue fever, DENV, is RNA and belongs to the *Flavivirus* genus of the *Flaviviridae* family, and has 4 serotypes, from DENV1 to DENV4. Although similar, infection with one of the serotypes does not confer cross-immunity with any other. On the contrary, several studies report that a second infection with a different serotype is more likely to develop severe cases of the disease (MINISTÉRIO DA SAÚDE, 2025, MULLER DA, et al., 2017, SIRISENA PDNN, et al., 2021).

In Brazil, since 2014, the World Health Organization (WHO) dengue classification criteria have been adopted, according to which this is a unique, systemic and dynamic disease, in which, like several viral infections, dengue fever is self-limiting, with most patients recovering without any complications. However, few cases evolve into severe forms, such as hemorrhagic dengue fever, especially in the presence of antibodies to a serotype different from the current infection. Therefore, identifying previous infections and determining the etiology of the current condition are essential in predicting the progression and possible complications of the condition (MENEZES L, et al., 2025, MOALLEMI S, et al., 2023).

Regarding symptoms, Chikungunya is characterized by pain and swelling in the joints, while Zika is characterized by low or absent fever and skin spots. It has a wide range of symptoms, with 70 to 80% of cases being asymptomatic. When present, the clinical manifestation is characterized mainly by body pain and also presents clinical pictures of high fever, intense headache, moderate hemorrhage, asthenia, skin rashes, mild itching, mild lymph node hypertrophy and arthralgia (MULLER DA, et al., 2017, de SOUZA LR, et al., 2024), which in generally is very similar with dengue infection symptoms.

Since the clinical manifestation does not allow a conclusive diagnosis, laboratory tests are of utmost importance for the differentiation of the arboviruses presented. In this case, viral detection by reverse transcription polymerase chain reaction (RT-PCR) is performed during the infection phase. In addition, the viral etiology can be confirmed by specific serological test (ELISA) for each virus from the 6th day of infection, in the coalescence phase (de SOUZA LR, et al., 2024).

One of the tests performed after dengue fever is confirmed is a complete blood count. The main expected results, if dengue fever is confirmed, are leukopenia and thrombocytopenia. Many studies also indicate lymphopenia and monocytosis. Regarding the biochemical profile, alanine aminotransferase (ALT) may be increased and aspartate aminotransferase (AST) was increased in a considerable number of the sample in some studies (MULLER DA, et al., 2017, JAYATHILAKA D, et al, 2018). The neutrophil/lymphocyte ratio (NLR) has emerged as a contemporary biomarker of great use for assessing the inflammatory state of individuals, playing a significant role as a prognostic indicator in several pathological conditions, such as episodes of severe malaria and cardiac complications. Its interpretation is based on the observation that neutrophilia and lymphocytopenia, reflected by the widening of the disparity between both blood elements, often indicate a worsening of the patient's clinical condition. Reference values for NLR in adults without chronic diseases generally range between 0.78 and 3.58 (MENZES AMF, at el., 2022).

In parallel, the platelet-to-lymphocyte ratio (PLR) also stands out as an innovative biomarker widely used in the evaluation of a variety of conditions, including neoplastic, prothrombotic, metabolic and inflammatory diseases. PLR is sensitive to fluctuations in the inflammatory responses of the immune system, showing a positive correlation with the aforementioned NLR(SIRISENA PDNN, et al., 2021).

Regarding the diagnostic methods, it can be said that the following are investigated: the virus itself, the viral products or also the immune response to the viral infection. The method of detecting the virus itself is one of the first to emerge, however, it is not widely used due to the delay in releasing the results. This method uses a culture of a mosquito cell line, from samples of patients with suspected contamination (MULLER DA, et al., 2017).

Another target for diagnostic measurement is the glycoprotein that is secreted by infected cells and appears in the blood serum even before the antibodies, called dengue non-structural protein 1 (NS1). This method has high sensitivity and specificity with simple technology. Diagnostic methods using serology are also commonly performed, with the detection of IgG and IgM considered routine. Due to the detection windows, the combined measurement of NS1 and IgG and IgM, the diagnosis of dengue has improved (MULLER DA, et al., 2017, JAYATHILAKA D, et al, 2018). Due to the variation in the appearance of these biomarkers according to the development of the infectious condition, the increase in each of them can be an indicator of the patient's infection time during primary or secondary infection. During primary infection, particles of the virus itself and the NS1 protein can be detected in the initial stages of the disease. IgM can be detected in the first 3 to 5 days in a primary infection and can remain detectable for several months. IgG, on the other hand, does not normally appear in the acute phase of the first infection; or appears at the end of the acute phase, however, in secondary infection it can appear in the first 3 days (MULLER DA, et al., 2017).

After the first dengue infection, the patient develops immunity to the disease caused by the specific serotype with which he was infected, and may demonstrate positive IgG values after the acute phase of the first infection is cured. Furthermore, in secondary infection, viral and NS1 detection occurs for a shorter period of the condition(MULLER DA, et al., 2017).

The epidemiological profile of dengue in Brazil is essential, since this disease has endemic characteristics and its reinfection characterizes a more severe clinical picture of the disease. According to the Ministry of Health's 2022 epidemiological bulletin, which covers notifications from January to September of that year, there were 1,337,413 probable cases of dengue in Brazil, an increase of 189.1% compared to 2021. The Central-West region also stands out as having the highest incidence of dengue in the country, 1867.3 cases/100,000 inhabitants, highlighting the need for studies focused on dengue in this region of Brazil (MINISTERIO DA SAÚDE, 2022).

The Laboratory Environment Management System provides laboratory surveillance. In this system, 326,588 tests were requested for laboratory diagnosis of DENV, of which 85.4% were performed using serological methods, 14% using molecular methods and 0.5% using viral isolation. Of these, 38.8% were positive using serological methods, 46% using molecular methods and 13.5% using viral isolation (MINISTERIO DA SAUDE, 2022)<sup>9</sup>.

These cases range from mild to severe, and can be analyzed and differentiated clinically and in laboratory terms. Tests such as NS1, IgG and IgM levels are used as diagnostic and prognostic criteria for this disease, making it possible to study the progression of the disease in infected patients, as well as to compare the clinical picture between the first and second infection in the same patient, information that can expand clinical knowledge about this endemic disease in Brazil (MINISTÉRIO DA SAÚDE, 2022, NGUYEN THT, et al., 2018).

The study of the epidemiology and laboratory descriptions of infected patients also makes it possible to describe the population profiles of dengue outbreaks over the years, taking into account variables such as weight, sex and age, which can affect the patient's exposure to the dengue virus (DIAS LBDA, et al., 2010, VICENTE CR, et al., 2017).

In studies of large populations, it is important to sample different profiles and a significant number of individuals. In this study, this is made possible by the database of the Military Police Hospital, which provides clinical and laboratory data on police officers and their family members over the age of 18 who underwent tests to diagnose dengue. This sample is advantageous due to the periodic nature of the tests performed on this group, allowing for a greater clinical and laboratory description of the patient during the course of the disease and beyond (MENEZES AMF, et al., 2021, VICENTE CR, ET AL., 2017). Considering the relevance of the epidemiological, clinical and laboratory study of dengue in the Brazilian population, the present study aims to evaluate the population present in the database, which underwent diagnostic tests for dengue and the data from laboratory tests, so that, when analyzing their results, it is possible to identify the clinical and laboratory characteristics of infected patients that determine a poor prognosis.

## Material and methods

**Type of study:** This is a retrospective study with an evaluation of secondary data regarding the dosage of NS1, IgG, IgM and complete blood count, which includes hematological parameters such as: total leukocytes, neutrophils, lymphocytes and platelet count, and the platelet/lymphocyte (PLR), neutrophil/lymphocyte (NLR) and leukocyte/lymphocyte (LLR) ratios.

**Population:** composed of 2,117 patients treated at the Clinical Hospital Laboratory of the Military Police of the State of Goiás (LCHPM), who were treated from 2020 onwards, including military police officers and dependents who underwent diagnostic tests for dengue, including the search for IgG and IgM antibodies and NS1 viral metabolites.

**Inclusion criteria:** patients who underwent diagnostic tests for dengue and who underwent tests within 15 days after the test or diagnosis of infection; patients with positive IgM or NS1 detection were considered diagnosed with dengue.

**Exclusion criteria:** Patients who did not undergo diagnostic tests for dengue or did not undergo any type of blood test after the test.

**Tests used:** The Dengue NS1 Rapid Test (MedTest) was performed, a rapid chromatographic immunoassay that performs the qualitative detection of the dengue NS1 antigen through a human sample of

whole blood, serum or plasma. To evaluate IgG and IgM, the Dengue Rapid Test (MedTest) was used, a rapid chromatographic immunoassay that performs the qualitative detection of IgG and IgM antibodies for dengue virus types 1, 2, 3 and 4 from human samples of whole blood, serum or plasma.

**Variables analyzed:** diagnostic tests for dengue, parameters of the white blood cell count (WBC) and red blood cell count (RBC), liver function, sex, age, and calculation of the platelet/lymphocyte ratio (PNR) and neutrophil/lymphocyte ratio (NLR).

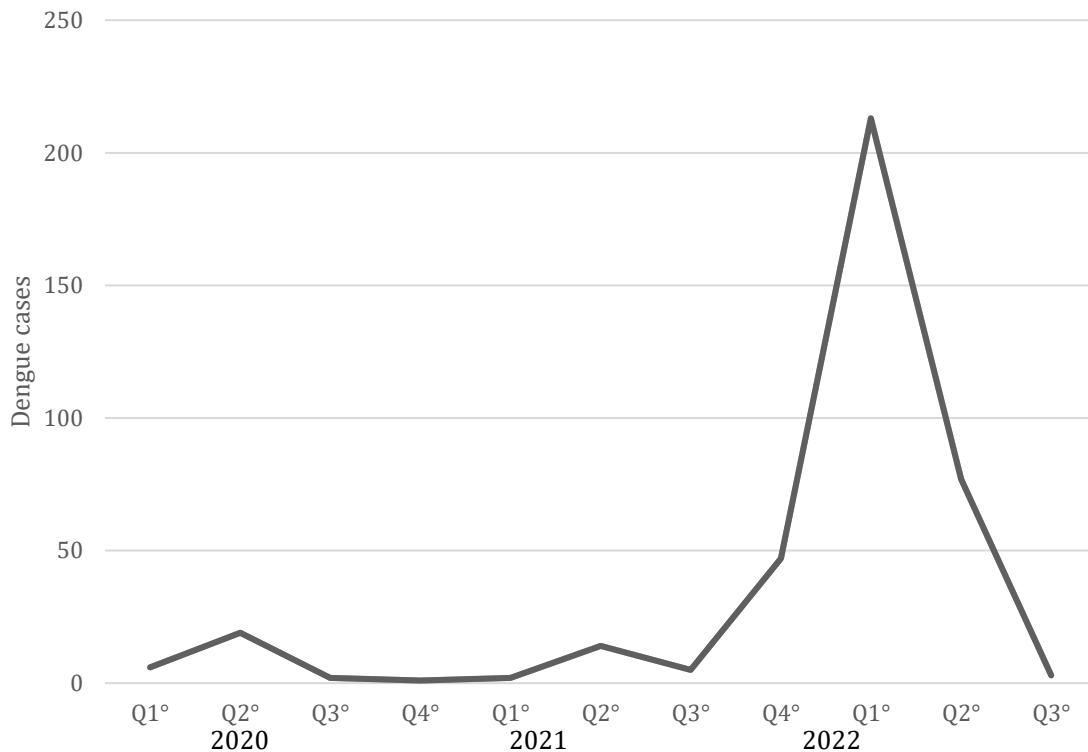
**Ethical Considerations:** Study without any type of nominal identification, which follows the standards set forth in Resolution 466/2012 of the National Health Council, regarding research conducted with human beings, approved by the National Research Ethics Committee (CEP), with opinion no. 4,272,030/CAAE 35099020.1.0000.5078 of September 12, 2020.

**Statistical analysis:** the normality test was performed, followed by the chi-square association test for categorical variables and the Mann-Whitney test for continuous variables. The significance value adopted was  $p < 0.05$ . The software used for the analysis was: Microsoft Excel, BioEstat 3.0, EpiInfo version 7 and GraphPad Prism 7.

## RESULTS

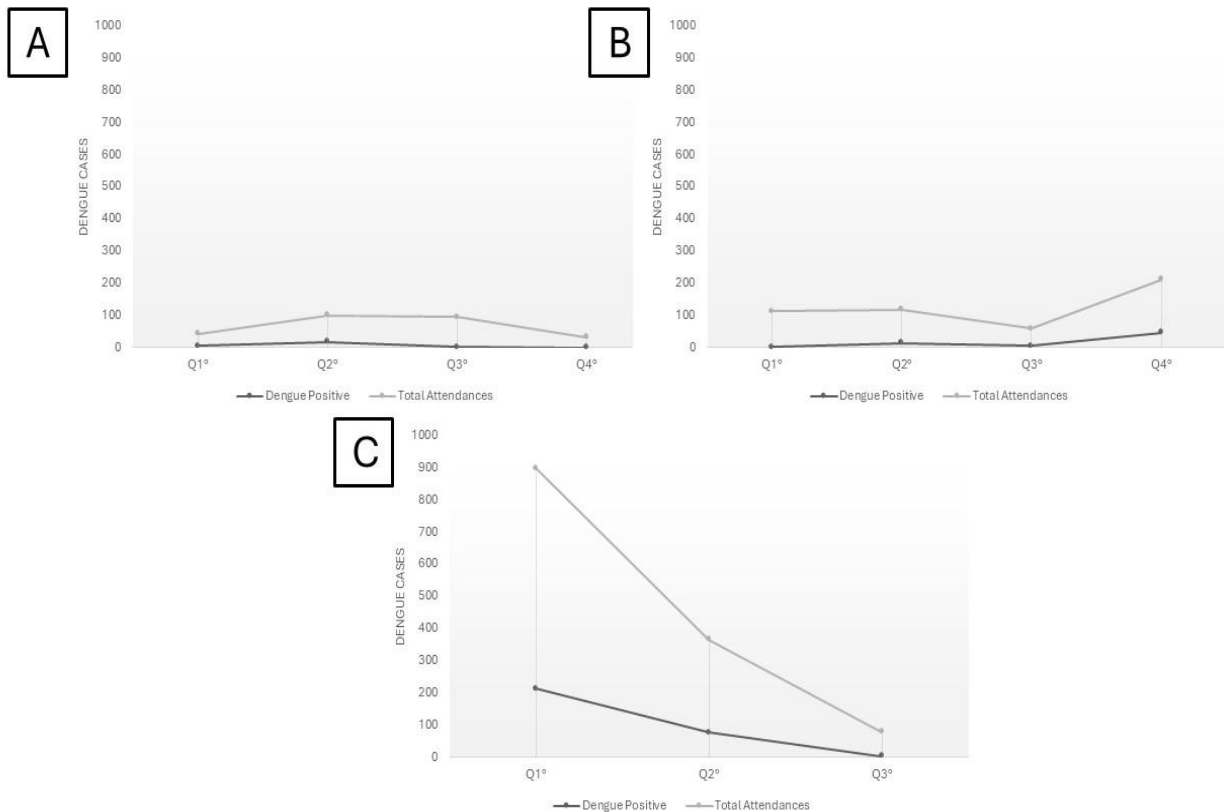
The research was conducted by analyzing the medical records of 2,117 patients who consulted the Military Police Hospital of Goiás. With the consultations performed and the medical records studied, it was possible to describe the pattern in the number of cases throughout the years 2020 to 2022. Thus, throughout the year 2020 until the third quarter of 2021, the number of cases remained below 50, while from the fourth quarter of that year until the third quarter of 2022, there was a drastic increase in cases, reaching more than 200 diagnoses of dengue during the first quarter of 2022 (**Figures 1 and 2, and Table 1**).

**Figure 1** - Positive dengue cases per year from 2020 to 2022.



**Legend:** Black line: positive cases for dengue in the years 2020, 2021 and 2022 Q1°: First quarter of the year; Q2°: Second quarter of the year; Q3°: Third quarter of the year; Q4°: Fourth quarter of the year. **Source:** Lima IS, et al., 2025.

**Figure 2** - Dengue cases compared to the number of visits per quarter in 2020, 2021 and 2022.



**Figure 2:** A: Description of the number of visits and number of dengue cases in 2020. B: Description of the number of visits and number of dengue cases in 2021. C: Description of the number of visits and number of dengue cases in 2022.; Gray line: Total number of appointments; Black line: Number of positive cases for dengue. Q: Quarter.

**Source:** Lima IS, et al., 2025, data from medical records of Military Police Hospital of Goiás.

**Table 1** - Diagnostic criteria for dengue infection in the participants treated.

Criterion	Men	Women	Total
IgM or NS1 positive	209	180	389
Negative	928	800	1728
<b>Total</b>	<b>1137</b>	<b>980</b>	<b>2117</b>

**Legend:** NS1: viral protein. IgM: antibody.

**Source:** Lima IS, et al., 2025. Data from medical records of Military Police Hospital of Goiás.

From these cases described, tests were collected that enabled the diagnosis of dengue and laboratory analysis of patients with a positive diagnosis compared to patients free of the infection. Of the patients consulted, 980 (46.30%) were female, while 1,137 (53.71%) were male (**Table 2**).

Regarding positivity, a total of 389 (18.37%) positive patients were obtained, being NS1 or IgM positive, while 1,728 (81.63%) were considered negative. The study population ranged from 0 to 87 years of age, with 60 (2.83%) patients from 0 to 12 years of age, 155 (7.32%) from 12 to 17 years of age, 1,786 (84.37%) from 18 to 65 years of age and 116 (5.48%) over 65 years of age (**Table 2**).

It is worth mentioning that not all patients who underwent diagnostic tests performed the tests with a blood sample, thus 1,831 patients underwent both tests. During the analysis, the mean, median, minimum and maximum values of each of the laboratory parameters were determined, such as: blood count and liver function, both for patients diagnosed with dengue and for those free of the infection.

To address the laboratory parameters, it is important to highlight that not all patients present in the study underwent all the tests covered for analysis, in this case we will take into account the total number of patients who underwent liver evaluation for aspartate aminotransferase (AST or TGO) and alanine aminotransferase (ALT or TGP), a total of 1,080, of which 864 had tested negative and 216 had tested positive for dengue. As for the tests for the other blood count parameters, a total of 1,830 results were analyzed, of which 355 were positive and 1,475 were negative (**Table 2**).

Of the group of women with complete tests (854), 168 (19.67%) presented positive results for the diagnosis of dengue, while 686 (80.32%) tested negative for the infection. In the analysis of red blood cells, there was no significant difference between the groups of patients ( $p=0.71$ ), as well as there was no significance in the difference in hematocrit ( $p=0.78$ ), or hemoglobin ( $p=0.50$ ) between the groups of positive and negative patients.

In the group of male patients, 977 underwent the tests, with 187 (19.14%) with a positive diagnosis and 790 (80.86%) with a negative diagnosis. Regarding the values of red blood cells ( $p=0.55$ ), hematocrit ( $p=0.55$ ) and hemoglobin ( $p=0.27$ ), there was no statistically significant difference between the groups. Of the other blood count parameters analyzed, a total of 1,830 patients were included, of which 355 (19.40%) were diagnosed with dengue and 1,475 (80.60%) were negative for the disease.

Of the positive patients, 46.48% had reduced platelets, while only 17.15% of the negative patients had levels below the reference, with a statistically significant difference between the groups ( $p<0.0001$ ). Of the leukocytes, 50.98% of the positive patients had increased levels, while 6.30% of the negative patients had such values ( $p<0.0001$ ).

There was a difference in the neutrophil values between the groups ( $p<0.0001$ ), with 21.41% of the positive patients having an increased value and 5.9% of the negative patients having higher values. Regarding lymphocytes, 68.17% of the positive patients had levels below the reference, while 26.98% of the negative group had a lower value ( $p<0.0001$ ).

Furthermore, in the analysis of monocytes, 3.09% and 1.41% of positive patients had values above and below the reference, respectively, while 5.49% of negative patients had values above and 0.27% had values below the reference ( $p=0.004$ ).

The NLR and PLR ratios were performed only with patients who presented the necessary data for such analysis, so 355 positive patients and 1,475 negative patients were considered. For the DENV-positive group, 167 (47.04%) of the cases presented normal NLR values, 185 (52.11%) had higher values and only (0.85%) presented lower values. In the DENV-negative group, 58.98% of the cases had normal NLR values, 37.9% had higher values and 3.12% had lower values, showing a statistically significant difference between them ( $p<0.0001$ ).

Regarding RPL, in the DENV-positive group, 87 (24.51%) of the cases presented normal RPL values, 240 (67.61%) with higher values and 28 (7.89%) with lower values. In the DENV-negative group, 625 (42.37%) of the cases presented normal RPL values, 580 (39.32%) showed higher values and 270 (18.31%) with lower values.

As for the study of most of the parameters of the red blood cell series, there was no statistically significant difference between the positive and negative groups of patients, that is, the MCV ( $p=0.327$ ), MCH ( $p=0.187$ ) and CHCM ( $p=0.179$ ) values did not show significant changes in those diagnosed with dengue. Finally, the last parameter of the exams, the RDW, showed significant changes between the groups studied ( $p=0.0046$ ).

Of the patients who underwent laboratory follow-up after diagnostic tests, a total of 1,080 underwent tests for AST analysis, while 1,081 underwent tests for ALT. Of these parameters, there was a statistically significant difference in AST values between patients with and without a dengue diagnosis, with 43.32% of positive patients having increased levels, while only 22.83% of negative patients exceeded the reference values ( $p<0.0001$ ). However, the difference in ALT values between the patient groups was not significant ( $p<0.052$ ).

**Table 2** - Laboratory parameters of patients with positive and negative diagnostic tests for dengue.

Parameters	N= 854 n (%)	DENV-Positive (n=168)	DENV-Negative (n=686)	p
<b>Red blood cells</b>				
Normal (3,8- 4,8 x 10 <sup>12</sup> /L)	600 (70,25%)	120 (60,6%)	480 (69,9%)	0,7128
Upper (>4,8 x 10 <sup>12</sup> /L)	225 (26,34%)	44(26,19%)	181 (26,38%)	
Lower (<3,8 x 10 <sup>12</sup> /L)	29 (3,39%)	4(2,38%)	25 (3,64%)	
<b>Hematocrit</b>				
Normal (36-46%)	756(88,52%)	147 (87,5%)	609 (88,77%)	0,7895
Lower (<36%)	74 (8,66%)	15 (8,92%)	59 (8,60%)	
Upper (<46%)	24(2,81%)	6 (3,57%)	18 (2,62%)	
<b>Hemoglobin</b>				
Normal (12-15g/dL)	729 (85,36%)	142 (84,52%)	587 (85,57%)	0,5053
Lower (<12g/dL)	65 (7,61%)	16 (9,52%)	49 (7,14%)	
Upper (>15g/dL)	60 (7,02%)	10 (5,95%)	50 (7,29%)	

**Legend:** AST (Aspartate aminotransferase) (p< 0.0001); ALT (Alanine aminotransferase); MCV (mean corpuscular volume); MCH (mean corpuscular hemoglobin); MCHC (Mean corpuscular hemoglobin concentration); RDW (Red cell distribution width) (p= 0.0046; chi-square test). NLR (neutrophil/lymphocyte ratio). PLR (platelet/lymphocyte ratio). LLR (leukocyte/lymphocyte ratio). **Source:** Lima IS, et al., 2025. Data from medical records of Military Police Hospital of Goiás.

Regarding the red blood cell tests, it was observed that neither men nor women presented statistically significant differences in the differences between positive and negative patients (**Tables 3** and **4**).

**Table 3** - Red blood cell series parameters of the blood count of female patients who underwent blood tests.

Parameter	N= 854 n (%)	DENV-Positive (n=168)	DENV-Negative (n=686)	p
<b>Red blood cells</b>				
Normal (3,8- 4,8 x 10 <sup>12</sup> /L)	600 (70,25%)	120 (60,6%)	480 (69,9%)	0,7128
Upper (>4,8 x 10 <sup>12</sup> /L)	225 (26,34%)	44(26,19%)	181 (26,38%)	
Lower (<3,8 x 10 <sup>12</sup> /L)	29 (3,39%)	4(2,38%)	25 (3,64%)	
<b>Hematocrit</b>				
Normal (36-46%)	756(88,52%)	147 (87,5%)	609 (88,77%)	0,7895
Lower (<36%)	74 (8,66%)	15 (8,92%)	59 (8,60%)	
Upper (<46%)	24(2,81%)	6 (3,57%)	18 (2,62%)	
<b>Hemoglobin</b>				
Normal (12-15g/dL)	729 (85,36%)	142 (84,52%)	587 (85,57%)	0,5053
Lower (<12g/dL)	65 (7,61%)	16 (9,52%)	49 (7,14%)	
Upper (>15g/dL)	60 (7,02%)	10 (5,95%)	50 (7,29%)	

**Legend:** (+) positive participants; (-) negative participants; MCV (mean corpuscular volume); MCH (mean corpuscular hemoglobin); MCHC (Corpuscular hemoglobin concentration). **Source:** Lima IS, et al., 2025. Data from medical records of Military Police Hospital of Goiás.

**Table 4** - Red blood cell series parameters of the blood count of male patients who underwent blood tests.

Parameter	N= 977 n (%)	DENV-Positive (n=187)	DENV-Negative (n=790)	p
<b>Red blood cells</b>				
Normal (4,5-5,5 x 10 <sup>12</sup> /L)	721 (73,79%)	143 (76,47%)	578 (73,16%)	0,5576
Lower (<4,5 x 10 <sup>12</sup> /L)	76 (7,78%)	15(8,02%)	61 (7,72%)	
Upper (>5,5 x 10 <sup>12</sup> /L)	180 (18,42%)	29(15,50%)	151 (19,11%)	
<b>Hematocrit</b>				
Normal (40-50%)	816 (83,52%)	161 (86,10%)	655 (82,91%)	0,5506
Lower (<40%)	70 (7,16%)	12 (6,41%)	58 (7,34%)	
Upper (>50%)	91 (9,31%)	14 (7,49%)	77 (9,75%)	
<b>Hemoglobin</b>				
Normal (13-18g/dL)	921 (94,26%)	181 (96,79%)	740 (93,67%)	0,2735
Lower (<13 g/dL)	48 (4,91%)	5 (2,67%)	43 (5,44%)	
Upper (>18 g/dL)	4 (0,40%)	1 (0,53%)	3 (0,38%)	

**Legend:** MCV (mean corpuscular volume); MCH (mean corpuscular hemoglobin); MCHC (mean corpuscular hemoglobin concentration); RDW (red cell distribution width); MPV (mean platelet volume).

**Source:** Lima IS, et al., 2025. Data from medical records of Military Police Hospital of Goiás.

The mean and median values were also compared, as well as the highest and lowest number of each of the laboratory parameters analyzed between patients with and without infection. In the study of liver function, the AST and ALT values showed a significant difference between the groups, with values of  $p < 0.0001$  and  $p = 0.0012$ , respectively. Of the red blood cell series, only the RDW measurements showed a significant difference in positive patients ( $p = 0.0025$ ).

The white blood cell count, however, showed significant differences between patients with and without dengue, such as: platelet counts ( $p < 0.0001$ ), leukocytes ( $p < 0.0001$ ), absolute rod counts ( $p < 0.0001$ ), segmented counts ( $p = 0.0004$ ) and absolute segmented counts ( $p < 0.0001$ ), eosinophils ( $p < 0.0001$ ) and absolute eosinophils ( $p < 0.0001$ ), lymphocytes and absolute lymphocytes ( $p < 0.0001$ ), monocytes and absolute monocytes ( $p < 0.0001$ ) (**Table 5**). Among the ratios that were calculated, significant differences were observed between patients with and without dengue in NLR ( $p < 0.0001$ ), PLR ( $p < 0.0001$ ) and LLR ( $p < 0.0001$ ).

**Table 5 - Mean and median comparison of laboratory parameters of patients negative and positive for dengue.**

Parameter	Largest number	Smallest number	Average	Median	SP	p
AST (+)	694	10	52,02	37	43.73	
AST (-)	441	17	54,44	40	37.65	<0,0001
ALT (+)	283	6	43,71	31	45.69	
ALT (-)	410	17	63,29	46	46.94	0,0012
Red blood cells (+)	6,31	3,1	4,85	4,86	0.52	
Red blood cells (-)	7,42	4,59	5,42	5,38	0.53	0,8597
Hematocrit (+)	53	26,6	42,80	42,9	4.36	
Hematocrit (-)	58,4	45,8	48,41	47,9	4.39	0,6646
Hemoglobin (+)	18,5	8,9	14,36	14,4	1.52	
Hemoglobin (-)	19,4	14,9	16,32	16,2	1.53	0,4579
VCM (+)	102,1	69,5	88,35	88,7	4.85	
VCM (-)	104	72,2	89,55	89,65	4.87	0,899
HCM (+)	35,3	22,1	29,65	29,8	1.88	
HCM (-)	35,5	22,8	30,20	30,20	1.9	0,369
CHCM (+)	35	30,2	33,55	33,6	0.62	
CHCM (-)	35,5	31,5	33,71	33,70	0.63	0,1503
RDW (+)	19	12,4	13,77	13,7	0.71	
RDW (-)	15,1	12,4	13,58	13,60	0.71	0,0025
Platelets (+)	443000	41000	160729,58	153000	67427	
Platelets (-)	455000	140000	196862,69	193000	66636	<0,0001
VPM (+)	11,6	6,7	8,13	8	0.7	
VPM (-)	10,3	6,7	8,12	8,20	0.69	0,433
Leukocytes (+)	29600	1200	4146,20	3600	2914	
Leukocytes (-)	19800	1800	6447,44	5950	2836	<0,0001
Rods (+)	22	1	2,31	2	1.1	
Rods (-)	7	1	2,18	2	0.93	0,6603
Absolute Rods (+)	4144	13	103,74	76	152.72	
Absolute Rods (-)	980	18	143,55	126	127.03	<0,0001
Segmented (+)	88	33	64,99	66	13.14	
Segmented (-)	92	26	60,47	60	13.29	0,0004
Absolute segmented (+)	21312	552	2770,01	2272	2387	
Absolute segmented (-)	17028	696	4082,48	3441	2396	<0,0001
Eosinophils (+)	8	0	1,75	1	1.69	
Eosinophils (-)	14	0	2,25	2	1.76	<0,0001
Absolute eosinophils (+)	628	0	73,67	47	126.23	
Absolute eosinophils (-)	1111	0	139,69	100	131.96	<0,0001
Basophils (+)	2	0	0,10	0	0.34	
Basophils (-)	2	0	0,16	0	0.34	0,6032
Absolute basophils (+)	115	0	3,60	0	20.48	
Absolute basophils (-)	91	0	7,78	0	21.92	0,4877
Lymphocytes (+)	59	4	19,08	17	12.08	
Lymphocytes (-)	62	5	24,95	24	12.25	<0,0001
Absolute lymphocyte (+)	4508	120	741,80	600	876.02	
Absolute lymphocyte (-)	4018	205	1482,04	1320	887.78	<0,0001
Monocytes (+)	31	2	11,74	11	4.52	
Monocytes (-)	28	1	9,97	9	4.28	<0,0001
Absolute monocyte (+)	2960	400	452,72	400	266.04	
Absolute monocyte (-)	1560	88	591,30	545	262.8	<0,0001
RNL (+)	21,25	0,55	5,21	3,73	5.15	
RNL (-)	46	0,31	4,38	2,73	4.58	<0,0001
RPL (+)	1625	30,8	309,75	255,88	176.5	
RPL (-)	405,71	5,11	206,17	160,77	149.76	<0,0001
RLL (+)	25	1,69	7,33	5,88		
RLL (-)	50	1,42	6,2	4,34	5.1	<0,0001

**Legend:** (+) positive participant, (-) negative participant; MCV (mean corpuscular volume); MCH (mean corpuscular hemoglobin); MCHC (mean corpuscular hemoglobin concentration); RDW (red cell distribution width); MPV (mean platelet volume); SD (standard deviation). NLR (neutrophil/lymphocyte ratio). PLR (platelet/lymphocyte ratio). LLR (leukocyte/lymphocyte ratio).

**Source:** Lima IS, et al., 2025. Data from medical records of Military Police Hospital of Goiás.

## DISCUSSION

Dengue fever is one of the fastest growing viral infections transmitted by mosquito bites in the world. It is a hyperendemic disease in tropical and subtropical regions of the world, predominating in urban and urbanizing areas, which is why its research is extremely relevant in the state of Goiás (MULLER DA, et al., 2017, SANTOS WJ, et al., 2024).

The differential diagnosis of dengue fever from other viral infections, such as COVID-19, influenza, adenovirus, Zika, enteroviral infections, among other diseases, can be a challenge due to its extremely nonspecific clinical picture. Therefore, the use of laboratory tests is essential in identifying the causal agent of infection. Such confirmation can be done by directly detecting viral components in the blood or by serological tests (MALAVIGE GM, et al., 2022, MULLER DA, et al., 2017).

The choice of test depends on the time of evolution of the condition, or how long the infection has been going on. During the beginning of the clinical evolution, in the febrile phase, the detection of viral components is highly sensitive. Among these tests, there the viral protein NS1 detection, through ELISA test. Serological tests identify IgM antibodies, which demonstrate acute or recent infection, and IgG, which arises as immunity from a previous infection. In this case, the diagnosis of the infection can be made when NS1 or IgM are identified (MULLER DA, et al., 2017, SANTOS WJ, et al., 2024).

The complete blood count is an extremely important test for identifying the progression of the disease, as it evaluates the leukogram, erythrogram and platelet count. Thus, the Ministry of Health recommends a complete blood count for all patients with symptoms of dengue infection (SANTOS WJ, et al., 2024).

The typical laboratory findings of infected patients consist of a low platelet count, as observed in this present study. However, it has been described leukopenia and leukocytosis as typical findings in dengue infection. In the present study, some patients only manifest these typical findings at the onset of the disease (SANTOS WJ, et al., 2024).

Anemia associated with dengue infection has also been described, mainly in severe cases; however, in the present study, the patients did not present significant changes in the red blood cell count series. Neutropenia is seen in isolated cases, and this change was also not present in the patients involved in the study (HAKAMI A, et al., 2025, MENEZES L, et al., 2025).

Regarding the analysis of liver function, it has been described in the literature that AST is the most altered transaminase in the progression of dengue, a situation consistent with the results presented by the patients analyzed. In addition, a failure in clinical conduct was mentioned in which not all diagnosed patients always undergo transaminase and liver function testing, and this conduct was also evident in the medical records of the hospital in which this study was conducted (AVUTHU OPR, et al., 2024, NANAWARE N, et al., 2021).

Both RPL and NLR and RLL are markers that have been increasingly used recently to search for prognostic factors and as inflammatory markers in various diseases, such as COVID-19. Studies have shown that RPL >180 has a specificity of 0.44 and a sensitivity of 0.77 in COVID-19; NLR was not measured. However, data from this same study are similar to the present study, as both show positive relationships ( $p < 0.0001$ ) when we compare infected patients with uninfected patients (YANG AP, et al., 2020).

Recent studies have shown NLR to be a systemic inflammatory marker, which can be a factor in a worse prognosis. Therefore, it is necessary to monitor the clinical condition of these patients more closely so that we can better assess this situation. However, patients with dengue fever have a high ratio, although less high when compared to other infections, such as COVID-19 (MENEZES L, et al., 2025, MAGALHÃES GCN, et al., 2025).

## CONCLUSION

Dengue fever is an arbovirus that has always been epidemiologically relevant in Brazil. Therefore, studies that cover its epidemiology and clinical aspects of infected patients are important in the search for a better understanding of the disease. In the present study, an increase in the number of cases was evident in 2022. In addition, the laboratory pattern of the patients analyzed confirmed alterations, such as: thrombocytopenia, leukocytosis, lymphopenia, monocytosis, increased neutrophils, and alterations in liver function.

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