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ORIGINAL ARTICLE

Temporal patterns of probable dengue cases before and during the COVID-19 pandemic, Jaboatão dos Guararapes-PE

Padrões temporais dos casos prováveis de dengue antes e durante a pandemia de COVID-19, Jaboatão dos Guararapes-PE

Patrones temporales de casos probables de dengue antes y durante la pandemia de COVID-19, Jaboatão dos Guararapes-PE

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ABSTRACT

Justification and Objectives: dengue is one of the serious public health concerns in the world, due to the severity of its infection, which can lead to serious cases and death. The study aimed to analyze the epidemiological profile of dengue cases as well as their temporal distribution in the municipality of Jaboatão dos Guararapes-PE before and during the COVID-19 pandemic. **Methods:** this is an ecological time series study, with a descriptive character of suspected cases of dengue in the Notifiable Diseases Information System, from 2018 to 2021. **Results:** it should be noted that 2018 had the lowest dengue incidence rate of the years analyzed. The other years had high incidence rates, however 2020 had a decline in cases when compared to 2019. The year 2021 was marked by the highest number of cases in the study period. **Conclusion:** it was possible to observe a seasonal pattern of dengue in 2020 that was different from other years, with a more pronounced decrease in dengue cases following the arrival of COVID-19 in the municipality.

Keywords: Dengue. COVID-19. Temporal Distribution. Epidemiology.

RESUMO

Justificativa e Objetivos: a dengue é um dos graves problemas de saúde pública no mundo, devido à gravidade de sua infecção, podendo evoluir para casos graves e a óbito. O estudo teve como objetivo analisar o perfil epidemiológico dos casos de dengue, bem como sua distribuição temporal no município do Jaboatão dos Guararapes-PE antes e durante a pandemia de COVID-19. **Métodos:** trata-se de estudo ecológico de série temporal, com caráter descritivo dos casos suspeitos de dengue no Sistema de Informação de Agravos de Notificação, de 2018 a 2021. **Resultados:**

observou-se que o ano de 2018 apresentou a menor taxa de incidência de dengue dos anos analisados. Os demais anos tiveram altas taxas de incidência, no entanto 2020 teve um decréscimo dos casos quando comparado com o ano de 2019. Já o ano de 2021 foi marcado pela maior quantidade de casos do período temporal de estudo. **Conclusão:** foi possível observar um padrão de sazonalidade da dengue em 2020 diferente dos demais anos, com um decréscimo mais acentuado dos casos de dengue a partir da chegada da COVID-19 no município.

Descritores: Dengue. COVID-19. Distribuição Temporal. Epidemiologia.

RESUMEN

Justificación y Objetivos: el dengue se presenta como uno de los graves problemas de salud pública en el mundo, debido a la gravedad de su infección, que puede provocar casos graves y la muerte. El estudio tuvo como objetivo analizar el perfil epidemiológico de los casos de dengue, así como su distribución temporal en el municipio de Jaboatão dos Guararapes-PE antes y durante la pandemia de COVID-19. **Métodos:** un estudio de serie temporal ecológica, con carácter descriptivo de casos sospechosos de dengue en el Sistema de Información de Enfermedades de Declaración Obligatoria, del 2018 al 2021. **Resultados:** cabe señalar que el año 2018 tuvo la tasa de incidencia de dengue más baja de los años analizados. Los demás años tuvieron altas tasas de incidencia, sin embargo el 2020 tuvo una disminución de casos en comparación con el 2019. El año 2021 estuvo marcado por el mayor número de casos en el período de estudio. **Conclusión:** se pudo observar un patrón estacional del dengue en el año 2020 diferente a otros años, con una disminución más pronunciada de los casos de dengue tras la llegada del COVID-19 al municipio.

Palabras Clave: Dengue. COVID-19. Distribución Temporal. Epidemiología.

INTRODUCTION

Dengue is one of the most serious public health concerns in the world, due to the severity of its infection.[1] It is an infectious, acute and systemic disease, caused by the virus of the *Flaviviridae* family and spread mainly by the *Aedes aegypti* mosquito, with the female being responsible for this transmission.[1] Dengue can present as asymptomatic forms or more severe cases, with shock, intense bleeding and/or organ complications, which can lead to death.[1] Its transmission is related to numerous factors, such as climatic, social, urbanization, sanitation, environmental, economic and educational conditions.[2]

In the Northeast, the state of Pernambuco had its first dengue outbreak in 1987 and currently still has a high prevalence scenario.[4] In 2021, the state had an 89.4% increase in dengue cases compared to the previous year.[4] In the municipality of Jaboatão dos Guararapes, the scenario was no different, as it also showed an increase in dengue cases when compared to 2020 and 2021.[5] Furthermore, it is the second most populous municipality in the state and has marked socioeconomic and demographic differences,[6] in addition to a precarious basic sanitation system,[7] which have a strong influence on dengue.

During 2020, dengue notifications decreased in the country when compared to the same period in 2019, a fact that may be associated with the introduction of the COVID-19 virus in Brazil from 2020 onwards.[8]

Since they initially share similar signs and symptoms, dengue and COVID-19 can have difficult diagnoses as well as adequate notifications and management in the Brazilian healthcare system.[9] At the same time, the numerous cases of COVID-19 have had an impact on healthcare services and neglected the care of diseases present in the daily routine of the Healthcare Network.[10]

A better way to understand the distribution of dengue in the context of the COVID-19 epidemiological scenario is through temporal analysis techniques. These can identify non-random patterns and estimate the effect of external factors on the variation of a time series of interest, allowing seasonal variations to be detected.[11]

Therefore, this study aimed to describe the epidemiological profile of dengue cases, as well as to analyze the temporal distribution of these cases in the municipality of Jaboatão dos Guararapes before and during the COVID-19 pandemic, based on the hypothesis that there was a change in the scenario of this arbovirus after the introduction of the new coronavirus.

METHODS

This is an ecological time series study with a descriptive character. In the research, probable dengue cases (notified cases, excluding discarded cases) were selected in the period preceding the COVID-19 pandemic (2018 to 2019) and during the pandemic (2020 to 2021).

The study took place in Jaboatão dos Guararapes, located in the state of Pernambuco, northeastern Brazil, which makes up the metropolitan mesoregion of Recife, being the second most populous municipality in the state. It is divided into seven regions and 27 neighborhoods.[6] It has a territorial area of 258,724 km² and a population density of 2,491.82 inhabitants/km², with an estimated population of 711,330 people in 2021 and a Human Development Index of 0.71.[6]

The data used in this study were extracted from the Notifiable Diseases Information System (SINAN - *Sistema*

de Informação de Agravos de Notificação) of the Municipal Health Department of Jaboatão dos Guararapes, through notification forms. The database was subsequently cleaned to remove duplicates, inconsistencies and incompleteness. The population data for calculating the indicators were obtained from the Brazilian Institute of Geography and Statistics (IBGE - Instituto Brasileiro de Geografia e Estatística) for each year analyzed.

Concerning the completion of the fields from notification forms, those that were blank or filled in as "ignored" were considered incomplete. Therefore, only variables classified as excellent and regular were considered in this study, according to criteria of Oliveira et al. (2009),[12] being ≥90% and between 70% and 89%, respectively.

Thus, the variables used to describe the epidemiological profile of notified dengue cases were sex, age, clinical signs, preexisting diseases and final classification, which were described by means of absolute and relative frequency as well as organized in a table. Regarding the final classification of cases, for the notified cases that exceeded the 60-day deadline for closure, the system automatically categorizes them as inconclusive.

The incidence rate of dengue by year of onset of symptoms, used to calculate the time series of probable cases, was calculated as follows: number of probable cases in each year, divided by the study area population in the same year, multiplied by 100,000 inhabitants. The classification of dengue incidence according to the Brazilian National Dengue Control Program occurs as: low incidence: less than 100 cases/100,000 inhabitants; medium incidence: 101 to 299 cases/100,000 inhabitants; and high incidence: 300 or more cases/100,000 inhabitants.[13]

The analysis of the time series of dengue cases in the municipality was performed using the joinpoint regression model (version 4.9.1.0). This model allows us to observe whether a line with multiple segments is, according to statistics, better for developing a temporal evolution of a given event than a straight line or line with fewer segments.[14] This, in turn, allows us to observe and identify joinpoints of a time series with statistically significant changes.[14]

To carry out the study using this model, the Monthly Percent Change (MPC) was performed for each year of the study, where each joinpoint indicated a change in the line. The classification is made as follows: when positive, it shows growth; when negative, it shows reduction; when equal to zero, it represents maintenance.[14] The MPC was calculated considering a 95% Confidence Interval and a 5% significance level.

The study was carried out in compliance with ethical standards required by Resolutions 466/2012, 510/2016 and 580/2018 of the Ministry of Health, and was approved by the Faculdade Tiradentes do Jaboatão dos Guararapes (FTJG) Research Ethics Committee (REC), under Opinion 5,554,360 and CAAE (Certificado de Apresentação para Apreciação Ética - Certificate of Presentation for Ethical Consideration) 58177722.3.0000.872, on August 1, 2022.

RESULTS

During the study period, 18,427 probable cases of dengue were identified, 347 in 2018, 4,848 in 2019, 3,414 in 2020, and 9,818 in 2021.

It was observed that probable cases of dengue were more frequent in females (54.57%) and in the age group between 20 and 39 years (37.55%). The main signs and symptoms found were fever (87.61%), headache (67.32%), and myalgia (65.61%). As for preexisting diseases, the one that presented most frequently was hypertension (1.16%) (Table 1).

In relation to the incidence of probable dengue cases, the following rates were noted: 52.75 cases/100,000 inhabitants. In 2018, it could be classified as having a low incidence, while in the other years, they presented high incidence rates, being: 693.30 cases/100,000 inhabitants (in 2019); 481.99 cases/100,000 inhabitants (in 2020); and 1,375 cases/100,000 inhabitants (in 2021).

It is possible to observe a reduction in the incidence rate of dengue in 2020 from February onwards. This decrease intensified with the introduction of the new coronavirus in the municipality, represented by the red dot, as well as with the insertion of a contingency plan against COVID-19, represented by the green dot in April 2020, a period in which municipal services are subject to restrictions and their priorities are directed towards the new coronavirus pandemic (Figure 1).

It is possible to observe that, in May 2020, there was a 94% reduction in incidence (incidence rate = 6.37 cases/100,000 inhabitants) compared to May 2019 (incidence rate = 112.63 cases/100,000 inhabitants). In contrast, in May 2021, the incidence rate was 276.52 cases/100,000 inhabitants, which represents a growth of 97.7% compared to the same month in 2020.

Regarding the temporal trends in this study, it was observed that only 2018 did not present any statistically significant trend. Regarding the other years, only 2020 had a declining trend (MPC -31.5), whereas in other years these trends were positive compared to the first months of the year (January to May 2019 and January to April 2021), which represents an increase in dengue cases during this period. When analyzing all the years in this study (2018 to 2021), 2021 presented the greatest increasing trend of the years analyzed (MPC 226.2) and had two trends, initially increasing (January to April) and, subsequently, decreasing (July to December) (Table 2).

Figure 2 shows the trend in the incidence rates of probable dengue cases, observed and adjusted, in the years analyzed, and the joinpoints of the series. The year 2018 (Figure 2A), even though it did not present significant changes, had two joinpoints: June and September. As for 2019 (Figure 2B), the points were in May and October. In 2020 (Figure 2C), the points were in May and August, and in 2021 (Figure 2D), in April and July.

Table 1. Epidemiological variables of probable dengue cases from 2018 to 2021. Jaboatão dos Guararapes, Pernambuco, Brazil.

Variables	2018 N (347) N	%	2019 N (4,848) N	%	2020 N (3,414) N	%	2021 N (9,818) N	%	TOTAL N (18,427) N	%
Sex										
Male	168	48.41	2,259	46.60	1,516	44.41	4,400	44.82	8,343	42.28
Female	179	51.59	2,589	53.40	1,891	55.39	5,396	54.96	10,055	54.57
Ignored/blank	0	0.0	0	0.0	7	0.21	22	0.22	29	0.16
Age group										
0 to 9 years	69	19.88	594	12.55	374	10.95	1,084	11.04	2,121	11.51
10 to 19 years	91	26.22	1,179	24.32	370	10.84	1,408	14.34	3,048	16.54
20 to 39 years	118	34.01	1,840	37.95	1,420	41.59	3,542	36.08	6,920	37.55
40 to 59 years	53	15.27	895	18.46	908	26.60	2,681	27.31	4,537	24.62
60 years or older	14	4.03	312	6.44	304	8.90	977	9.95	1,607	8.72
Ignored/blank	2	0.58	28	0.58	38	1.11	126	1.28	194	1.05
Clinical signs										
Fever	344	99.14	4,413	91.03	2,871	84.09	8,516	86.74	16,144	87.61
Myalgia	270	77.81	3,221	66.44	2,035	59.61	6,564	66.86	12,090	65.61
Headache	259	74.64	3,267	67.39	2,155	63.12	6,724	68.49	12,405	67.32
Rash	67	19.31	1,039	21.43	706	20.68	3,288	33.49	5,100	27.68
Vomiting	115	33.14	1,263	26.05	614	17.98	1,471	14.98	3,463	18.79
Nausea	53	15.27	866	17.86	449	13.15	1,155	11.76	2,523	13.69
Back pain	11	3.17	226	4.66	242	7.09	869	8.85	1,348	7.32
Conjunctivitis	2	0.58	58	1.20	28	0.82	129	1.31	217	1.18
Arthritis	2	0.58	98	2.02	111	3.25	189	1.93	400	2.17
Severe arthralgia	73	21.04	923	19.04	907	26.57	4,919	50.10	6,822	37.02
Petechiae	7	2.02	180	3.71	94	2.75	401	4.08	682	3.70
Leukopenia	7	2.02	104	2.15	37	1.08	75	0.76	223	1.21
Positive tourniquet test	1	0.29	24	0.50	18	0.53	23	0.23	66	0.36
Retroorbital pain	57	16.43	856	17.66	534	15.64	2,568	26.16	4,015	21.79
Ignored/blank	0	0.0	96	1.98	98	2.87	215	2.19	409	2.22
Preexisting diseases										
Diabetes	0	0.0	39	0.80	25	0.73	48	0.49	112	0.61
Hematological diseases	0	0.0	10	0.21	10	0.29	24	0.24	44	0.24
Liver diseases	0	0.0	17	0.35	12	0.35	16	0.16	45	0.24
Chronic kidney disease	0	0.0	10	0.21	8	0.23	15	0.15	33	0.18
Hypertension	2	0.58	72	1.49	44	1.29	96	0.98	214	1.16
Acid-peptic disease	1	0.29	10	0.21	12	0.35	24	0.24	47	0.26
Autoimmune diseases	1	0.29	10	0.21	11	0.32	31	0.32	53	0.29
Ignored/blank	0	0.0	96	1.98	98	2.87	215	2.19	409	2.22
Final classification										
Dengue	303	87.32	557	11.49	60	1.76	115	1.17	1,035	5.62
Dengue with warning signs	40	11.53	33	0.68	6	0.18	8	0.08	87	0.47
Severe dengue	2	0.58	3	0.06	4	0.12	0	0.0	9	0.05
Inconclusive	2	0.58	4,203	86.70	3,312	97.01	9,581	97.69	17,108	92.84
Ignored/blank	0	0.0	52	1.07	32	0.94	104	1.06	188	1.02

Table 2. Analysis of temporal trend of incidence of probable dengue cases per 100,000 inhabitants between 2018 and 2021. Jaboatão dos Guararapes, Pernambuco, Brazil.

Year	Period	Trend 1 MPC	95% CI	Period	Trend 1 MPC	95% CI
2018	-	-	-	July-December	-	-
2019	January-May	99.1	38.1 to 187.1	July-December	-	-
2020	January-May	-31.5	-48.8 to -8.5	July-December		
2021	January-April	226.2	34.2 to 692.9	July-December	-36.4	-57.3 to -5.4

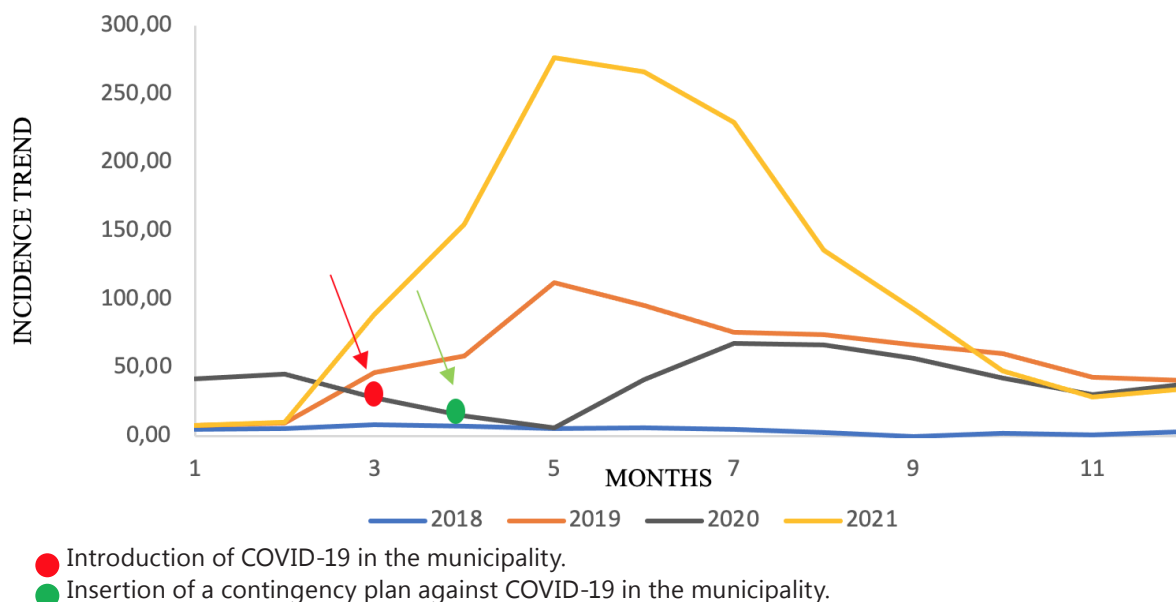*Note: MPC - Monthly Percent Change; CI - Confidence Interval.*

Figure 1. Incidence rate of probable dengue cases per 100,000 inhabitants, from 2018 to 2021. Jaboatão dos Guararapes, Pernambuco, Brazil.
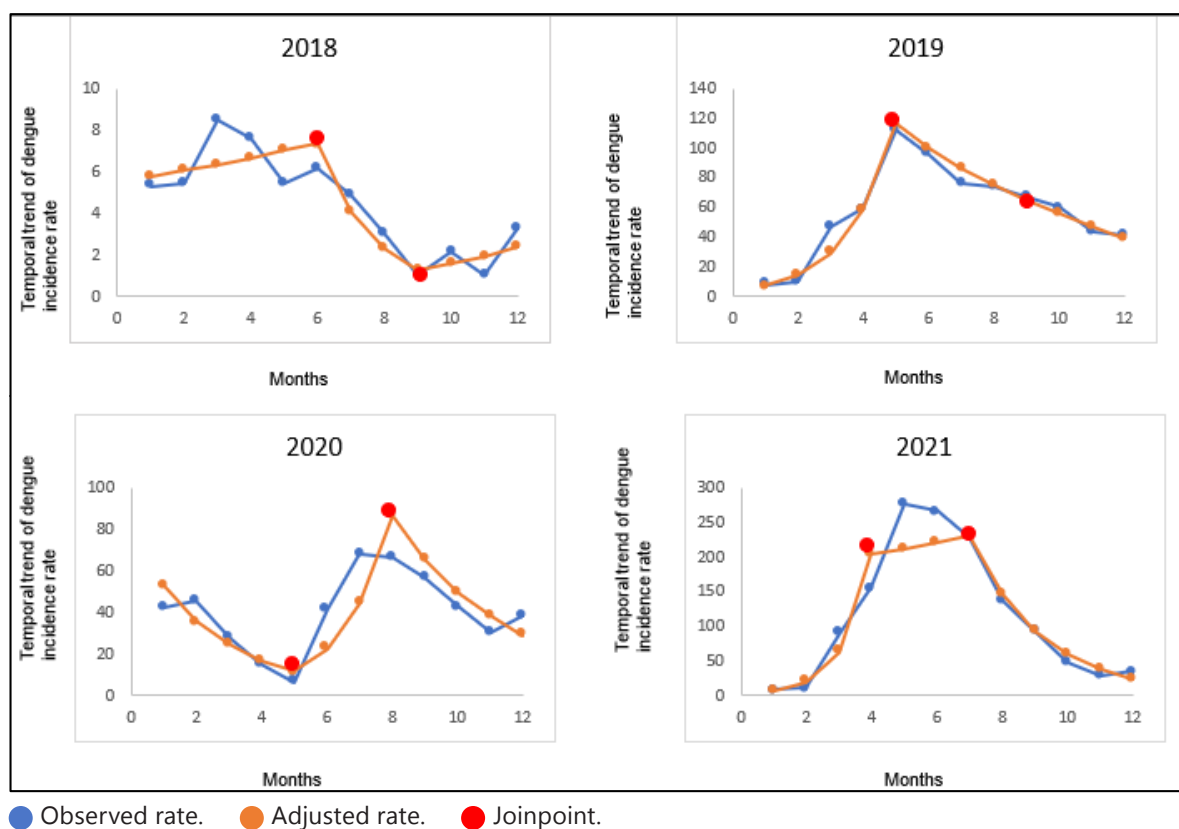

Figure 2. Time trend of observed and adjusted incidence rate of probable dengue cases per 100,000 inhabitants and joinpoints, from 2018 to 2021. Jaboatão dos Guararapes, Pernambuco, Brazil

DISCUSSION

In this study, we sought to analyze the temporal pattern of dengue cases from 2018 to 2022 to analyze the influence of COVID-19 in this period. When analyzed, the variables female gender and the age group between 20 and 39 years were the most affected by dengue. In a study carried out in the municipality of Primavera do Leste-MT, between 2014 and 2017, a higher occurrence was also observed in this population.[15] The predominance of cases in this population can be explained by the fact that they are the most economically active age group and

move around the most.

The greater incidence of the female population may be associated with a greater demand for healthcare services and more time spent in the home and peridomestic environment, places where there is a greater predisposition to mosquito dispersion.[16]

When analyzing clinical variables, the most prevalent preexisting disease was hypertension, which was also present in greater numbers in a study carried out in Goiânia.[7] the main signs and symptoms found were fever, headache and myalgia. These may also be present in other pathologies, including COVID-19,[18,19] since, in the initial stages, dengue and COVID-19 share similar signs and symptoms, allowing for erroneous diagnoses and, consequently, undernotification of arbovirus cases.

Moreover, the healthcare system was focusing its actions on the pandemic caused by the new coronavirus and its human resources were mainly directed towards combating COVID-19. Likewise, restrictions on services and transportation, as well as recommendations to stay at home, may have made it difficult for users to access healthcare services, especially primary care,[20,21] supporting the hypothesis of undernotification of dengue in 2020.

The aforementioned situations may have contributed to the scenario observed in the municipality under study. When analyzing the COVID-19 epidemiological bulletin version 275, from Jaboatão dos Guararapes,[22] it is possible to observe that the peaks of COVID-19 cases in 2020, in the municipality, occurred at the end of April and beginning of May as well as deaths, mostly caused by the new coronavirus that occurred in May of the same year, a time when there was a sharper decrease in dengue cases in the municipality.

The findings of this study also demonstrate increasing temporal trends in dengue cases in the first months of 2019 and 2021, represented by positive MPC. However, 2020 presented a different scenario from the others in relation to this problem, a fact that may also have been triggered by the consequences arising from the COVID-19 pandemic.

The year 2021 was marked by a considerable increase in dengue cases in Jaboatão dos Guararapes, similar to some findings of a study that analyzed cases of arboviruses in the state of Amazonas, between 2018 and 2022.[23] In this research, it was observed that the largest number of cases was also found in 2021, and they attributed this fact to COVID-19, associating it with the justification of a greater search by the population for testing for the coronavirus; with this, individuals ended up being considered suspects for dengue.

It is also possible to observe the seasonality pattern of dengue, since it showed increasing incidence curves in the first months of the year, with the exception of 2020, which presented an atypical scenario compared to the others. The first five months of the year are characterized by high temperatures and greater humidity, which favor an increase in the incidence of dengue.[15]

Studies report that, in addition to climatic conditions, other factors are associated with the emergence of dengue cases, such as disorderly population growth, poor sanitation conditions, inadequate housing, no running water, sanitation and open sewage, disorganization of cities, with inadequate infrastructure, deficiencies in garbage collection, in addition to cultural and educational factors.[24,25]

As it is one of the most populous municipalities in the state of Pernambuco and is a large urban center, it has peculiarities such as accelerated urbanization, social inequality, high consumption of industrialized and disposable products that consequently create conditions and environments favorable to outbreaks of the disease. The combination of these factors predisposes to a high incidence of dengue, as seen in most of the years analyzed in the study (2019, 2020 and 2021).

According to the *Instituto Trata Brasil* (2022),[7] the municipality also has a precarious sewage and basic sanitation system with around 79% of water supply in homes. A study carried out in northeastern Brazil found that the most populous municipalities had a higher incidence rate of dengue and also observed a correlation between lack of access to piped water and its incidence.[24] A population that does not have access to running water ends up storing this resource incorrectly, predisposing it to the emergence of arboviruses.

The present study made it possible to identify and associate its findings with the reality of Jaboatão dos Guararapes, and, therefore, contributed to greater epidemiological knowledge of dengue in the municipality and its presentation during the COVID-19 pandemic.

With the decrease in notified dengue cases in 2020 and their explosion in 2021, it is suggested that healthcare professionals, especially those involved in primary care, health surveillance, and municipal management, monitor this condition more closely. There is also a need for greater attention to timely closure of cases as well as an alert for municipal planning in interventions in the face of new syndemics.

Regarding limitations, since this is a study produced from a secondary database, there is the possibility of reporting bias, which may present inconsistencies in the quantity, quality and processing of information. There were also restrictions on the variables analyzed due to the low percentage of completion of notification forms. These variables include race/color, education, case classification, confirmation/discard criteria and case evolution. However, even with these circumstances, the study was able to analyze the temporal patterns of dengue in the municipality.

In fact, improving the socio-environmental conditions of a population and raising awareness is a path that can be effective against the spread of the mosquito and the occurrence of the disease. Finally, the knowledge provided in this study allows us to assess the health situation regarding dengue notifications before and during the COVID-19 pandemic, in order to subsidize healthcare professionals, with the aim of reducing the burden of dengue.

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AUTHOR'S CONTRIBUTIONS

Natália Ferreira de Sousa contributed to the bibliographic research, writing of the abstract, introduction, methodology, discussion, interpretation and description of results, preparation of tables, conclusions, review and statistics. **Celivane Cavalcanti Barbosa** contributed to writing the manuscript, interpretation and description of results, conclusions, review and statistics. **Edivânia Felix dos Santos and Paulino José de Albuquerque Vasconcelos Neto** contributed to writing and critically reviewing the content of the manuscript. **Emília Carolle Azevedo de Oliveira** contributed to the conception and design of the study, writing and critically reviewing the content of the manuscript.

All authors approved the final version to be published and are responsible for all aspects of the work, including ensuring its accuracy and integrity.