doi: 10.5123/S2176-6223202301312

Chikungunya fever in pregnant women and its immediate repercussions at the birth time: a clinical, epidemiological, and spatial analysis in Belém, Pará State, eastern Brazilian Amazon

A febre de chikungunya em gestantes e suas repercussões imediatas no momento do parto: uma análise clínica, epidemiológica e espacial em Belém, estado do Pará, Amazônia oriental brasileira

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ABSTRACT

OBJECTIVE: To analyze the clinical-epidemiological profile and spatial distribution of chikungunya fever reported cases in pregnant women, as well as the immediate disease repercussions on newborns, in Belém City, Pará State, Brazil, from 2016 to 2018. MATERIALS AND METHODS: This descriptive, ecological, cross-sectional study used secondary data from the Notifiable Diseases Information System and the Live Births Information System of the Belém Municipal Health Department. The clinical and epidemiological variables of the cases were described, followed by statistical and geostatistical analysis. RESULTS: From 52 pregnant women with chikungunya fever, the majority were brown (61.5%), aged between 20 and 29 (48.1%), and had completed high school (36.6%). The cases mainly presented fever, myalgia, rash, and arthralgia. The highest percentage of newborns was born by caesarean section. There was also a predominance of full-term newborns and a higher proportion of neonates with adequate weight. The disease showed a heterogeneous spatial distribution pattern in Belém's neighborhoods, with a high density of pregnant women living in Ponta Grossa, Agulha, Parque Guajará, Guamá, and Canudos. CONCLUSION: An uneven distribution of the disease was observed in different neighborhoods of Belém, highlighting the importance of public health policies aimed at at-risk groups and areas of higher incidence to prevent and control chikungunya fever in pregnant women.

Keywords: Spatial Distribution; Epidemiology; Chikungunya Fever; Pregnant Women; Newborn.

RESUMO

OBJETIVO: Analisar o perfil clínico-epidemiológico e a distribuição espacial dos casos notificados de febre de chikungunya em gestantes, bem como a repercussão imediata da doença nos recém-nascidos, no município de Belém, estado do Pará, Brasil, nos anos de 2016 a 2018. MATERIAIS E MÉTODOS: Este é um estudo descritivo, ecológico e transversal, que utilizou dados secundários presentes no Sistema de Informação de Agravos de Notificação e no Sistema de Informações sobre Nascidos Vivos da Secretaria Municipal de Saúde de Belém. Foram descritas variáveis clínicas e epidemiológicas dos casos, seguidas de análises estatísticas e geoestatísticas. RESULTADOS: Das 52 gestantes com febre de chikungunya, houve predomínio de pardas (61,5%), da faixa etária de 20 a 29 anos (48,1%) e com o ensino médio completo (36,6%). Além disso, os casos apresentaram, principalmente, febre, mialgia, exantema e artralgia. O maior percentual de recém-nascidos nasceu de parto cesáreo. Houve ainda a predominância de recém-nascidos a termo e maior proporção de neonatais com peso adequado. A doença apresentou um padrão de distribuição espacial heterogênea nos bairros de Belém, com densidade muito alta em gestantes residentes em Ponta Grossa, Agulha, Parque Guajará, Guamá e Canudos. CONCLUSÃO: Observou-se uma distribuição desigual da doença em diferentes bairros de Belém, evidenciando a importância de políticas de saúde pública direcionadas para grupos de risco e áreas de maior incidência, visando à prevenção e ao controle da febre de chikungunya em gestantes.

Palavras-chave: Distribuição Espacial; Epidemiologia; Febre de Chikungunya; Gestantes; Recém-Nascido.

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INTRODUCTION

Chikungunya fever is an arboviral disease caused by the *Chikungunya virus* (CHIKV), primarily found in tropical and subtropical regions. This enzootic virus has broad dispersal potential through vectors[1], mainly the female mosquitoes *Aedes aegypti* and *Aedes albopictus*, two species widely distributed worldwide[2]. The disease triggers a debilitating febrile syndrome with a low lethality rate, but a high morbidity rate related to persistent arthralgia. Consequently, affected individuals experience decreased productivity and a compromised quality of life[3].

The virus transmission to newborns can occur transplacentally in pregnant women affected by the disease[4]. In this situation, the transmission rate can reach 49%, and of the affected newborns, at least 90% fall ill and may progress to severe forms. Therefore, it is crucial to properly monitor these pregnant women to detect possible risk signs and take necessary measures to prevent fetal distress. However, infection during pregnancy is not related to teratogenic effects, and there are few reports of spontaneous abortion cases[5].

In Belém city, Pará State, as in several other Brazilian territories, chikungunya fever is more prevalent in places with low socioeconomic status, where public health policies have limited reach. Thus, the disease has been characterized by a high endemicity pattern, evidencing the relationship between its spatial occurrence and health services coverage, indicating the need to intensify epidemiological surveillance actions[6].

In this context, geoprocessing consists of techniques for collecting, processing, manipulating, and presenting spatial data[7], which can help generate systematic and procedural analyses of disease occurrence and health risks. Thus, within the health sciences, Geographic Information Systems allow the use of these spatial analysis techniques, especially for ecological research, since they facilitate the analysis of relationships between diseases and their conditioning factors[8].

According to the above view, this study aimed to analyze the clinical-epidemiological profile and spatial distribution of reported cases of chikungunya fever in pregnant women and the immediate impact of the disease on newborns in Belém from 2016 to 2018.

MATERIALS AND METHODS

This descriptive, ecological, and cross-sectional study used secondary data from notified and confirmed cases of pregnant women with chikungunya fever living in Belém neighborhoods from 2016 to 2018. The Pará capital has an area of 1,059 km^2 and an approximate population of 1.5 million inhabitants[9]. According to data from Belém City Hall, the city is divided into eight administrative districts: Belém Administrative District (DABEL), Benguí Administrative District (DABEN), Entroncamento Administrative District (DAENT), Guamá Administrative District (DAGUA), Icoaraci Administrative District (DAICO), Mosqueiro Administrative District (DAMOS), Outeiro Administrative District (DAOUT), and Sacramenta Administrative District (DASAC). These districts guide the organization and planning of services in numerous sectors, such as education, transportation, health, public safety, among others[10].

Data on cases of the disease in pregnant women were obtained from the Notifiable Diseases Information System (SINAN). Data on prenatal care and childbirth conditions were extracted from the Live Birth Information System (SINASC), both from the Belém Municipal Health Department (SESMA). Cartographic and demographic data on the cities' population were obtained from the Demographic Census (2010) and the Epidemiology and Geoprocessing Laboratory (EPIGEO) of Universidade Estadual do Pará (UEPA). Data on notified cases were available from health facilities in the National Registry of Health Establishments of the Ministry of Health.

All cases of chikungunya fever in pregnant women living in Belém and their respective live births with the Live Birth Certificate issued in that city were included. Thus, 52 pregnant women who acquired chikungunya fever during pregnancy and their 52 newborns between 2016 and 2018 were identified.

Analyses were based on the following clinical-epidemiological variables of the pregnant women: age group, race/color, education level, gestational age at which the pregnant woman was affected by the disease, signs and symptoms, disease clinical presentation, and hospitalization. The newborn variables were: type of delivery, birth weight, gestational age, number of prenatal consultations by the mother, and trimester of prenatal initiation.

After acquiring SESMA's SINAN and SINASC databases, the data underwent a debugging process using the TabWin v3.6b program (2010) to remove inconsistencies and incompleteness.

Statistical analyses of percentages and statistically significant differences of variables were performed using Microsoft Office Excel (2013) and BioEstat v5.0 (2007), respectively. The Pearson chi-square test was used for significance analysis. To calculate the p-value, which represents the probability that the detected difference between the analyzed groups occurred by chance, a chi-square distribution L x C table was used, comparing the observed value with the expected value, under the null hypothesis that the variables are not associated. If the p-value is less than the predetermined significance level, 0.05 in this study, the null hypothesis is rejected, indicating statistical evidence of an association between the variables[11].

Subsequently, mothers' addresses were georeferenced in the laboratory using Google Earth to build a geographic database. All study participants' addresses were found, and cases were aggregated by neighborhoods according to geolocation. The Kernel density estimator was used for spatial distribution analysis of cases, through the QGIS 3.28.2 software (2022).

This research followed the rules contained in Resolution No. 466/2012 and Resolution No. 510/2016, both from the National Health Council. The project was approved on March 6,

2021, by the Research Ethics Committee of the Center for Biological and Health Sciences of UEPA (opinion No. 4.573.962/CAAE 43221721.3.0000.5174).

RESULTS

From 52 pregnant women confirmed with chikungunya fever, a higher proportion were brown (61.5%; n = 32), aged 20 to 29 years (48.1%; n = 25), with completed high school education (36.6%; n = 19). It is noteworthy that 13.5% (n = 7) of the records for this last variable were blank or unknown on the notification form (Table 1).

Regarding the clinical variables of affected pregnant women, common signs and symptoms were fever (65.4%; n = 34), arthralgia (59.6%; n = 31), rash (53.8%; n = 28), and myalgia (30.8%; n = 16). Conjunctivitis showed the lowest percentage (21.1%; n = 11), and there were no cases of leukopenia, as shown in table 1.

As for clinical presentation, 59.6% (n = 31) of the cases developed the acute form of the disease, and there were no records of pregnant women developing the chronic phase. However, it should be noted that 40.4% (n = 21) of the cases did not have this variable filled in the notification form. Only two pregnant women (3.8%) required hospitalization due to the disease; however, this information was unknown for 40.4% (n = 21) of the cases (Table 1).

Table 1 – Clinical and epidemiological profile of pregnant women with chikungunya fever in Belém, Pará State, Brazil, from 2016 to 2018

(to be continued)

Variables	N = 52	%	*p*-valor
Race/Color			
White	13	25.0	
Black	3	5.8	
Yellow	–	–	< 0.0001
Brown	32	61.5	
Unknown	4	7.7	
Age group			
20 to 29 years old	25	48.1	
30 to 39 years old	21	40.4	0.0031
40 to 42 years old	6	11.5	
Education			
Unfinished elementary school	8	15.4	
Finished elementary school	2	3.8	
Unfinished high school	6	11.5	
Finished high school	19	36.6	0.0002
Unfinished college degree	2	3.8	
Finished college degree	8	15.4	
Unknown	7	13.5	
Gestational age at diagnosis			
1st trimester	15	28.8	
2nd trimester	20	38.5	0.6939
3rd trimester	17	32.7	
Hospitalização			
Yes	2	3.8	
No	29	55.8	< 0.0001
Unknown	21	40.4	
Clinical presentation			
Acute	31	59.6	
Chronic	–	–	< 0.0001
Unknown	21	40.4	

Table 1 – Clinical and epidemiological profile of pregnant women with chikungunya fever in Belém, Pará State, Brazil, from 2016 to 2018

(end)

Variables	N = 52	%	*p*-valor
Fever			
Yes	34	65.4	
No	2	3.8	< 0.0001
Unknown	16	30.8	
Artralgia			
Yes	31	59.6	
No	5	9.6	< 0.0001
Unknown	16	30.8	
Exanthema			
Yes	28	53.8	
No	8	15.4	0.0029
Unknown	16	30.8	
Myalgia			
Yes	16	30.8	
No	1	1.9	< 0.0001
Unknown	35	67.3	
Conjunctivitis			
Yes	11	21.1	
No	25	48.1	0.0548
Unknown	16	30.8	
Leukopenia			
Yes	–	–	
No	36	69.2	< 0.0001
Unknown	16	30.8	

Source: SESMA, 2021.

Conventional sign used: – Numeric data equal to zero, not resulting from rounding.

There was a predominance of six to eight prenatal consultations (36.6%; n = 19), although there was no statistically significant difference. A higher proportion of cases started prenatal care in the first trimester of pregnancy (75.0%; n = 39), with a statistically significant difference (p < 0.0001) compared to other trimesters (Table 2).

Regarding newborns of mothers with the disease, the highest percentage was born by caesarean section (63.5%; n = 33). There was a predominance of term newborns (86.6%; n = 45), and the majority had adequate weight (53.9%; n = 28). Type of delivery (p < 0.052) and number of prenatal consultations (p < 0.2453) were not statistically significant (Table 2).

Chikungunya fever in pregnant women showed a heterogeneous spatial distribution pattern in Belém's neighborhoods, as only 25 of the 71 existing neighborhoods had confirmed disease cases. The analysis of notified and confirmed cases of pregnant women with the disease showed a very high density of cases in the neighborhoods of Ponta Grossa (DAICO region), Agulha (DAICO region), Parque Guajará (DAICO region), Guamá (DAGUA region), and Canudos (DAGUA region), as shown in figure 1.

DISCUSSION

The signs and symptoms related to the disease in the pregnant women analyzed in this study followed the pattern already described in other studies evaluating the symptomatology of chikungunya fever in pregnant women[12,13], in which most cases presented fever, arthralgia, and myalgia.

Table 2 – Clinical and epidemiological profile of newborns born to mothers with chikungunya fever during pregnancy in Belém, Pará State, Brazil, from 2016 to 2018

Variables	N = 52	%	p-valor
Birth weight			
Very low	1	1.9	
Low	9	17.3	
Insufficient	13	25.0	< 0.0001
Adequate	28	53.9	
Excessive	1	1.9	
Type of delivery			
Vaginal	19	36.5	0.0522
Caesarean	33	63.5	
Gestational age			
Preterm	6	11.5	
Term	45	86.6	< 0.0001
Post-term	1	1.9	
Number of prenatal consultations			
3 to 5	10	19.2	
6 to 8	19	36.6	0.2453
9 to 11	13	25.0	
12 or more	10	19.2	
Start of prenatal care			
1st trimester	39	75.0	
2nd trimester	13	25.0	< 0.0001
3rd trimester	–	–	

Source: SESMA, 2021.

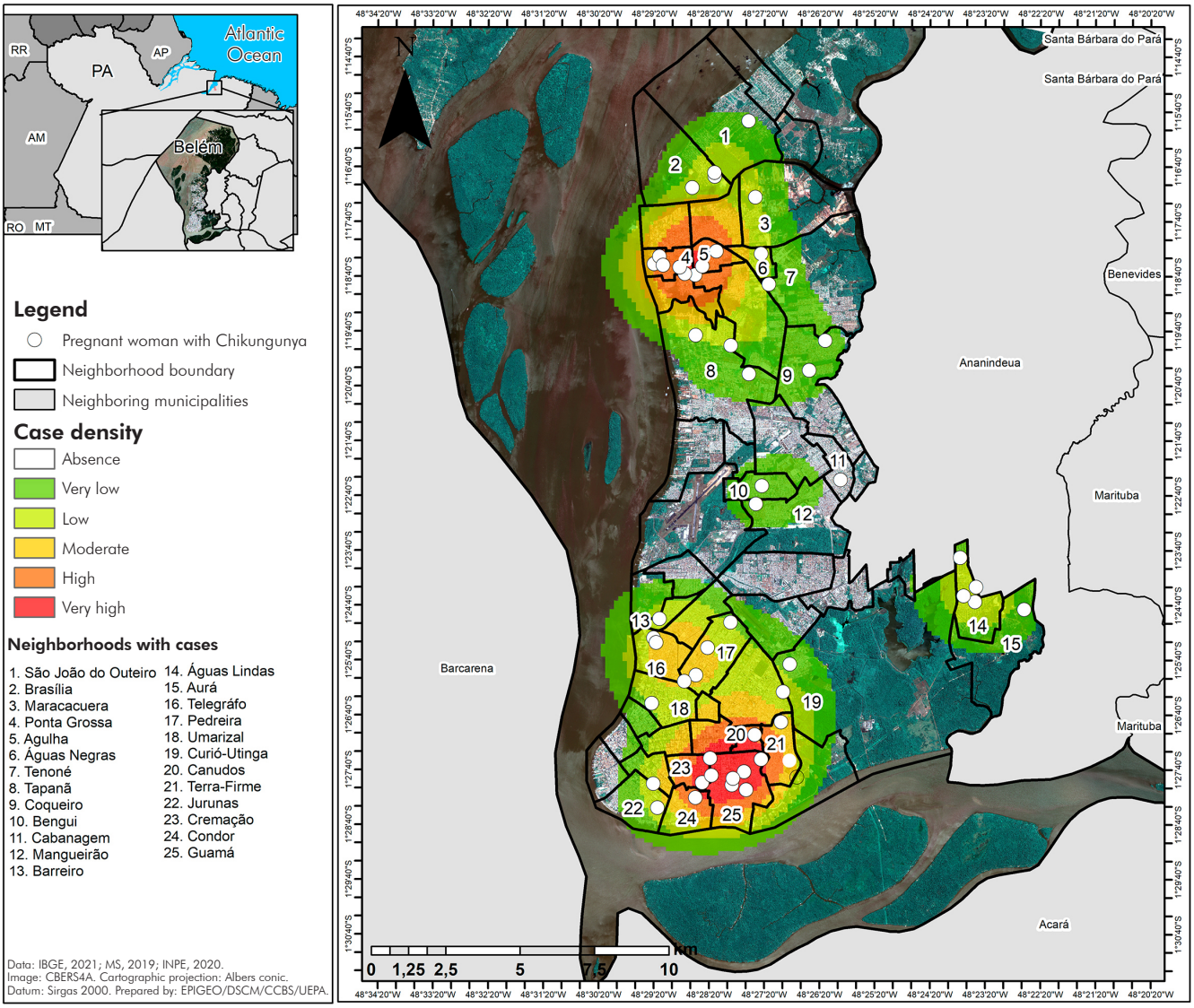
Conventional sign used: – Numeric data equal to zero, not resulting from rounding.

In this study, out of the 31 pregnant women with known hospitalization information, only two required hospitalizations, one of whom was diagnosed in the third trimester of pregnancy, following an investigation of fetal microcephaly. However, no records of tests on the newborn confirm that chikungunya fever led to this event. Other studies have described cases of microcephaly in newborns of mothers diagnosed with chikungunya fever during pregnancy[13,14,15]. In the cases of this study, the maternal clinical condition improved during hospitalizations.

It is worth noting that the initial studies to show the incidence of CHIKV infection in pregnant women took place on Reunion Island, in the Pacific region, during epidemics between 2005 and 2006[16,17]. Fritel et al.[16] selected 1,400 pregnant women after the introduction of CHIKV in the region, of whom 658 (47.0%) had markers of recent virus infection. Gérardin et al.[17], when analyzing CHIKV infection, observed that, in February 2006, pregnant women still behaved like everyone else despite their level of exposure to the virus not being different from others. Thus, these studies evidenced the high degree of pregnant women's vulnerability.

Pregnant women are predominantly affected by chikungunya fever in the second trimester of gestation, and the most common age group is 20 to 29 years old. The most prevalent race/color is brown, which can be explained by the high rate of Brazilian miscegenation[13,16,18].

A higher percentage of newborns born by caesarean section was observed, which agrees with the Ministry of Health's statement that caesarean section is the most prevalent type of delivery due to cultural practice in the Amazon Region. This fact shows that more effective measures are needed to reduce the occurrence of unnecessary caesarean deliveries, as this procedure can be a risk factor for prematurity, low birth weight, and neonatal and maternal mortality[19].



Source: EPIGEO/DSCM/CCBS/UEPA, 2022.

A: Map of Brazil; B: Map of Pará, highlighting Belém city; C: Heat map of notified and confirmed pregnant women with chikungunya fever, according to residence neighborhood.

Figure 1 – Map of the spatial distribution of chikungunya fever cases in pregnant women in Belém, Pará State, Brazil, from 2016 to 2018

It is worth noting that neonates infected in the peripartum period are born with very low or even undetectable viremia, which could make placental microtransfusion unlikely. In these cases, low viremia in pregnant women should result in low viremia in newborns. It is emphasized that the period for transmitted viral load to generate clinical manifestations of chikungunya fever in newborns is three to seven days, on average[15].

The predominance of full-term newborns may be associated with behavioral changes in pregnant women following the diagnosis of the disease. Women diagnosed with the disease during pregnancy are more likely to seek healthcare services and undergo monitoring. These changes may assist in the optimal progression of gestation[13]; however, more findings are needed to substantiate this observation. This study found fewer premature newborns, a similar result to other authors investigating chikungunya fever in newborns[16,20].

Most newborns were born at the ideal weight. This fact may be associated with the diagnosis of chikungunya fever during pregnancy, which may protect against low birth weight, as infected pregnant women tend to take better care of themselves due to the disease[13]. Some studies have reported cases of low birth weight in newborns of mothers affected by the disease during gestation; however, they have not proven a direct relationship between maternal infection and low birth weight in newborns[15,16,19].

Most pregnant women underwent six or more prenatal consultations, a quantity considered ideal for adequate gestational monitoring[21], indicating satisfactory prenatal adherence. However, ten cases (19.2%) did not reach this quantity throughout pregnancy.

Furthermore, according to the spatial distribution of cases of pregnant women with chikungunya fever, a high density of disease occurrences was observed in Ponta Grossa, Agulha, Parque Guajará,

Guamá, and Canudos neighborhoods, which may be related to various social, demographic, and environmental problems in Belém city. The city has experienced disordered urban growth, with population clusters, contributing to various infectious diseases' transmission[22]. The peak of this growth occurred from the 1960s onwards due to the implementation of large-scale projects in the Amazon Region, leading to uncontrolled population expansion without adequate planning, which caused various changes in the environment and the quality of life of this population[23].

With disordered urban growth, the number of households without basic sanitation also increases, leading to a higher incidence of vector-borne diseases. This is mainly due to the accumulation of garbage, which favors the emergence of breeding sites for immature vector forms[24].

Ponta Grossa, Agulha, and Parque Guajará neighborhoods are part of DAICO and have large subnormal population clusters and inadequate basic sanitation[22]. This administrative district is considered an area of precarious human occupation on the capital outskirts. On the other hand, Guamá and Canudos neighborhoods belong to DAGUA and have several areas of spontaneous population occupation or subnormal settlements, with poor basic sanitation[24]. These two districts have a significant low-income population, as well as insufficient coverage and supply of health services, which, combined with poor sanitation, can influence the occurrence of various infectious diseases, including those of viral etiology such as chikungunya fever, due to the proliferation of breeding sites for its vectors[9,25,26].

Moreover, this study's limitations include the large number of ignored or left blank variables in SINAN and those related to the possibility of underreporting cases due to mild or non-existent symptoms. In addition, being a cross-sectional study, it was not possible to follow up with pregnant women and children to assess other outcomes, such as the chronicity of the condition.

CONCLUSION

This study highlighted the predominance of pregnant women affected by chikungunya fever being of brown race/color, aged 20 to 29 years, and having completed high school, who presented fever, myalgia, rash, and arthralgia as main symptoms. Most newborns were born by caesarean section, at term, and with adequate weight. The disease in this population exhibited a heterogeneous spatial distribution pattern in the neighborhoods of Belém, with a very high density of cases in Ponta Grossa, Agulha, Parque Guajará, Guamá, and Canudos neighborhoods.

The analyses conducted could be helpful in public health decision-making processes, guiding services and management towards adequate promotion, prevention, and recovery of the population's health, especially in peripheral neighborhoods, which have a significant number of low-income individuals, making them more vulnerable. Thus, health surveillance activities play a fundamental role in this process.

Finally, it is crucial to expand public policies for monitoring maternal and child health so that actions in this life cycle are timely and can prevent potential adverse events related to infectious diseases during gestation.

ACKNOWLEDGEMENTS

To the entire UEPA's Epidemiology and Geoprocessing Laboratory (EPIGEO) team.

FINANCIAL SUPPORT

Social Demand Program of the Coordination for the Improvement of Higher Education Personnel (CAPES).

CONFLICTS OF INTEREST

The authors declare no conflicts of interest in this study.

AUTHORS' CONTRIBUTION

DAS and NVG were responsible for data collection, text production, discussion, and conclusion of this study. MCSP contributed to the discussion and conclusion. BCS processed the data and created the illustrative resources. CSCM, ECM, MFPC, and BVSP contributed to the writing analysis and textual revision.

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Received / Recebido em: 23/2/2022
Accepted / Aceito em: 5/7/2023

Article originally published in Portuguese (http://dx.doi.org/10.5123/S2176-6223202301312)
Translated by: Vera Maria Segurado Pimentel
Reviewed by: Isabella Mateus

How to cite this article / Como citar este artigo:

Spinelli DA, Peixoto MCS, Souza BC, Miranda CSC, Morais EC, Carrera MFP, et al. Chikungunya fever in pregnant women and its immediate repercussions at the birth time: a clinical, epidemiological, and spatial analysis in Belém, Pará State, eastern Brazilian Amazon. Rev Pan Amaz Saude. 2023;14:e202301312. Doi: https://doi.org/10.5123/S2176-6223202301312