Original Article

An overview of 30 days of confirmed COVID-19 cases in the state of Ceará

Panorama de 30 dias de casos confirmados de COVID-19 no estado do Ceará

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Special Call - COVID-19

ABSTRACT

Objective: to analyze the evolution of the number of confirmed COVID-19 cases in the 30 first days of transmission in the state of Ceará. **Methods**: ecological study of a temporal series. Measures of position and dispersion were calculated, as well as the coefficient of incidence for the first 30 days. The evolution of the number of cases was compared to the trend of advance of the disease. **Results:** in the 30th day there were 1,800 confirmed cases, peaking in the 23rd day. This study assumes that the measures implemented in the state started to influence the evolution of the disease in the 26th day after the first confirmed case. The incidence coefficient increased 146.5% between the 21st and the 30th days. **Conclusion:** the mean number of new cases consistently increased in the period analyzed, suggesting that the epidemic has not yet been controlled in the state, but is decelerating.
Descriptors: Coronavirus Infections; Betacoronavirus; Pandemics; Ecological Studies.

RESUMO

Objetivo: analisar a evolução do número de casos confirmados de COVID-19 nos 30 primeiros dias de transmissão no Ceará, Brasil. **Métodos**: estudo ecológico de séries temporais, no qual foram calculadas medidas de posição e dispersão e coeficiente de incidência para os 30 primeiros dias de COVID-19 no Ceará. A evolução do número de casos foi comparada à tendência de avanço da doença. **Resultados:** no 30º dia, havia confirmação de 1.800 casos, com pico no 23º dia. Presume-se que medidas de combate à COVID-19, implementadas no estado, passaram a influenciar a evolução da doença, a partir do 26º dia da primeira confirmação. O coeficiente de incidência aumentou 146,5% entre o 21º e o 30º dia. **Conclusão:** a média de novos casos manteve-se ascendente no período analisado, indicando que a epidemia não atingiu seu controle no estado, mas apresentou desaceleração ao que se esperava sem implementação de medidas de controle.
Descritores: Infecções por Coronavirus; Betacoronavirus; Pandemias; Estudos Ecológicos.

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Introduction

After cases of pneumonia with unknown etiology were detected in December 2019, in the city of Wuhan, China, investigations showed that the etiological agent was a new type of coronavirus, which was later named Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2)[1]. The SARS-CoV-2 is responsible for the infection which is currently called COVID-19 and disseminated fast throughout the globe[2].

The natural history of COVID-19 in China showed that it has a medium period of incubation, 5.1 days (Confidence Interval (CI) 95%: 4.5 to 5.8) and that symptoms start in up to 11.5 days (CI95%: 8.2 to 15.6) in individuals with the infection[3]. Risk factors for developing the disease are: advanced age and previous chronic diseases. During hospitalization from COVID-19, the impairment of renal functions and high levels of change in the procalcitonin biomarker have been associated to a worsening of the disease[4].

The basic reproduction number, which is the mathematical term that defines the potential a disease has to spread, is between 3.5 and 4.6 for COVID-19[5]. The high rates of transmission and the spread of the disease throughout the world led the World Health Organization to declare COVID-19 as a pandemic[6]. Later, in a report from April 2020, they found that, up to that point, 211 countries had registered confirmed cases of the disease[7].

The incidence of COVID-19 per 1,000 people varied in the three first months of recorded cases in the world, going from 1.82 in Japan to 61.44 in South Korea[8]. In Brazil, the accumulated incidence of confirmed cases of the disease is lower than in European countries, but has been increasing[9]. The highly varied ways in which the disease behaves in the countries are related, among other issues, to testing capabilities, population size, and measures adopted to contain the high transmission rates of SARS-CoV-2. Due to the gravity of this pandemic, the international response has been intense[10]. Measures such as the closing of boarders, social distancing, and closure of any service that is not deemed essential have been implemented in the affected nations.

COVID-19 has different rates of incidence in each location and, thus, understanding the trajectory of the disease in each territory is essential to adopt, intensify, or relax response measures. In Brazil, since the first cases of the disease, epidemiological information has been condensed in daily briefings and press releases from the Ministry of Health and Municipal and State Health Secretariats.

In this context, Ceará stands out, after 30 days of confirmed COVID-19 cases, as the third Brazilian state that was affected the most by the epidemic. Its capital city, Fortaleza, is the one with the highest incidence relative to the number of residents[11], despite the fact that municipal, state, and federal actions to fight the disease have been implemented.

Considering this setting, it is relevant to understand the behavior of the cases of the disease in the state, to encourage and plan the reduction, maintenance, or expansion of response measures based on consolidated information. As a result, this study was developed to analyze the evolution in the number of confirmed COVID-19 cases in the first 30 days of transmission in the state of Ceará.

Methods

This is an ecological, temporal-series study, which analyzed the state of Ceará. The period studied included the first 30 days of COVID-19 in the state, from March 15 to April 13, 2020.

Data was found through consultations to Epidemiological Press Releases and Briefings published by the Health Secretariat of the State of Ceará, which publicized daily updates on the landscape of COVID-19[12]. Population size estimates were found in the platform of the Brazilian Institute of Geography and Statistics[13]. Data was accessed on April 13, 2020.

The number of confirmed cases per day was tabulated in Microsoft Excel®. From the information, medians, interquartile range, and minimum and ma-

ximum values were calculated for the number of new confirmed cases of COVID-19 in Ceará. The Shapiro-Wilk test was used to analyze the normality of the distribution of new cases for each time frame. Considering the result of said analysis, the Kruskal-Wallis test was adopted for non-paired samples, to check for statistically significant differences between the number of confirmed cases in each period analyzed.

A simple linear regression analysis was used to identify the most adequate model with regards to the tendency of the evolution of COVID-19 cases in Ceará, between the 3rd and 30th day of the disease. To do so, the time, in days, was considered as an independent variable, and the aggregate number of cases as a dependent variable. The highest determining coefficient was used as a measure to define the adjustment.

Later, the incidence coefficient of COVID-19 in the population of the state was calculated. To do so, the numerator considered was the number of cases, and the denominator was the population estimate for 2020 in the state of Ceará. For standardization, the coefficient was calculated per 100,000 residents. The variation of the rate was analyzed in ten-day intervals, and to do so, the reference values prescribed by literature[14] were used for the calculations.

Data was analyzed using the software Stata v.15.0. Microsoft Word® was used to generate the tables, and Microsoft Excel® to elaborate graphs showing the dispersion of new cases, the tendency of new cases, and the variation of the incidence coefficient in Ceará.

This study was not submitted to the analysis of the Research Ethics Committee, since it used secondary data that was available in public platforms. However, the manipulation and interpretation of data followed all pertinent ethical guidelines.

Results

Up to the 30th day of COVID-19 in the state of Ceará (April 13, 2020), 1,800 cases of the disease had been confirmed. The daily number of new cases was variable in this period, with a minimum of three cases, within the first 10-day period, and a maximum of 119, in the third 10-day period (Figure 1).

As shown in Figure 1, in the 30-day interval, there were alternating increases and decreases in the daily number of new cases, and although the apex of the curve was in the 25th day of the epidemic in the state, further confirmed cases were similar to the numbers immediately prior to this peak. The exponential model (R^2=0.90) showed itself to the be the most adequate to the curve of COVID-19 cases, according to graph 3. Starting from the 26th day of the epidemic in the state, which was April 9, 2020, the number of cases began to be lower than expected. According to the exponential tendency curve, in the 30th day, Ceará would present approximately three thousand COVID-19 cases. However, the real number of cases was 40.0% lower.
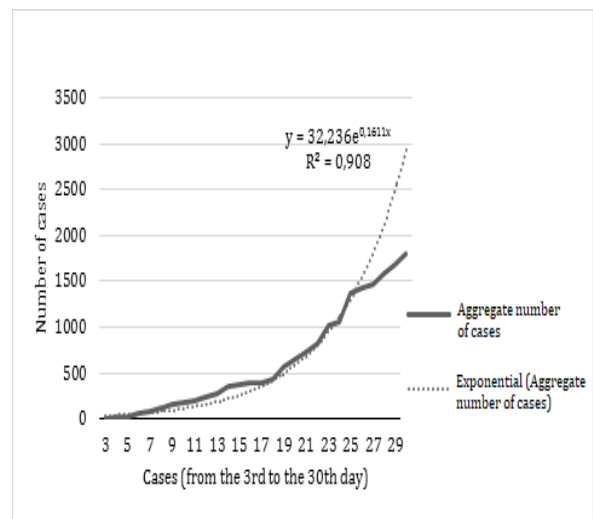

Figure 1 – New COVID-19 cases in the state of Ceará, from the 1st to the 30th day of the epidemic. Fortaleza, CE, Brazil, 2020

Table 1 indicates that the mean of new cases per day increased in each period analyzed. In the third interval analyzed, the mean was 6.2 times higher than the one found in the first 10 days of the epidemic in the state. There was an elevated standard-deviation in the third period, resulting from the fluctuation in the number of cases confirmed for each day within it.

A statistically significant change (p<0.001) was found between the means of new cases for each 10-day group.

Table 1 – New confirmed COVID-19 cases per day in the state of Ceará. Fortaleza, CE, Brazil, 2020

Measures	Confirmed cases (days)			p-value
	3rd to 10th	11th to 20th	21st to 30th	
Median	12.5	39	93.5	<0.001*
Interquartile range	35	48	71	
Minimum	1	11	38	–
Maximum	44	119	323	

*Kruskal-Wallis test

From the 3rd to the 30th day of COVID-19 cases in the state of Ceará the incidence coefficient increased daily and reached 19.71 cases per 100,000 people in the state. However, there are notable changes in the three intervals analyzed. Between the 11th and 20th days, there was an increase of 229.0% in the incidence coefficient, while the growtth from the 21st to the 30th day was 146.5% (Figure 2).
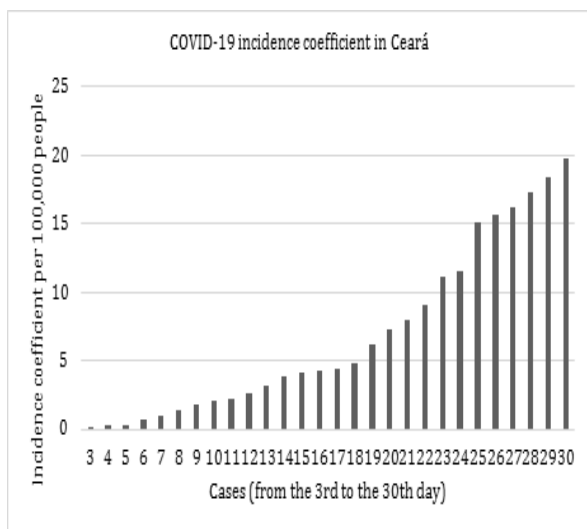

Figure 2 – Incidence coefficient of COVID-19 in the state of Ceará, per 100,000 residents. Fortaleza, CE, Brazil, 2020

Discussion

This study has limitations inherent to the ecological and retrospective methods, since it is based on secondary data. Additionally, the number of confirmed COVID-19 cases in the state may have been subnotified, due to the logistic and structural limitations for testing, and it should be highlighted that this may have led the state to publicize lower rates of incidence than the actual ones. Furthermore, the nature of the analysis, based on the number of new and aggregate cases, did not enable inferences on the sociodemographic and clinical profile of confirmed cases, nor did it allow to find the difference in incidence for specific population groups.

Considering the first 30 days of the epidemic in Brazil, it can be noted that the mean of new cases confirmed in Ceará was higher than the one in the state of São Paulo[15]. São Paulo, it should be noted, is the territory with the highest incidence of cases in Brazil.

An analysis of the incidence of COVID-19 in Ceará, for every 10 days, shows variations in the curve, with negative and positive deflection points but a general ascending trend.

Considering the first confirmed cases of COVID-19 in Ceará and the dissemination of the disease in other states of the Federation, in March 16, 2020, the government of the state published Decree No.33.510[16], which declared the sittuation a public health emergency and suspended the realization of educational and collective activities, to avoid crowding and seek to diminish the community transmission of the disease. These actions were soon after expanded by Decree No.33.519[17], from March 19, 2020, which suspended the functioning of many establishments in the state, such as restaurants, churches, gyms, malls, among others. Later, actions implemented to confront the pandemic in Ceará were extended through Decree No. 33.536[18], from April 05, 2020.

The findings of this study suggest that the number of aggregate COVID-19 cases in the state started

to distance itself from the previous trends of growth on the 26th day after the epidemic. From this moment on, the number of aggregate cases was lower than the one that was to be expected if the exponential rhythm of growth remained unchanged.

Due to the actions in response to the epidemics that were adopted in Ceará, and considering the natural history of the disease[3], it can be noted that the contingency measures adopted and the consequent response of the population to guidelines about social distancing may have had a role in the change in the curve of aggregate cases. These decisions are estimated to have taken 20 days to promote changes in COVID-19 cases in the state. The actions adopted in Ceará are in accordance to directives of mitigation and social distancing recommended by the Ministry of Health and the World Health Organization[19].

However, although the low incidence curve of COVID-19 in Ceará is below the projections for the first 30 days, the data showed that the trend is still one of ascension. Estimates suggest that the number of cases in Brazil will continue to grow, reaching its peak in May 2020, and that SARS-CoV-2 will continue its dissemination throughout the country at least until September 2020[20].

Until the contamination is effectively controlled through an efficient antiviral therapy for those contaminated or through the immunization of those susceptible, social isolation seems to be the most efficient prevention strategy to avoid community transmission[1]. As indicated in this study, it is related to the behavior of the cases which took place in the first 30 days of confirmed and registered cases in Ceará.

Therefore, the government would have more effective parameters to define more strictly the measures of restriction of movement. And as a result, the return to economical and social activities could take place in a safer and faster way. However, the implementation of this proposal requires tests to be made massively available to individuals, which is a challenge for municipalities, the state, and the union.

These and other proposals to systematize social distancing contribute for the balance between the need of controlling the community transmission and for a transitory return to economical and social activities. However, this is only feasible after the government takes protective measures, including the acquisition of individual protective equipment, physical, logistical, and personnel structuring in health services, and, especially, in the structuring of units for the attention of critical cases, the purchase of a bigger arsenal of diagnostic and serologic tests, in addition to the structuring of softwares that can allow for a more dynamic monitoring of confirmed and suspected cases.

Conclusion

The analysis of the first 30 days of the COVID-19 epidemic in the state of Ceará makes it possible to assume that, in the 26th day after the first confirmed case, a positive effect of the measures implemented could start to be noticed. However, the mean number of new cases consistently increased in the period analyzed, suggesting that the epidemic has not yet been controlled in the state, although it is decelerating in comparison to the values that were expected if no measures of control were implemented. The findings of this study contribute for the planning of the adoption, maintenance, or expansion of response actions for future periods, including the projection of the curve of new cases in extended scenarios through time.

Collaborations

Albuquerque NLS, Lima FSS, Ramos SLTC, Soares PRAL and Lopes MMCO contributed for the conception and for the project, data analysis and interpretation, article writing, in the relevant critical review of the intelectual content and the final approval of the version to be published.

References

1. Singh A, Shaikh A, Singh R, Singh AK. COVID-19: From bench to bed site. Diabetes & metabolic syndrome. Clin Res Rev. 2020; 14(4):177-81. doi: https://doi.org/10.1016/j.dsx.2020.04.011

2. Wang C, Horby PW, Hayden FG, Gao GF. A novel coronavirus outbreak of global health concern. Lancet. 2020; 395(10223):470-73. doi: https://doi.org/10.1016/S0140-6736(20)30185-9

3. Lauer SA, Grantz KH, Bi Q, Jones FK, Zheng Q, Meredith HR, et al. The incubation period of coronavirus disease 2019 (COVID-19) from publicly reported confirmed cases: estimation and application. Ann Intern Med. 2020; 172(9):577-82. doi: https://doi.org/10.7326/M20-0504

4. Chen TL, Dai Z, Mo P, Li X, Ma Z, Song S, et al. Clinical characteristics and outcomes of older patients with coronavirus disease 2019 (COVID-19) in Wuhan, China (2019): a single-centered, retrospective study. J Gerontol. 2020. doi: https://doi.org/10.1093/gerona/glaa089

5. Choi S, Ki M. Estimating the reproductive number and the outbreak size of Novel Coronavirus disease (COVID-19) using mathematical model in Republic of Korea. Epidemiol Health. 2020; 42:e2020011. doi: https://doi.org/10.4178/epih.e2020011

6. Cucinotta D, Vanelli M. WHO declares COVID-19 a pandemic. Acta Biomed. 2020; 19(91):157-60. doi: https://doi.org/10.23750/abm.v91i1.9397

7. World Health Organization. Coronavirus disease 2019 (COVID19)-situation report 78 [Internet]. 2020 [cited Apr 12, 2020]. Available from: https://www.who.int/docs/default-source/coronaviruse/situation-reports/20200407-sitrep-78-covid-19.pdf?sfvrsn=bc43e1b_2

8. Lai CC, Wang CY, Wang YH, Hsueh SC, Ko WC, Hsueh PR. Global epidemiology of coronavirus disease 2019 (COVID-19): disease incidence, daily cumulative index, mortality, and their association with country healthcare resources and economic status. Int J Antimicrob Agents. 2020; 55(4):105946. doi: https://doi.org/10.1016/j.ijantimicag.2020.105946

9. Albuquerque NLS, Pedrosa NL. Overview of confirmed cases of COVID-19 in five countries facing community transmission. SciELO Preprints [Internet]. 2020 [cited May 06, 2020]. doi: https://doi.org/10.1590/SciELOPreprints.21

10. Singhal T. A review of coronavirus disease-2019 (COVID-19). Indian J Pediatr. 2020; 87(4):281-6. doi: https://doi.org/10.1007/s12098-020-03263-6

11. Ministério da Saúde (BR). Portal coronavírus [Internet]. 2020 [cited Apr 12, 2020]. Available from: https://covid.saude.gov.br/

12. Secretaria da Saúde do Estado do Ceará. Boletins Epidemiológicos [Internet]. 2020 [cited Apr 12, 2020]. Available from: https://www.saude.ce.gov.br/download/boletins/

13. Instituto Brasileiro de Geografia e Estatística. Ceará – IBGE Cidades [Internet]. 2020 [cited Apr 01, 2020]. Available from: https://cidades.ibge.gov.br/brasil/ce/panorama

14. Souza DK, Peixoto SV. Estudo descritivo da evolução dos gastos com internações hospitalares por condições sensíveis à atenção primária no Brasil, 2000-2013. Epidemiol Serv Saúde. 2017; 26(2):285-94. doi: https://doi.org/10.5123/S1679-49742017000200006

15. Secretaria de Estado da Saúde. Situação Epidemiológica [Internet]. 2020 [cited Apr 13, 2020]. Available from: http://www.saude.sp.gov.br/cve-centro-de-vigilancia-epidemiologica-prof.-alexandre-vranjac/areas-de-vigilancia/doencas-de-transmissao-respiratoria/coronavirus-covid-19/situacao-epidemiologica

16. Governo do Estado do Ceará. Decreto nº 33.510, de 16 de março de 2020: decreta situação de emergência em saúde e dispõe sobre medidas para enfrentamento e contenção da infecção humana pelo novo coronavírus [Internet]. 2020 [cited Apr 13, 2020]. Available from: https://www.cge.ce.gov.br/wp-content/uploads/sites/20/2020/03/Decreto-n%C2%BA.-33.510-de-16-de-mar%C3%A7o-de-2020.-Decreta-situa%C3%A7%C3%A3o-de-Emerg%C3%AAncia-em-sa%C3%BAde-e-disp%C3%B5e-sobre-medidas-de-enfrentamento-e-conten%C3%A7%C3%A3o-da-infecc%C3%A7%C3%A3o-humana-pelo-novo-coronavirus.pdf

17. Governo do Estado do Ceará. Decreto nº 33.519, de 19 de março de 2020: intensifica as medidas para enfrentamento da infecção humana pelo novo coronavírus [Internet]. 2020 [cited Apr 13, 2020]. Available from: https://www.cge.ce.gov.br/wp-content/uploads/sites/20/2020/03/Decreto-n.-33.519-de-19-de-mar%C3%A7o-de-2020.-Intensifica-as-medidas-para-enfrentamento-da-infec%C3%A7%C3%A3o-humana-pelo-novo-coronavirus.pdf

18. Governo do Estado do Ceará. Decreto nº 33.536, de 05 de abril de 2020: prorroga as medidas de enfrentamento à disseminação do Novo Coronavírus no Estado do Ceará e dá outras providências. Ceará: [Internet]. 2020 [cited Apr 13, 2020]. Available from: https://www.cge.ce.gov.br/wp-content/uploads/sites/20/2020/04/Decreto-n%C2%BA.-33.536-de-05-de-abril-de-2020-Prorroga-as-medidas-de-enfrentamento-%C3%A0-dissemina%C3%A7%C3%A3o-do-novo-coronavirus.pdf

19. World Health Organization. Coronavirus disease 2019 (COVID19)-situation report 72 [Internet]. 2020 [cited Apr 12, 2020]. Available from: https://www.who.int/docs/default-source/coronaviruse/situation-reports/20200401-sitrep-72-covid-19.pdf?sfvrsn=3dd8971b_2

20. Freitas ARR, Napimoga M, Donalisio MR. Assessing the severity of COVID-19. Epidemiol Serv Saúde. 2020; 29(2):e2020119. doi: http://dx.doi.org/10.5123/s1679-49742020000200008