Rigid social isolation during COVID-19 pandemics in a state of brazilian northeast

Isolamento social rígido durante a pandemia de COVID-19 em um estado do nordeste brasileiro

Aislamiento social rígido durante la pandemia de COVID-19 en un estado del nordeste brasileño

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Abstract

Objective: This study aimed to analyze the temporal trend of incidence, mortality, coverage of wards and intensive care beds, and rigid social isolation in the Ceará State and correlate them.

Methods: Ecological study, which outcome variable was the mortality rate. Predictors were incidence, occupation rate of bed wards and intensive care beds, and social isolation rate. It was performed a multiple linear regression considering significant when p<0.05.

Results: It was observed an increasing trend of incidence and mortality by COVID-19 in the Ceará State (p=0.01). On the other hand, it was seen a decreasing trend in the occupation of wards and intensive care beds (p=0.02). The social isolation rate significantly decreased during the period (p=0.001). In the multiple linear regression, social isolation remained inversely related to mortality by COVID-19 (β=-0.08; p=0,02).

Conclusion: It was seen the effect of rigid social isolation during the COVID-19 pandemics. The anticipated implementation of it, with other public health actions, showed relevance to guarantee the continuity of its benefits.

Resumo

Objetivo: Analisar a tendência temporal da incidência, mortalidade, cobertura de enfermarias e leitos de terapia intensiva e rígido isolamento social no estado do Ceará e correlacioná-los.

Métodos: Estudo ecológico, cuja variável de desfecho foi a taxa de mortalidade. Os preditores foram a incidência, a taxa de ocupação de enfermarias e leitos de terapia intensiva e a taxa de isolamento social. Foi realizada uma regressão linear múltipla considerada significativa quando p <0,05.

Resultados: Observou-se tendência de aumento da incidência e mortalidade por COVID-19 no estado do Ceará (p = 0,01). Por outro lado, observou-se tendência de diminuição na ocupação de enfermarias e leitos de terapia intensiva (p = 0,02). A taxa de isolamento social diminuiu significativamente durante o período (p = 0,001). Na regressão linear múltipla, o isolamento social manteve-se inversamente relacionado à mortalidade pela COVID-19 (β = -0,08; p = 0,02).

Conclusão: Verificou-se o efeito do rígido isolamento social durante a pandemia de COVID-19. A implementação antecipada do mesmo, com outras ações de saúde pública, mostrou-se relevante para garantir a continuidade de seus benefícios.

Resumen

Objetivo: Analizar la tendencia temporal de la incidencia, mortalidad, ocupación de enfermerías y camas de terapia intensiva y el rígido aislamiento social en el estado de Ceará y correlacionarlos.

Métodos: Estudio ecológico, cuya variable de criterio de valoración fue el índice de mortalidad. Los predictores fueron la incidencia, el índice de ocupación de enfermerías y camas de terapia intensiva y el índice de aislamiento social. Se realizó una regresión lineal múltiple considerada significativa cuando p < 0,05.

Resultados: Se observó una tendencia de aumento de la incidencia y mortalidad por COVID-19 en el estado de Ceará (p = 0,01). Por otro lado, se observó una tendencia de reducción de ocupación de enfermerías y camas de terapia intensiva (p = 0,02). El índice de aislamiento social se redujo significativamente durante el período (p = 0,001). En la regresión lineal múltiple, el aislamiento social se mantuvo inversamente relacionado con la mortalidad por COVID-19 (β = -0,08; p = 0,02).

Conclusión: Se verificó el efecto del aislamiento social rígido durante la pandemia de COVID-19. La implementación anticipada de esta medida, junto con otras acciones de salud pública, demostró ser relevante para garantizar la continuidad de sus beneficios.

Introduction

Detected in December 2019 in Hubei-China, the new coronavirus (SARS-CoV-2) belongs to a virus family that causes respiratory diseases in humans. It spread rapidly, drawing the attention of Chinese health authorities and the World Health Organization (WHO). Soon coronavirus disease 2019 (COVID-19) advanced out of Chinese territory, being characterized by a pandemic by the WHO in late January,[1] when there were 10,000 confirmed cases in China, 80,000 cases a month later. At the end of January[2] 100 cases were confirmed in 19 countries and 6,000 cases in 53 countries a month later, with 750,890 cases confirmed worldwide at the end of March 2020.

Brazil confirmed its first case[3] of COVID-19 on February 26, 2020, and a month later it had 4,256 cases.[4] Soon it reached the level of third country in number of cases, with more than five million cases and 150 thousand deaths.[5] Within this context, São Paulo, Rio de Janeiro and Ceará were the most affected states in Brazil, and Ceará was also the state with the highest number of cases and deaths in the Northeast Region.[6] It is believed that these numbers would have been higher if strict measures of social isolation had not been adopted.[7]

In this study, rigid social isolation is considered as the following government measures adopted, exceptionally and temporarily in the researched state: I - special duty of confinement; II-special duty of protection for people in the risk group. III-special duty to stay at home; IV-control of the circulation of private vehicles; V-control of the entry and exit of a municipality.[6,8] Thus, in strict social isolation during the COVID-19 pandemic, people remained in their residencies to reduce the transmission of the disease to groups at greater risk of having severe clinical conditions.[9] It is believed that this measure favored flattening of the case curve, with the distribution of cases over a longer period, allowing a controlled and orderly offer of health care to the population. Thus, the analysis of the evolution of their cases and deaths was vital to verify the effect of the action taken. An increase in cases and demand for health services is considered as a hospital occupancy rate in the clinic and Intensive Care Unit (ICU) of relevant factors in the nosological analysis.

Given the above, the objective of the study was to analyze the temporal pattern of incidence, mortality, hospital bed coverage (clinical/ICU), and strict social isolation in Ceará and to correlate them.

Methods

This Ecological study conducted in 2020 in the Ceará State, Brazil. All data used in this piece of research were collected from May 1st to June 9th 2020, because rigid social isolation was decreed within such period.[6,8] It has as data source the IntegraSUS website, which aggregates the database of the cases tested to COVID-19 via reverse-transcriptase polymerase chain reaction (RT-PCR) in the State. This database is in the public domain, therefore are freely available to the public the State Health Secretary.[10]

Data collection was made by filling a new database by using variables of interest. The outcome variable was the daily mortality rate by COVID-19. It was calculated by the following formula:

$$Mortality = 100,000 \; x \; \frac{Deaths \; by \; COVID\text{-}19}{Ceará \; State \; population}$$

Predictors were: daily incidence rate and wards and intensive care beds occupation rate. Daily incidence was calculated by the formula:

$$Incidence = 100,000 \; x \; \frac{Number\ of\ COVID\text{-}19\ new\ cases}{Cear\acute{a}\ State\ population}$$

Moreover, the Ceará State's social isolation rate was included by data obtained from the In Loco platform that publishes a Brazilian map of social isolation based on mobile phone location.[11]

In Loco can obtain the location with precision through GPS, triangulation of Wi-Fi networks, Bluetooth signal and telephony. It also identifies age, gender, how long certain apps are open, user operator and phone model. The company created the Social Isolation Index, which allows mapping the movement of people within specific regions and measuring which point to greater social distance. The statistics generated point to data such as agglomeration of people and individual location in each region, so the social isolation index is obtained, calculating the percentage of the absolute number of cell phones tracked.[11]

In Loco's database has more than 60 million mobile devices across Brazil. In an encrypted and aggregated form, the survey allows the responsible agencies to act directly in the areas at risk or most affected by the virus. The platform is also used by public agencies and the press. Such index has good validity, considering that data generated does not depend on the subjectivity of individual responses once it is digital data. It should be noted that issues such as internet access, having a cell phone and ensuring that an individual always keep a cell phone may limit the index.[11]

Data analysis firstly included the creation of trend lines of each variable. The temporal trend was analyzed by simple linear regression where predictor was the time (in days) and presented by graphs. Moreover, it was identified the determining coefficient (R^2), which varies from 0 to 1, where numbers close to one identify a perfect relation. To evaluate this trend, it was defined as the linear equation and p-value; the first one indicates an increasing or decreasing trend and the second one indicates if it is significant ($p < 0.05$). When $p > 0.05$, it was considered a stationary trend.

After temporal trend analysis, predictors were related to the outcome by Spearman correlation. Spearman's rho (ρ) varies from -1 to +1, where negative values indicate inversely proportional relations and the positives indicate direct relation. It was considered significant the relations that presented $p < 0.05$.

Finally, to evaluate how these variables contribute together to mortality, it was performed multiple linear regression by inserting predictors that had $p < 0.20$ in the correlations. The interpretations of its results are similar to correlations but coefficients β that can vary from $-\infty$ to $+\infty$. In this case, $p < 0.05$ was also considered to statistical significance. The strength of these relations was given by their 95% Confidence Interval (95%CI).

This study does not need previous approval of the Ethics Committee because the database was freely available on the internet by the Ceará State Government. It is important to highlight that it was not possible to identify the cases because no information regarding it was given, such as name or address.

Results

On the first day of the data collection, 273 cases were notified and 2779 on the last day. During the 40 days of analysis, it was observed an increasing trend of COVID-19 incidence ($p=0.01$). The incidence peak occurred among 29 to 31 May. Regarding mortality, it was also identified as an increasing trend ($p=0.01$), and 21 May represented the peak of deaths in the period (Table 1). Regarding the predictors studied, it was seen a decreasing trend of wards beds occupation ($p<0.001$) and an increasing trend of occupation of intensive care beds ($p=0.02$). It is important to note that the occupation of ward beds was above 100% in two moments: 5 May (110%) and 7 June (109%), which evidences an overcrowded health system. Furthermore, the social isolation rate was among 50% during the whole period but significantly decreased ($p=0.001$), presenting peaks (>50%) only on the Sundays of May (Table 1).

Table 1. Trend analysis of the mortality by COVID-19 and its predictors

Rates	Linear equation	R^{2a}	p-value	Trend
Mortality by COVID-19	0.02x − 1027.3	0.1352	0.02	Increasing
Incidence of COVID-19	0.49x−21340	0.1717	0.01	Increasing
ICU[b] beds occupation	0.16x − 6976.1	0.1429	0.02	Increasing
Ward beds occupation	-0.51x + 22462	0.5847	<0.001	Decreasing
Social Isolation	-0.17x + 7510.6	0.2672	0.001	Decreasing

a = R^2 – linear determining coefficient; b = ICU – Intensive Care Unit

By correlating the indicators with mortality of COVID-19, it was evidenced a positive relation between the incidence of the disease and its mortality (ρ=0.35; p=0.027). It was also possible to observe a negative relation between mortality rate and wards occupation rate (ρ=-0.33; p=0.035) and, mostly, social isolation rate (ρ=-0.57; p=0.001) (Table 2).

Table 2. Correlation between the mortality rate of COVID-19 and indicators

Indicators	Spearman's rho	p-value
Incidence	0.3482	0.027
Ward beds occupation	-0.3339	0.035
ICU[a] beds occupation	-0.0708	0.664
Social isolation rate	-0.5707	0.001

a = ICU – Intensive Care Unit

Finally, by adjusting the variables in multivariate linear regression, it was evidenced that the social isolation rate was inversely related to mortality by COVID-19 (β=-0.08; p=0.02), demonstrating its influence in the deaths of the disease (Table 3).

Table 3. Multivariate regression of the factors related to mortality by COVID-19

Factors related to mortality by COVID-19	$β^a$	Standard Error	p-value	95% CI[b]
Ward beds occupation	-0.01	1.30	0.61	-0.04 – 0.02
Incidence	0.00	0.01	0.69	-0.01 – 0.01
Social isolation rate	-0.08	0.03	0.02	-0.15 – -0.17
Constant	694.91	194.07	0.001	300.92 – 1088.90

a = β – Coefficient of the multiple linear regression; b = CI – Confidence Interval

Discussion

The present study demonstrated the effect of rigid social isolation implemented on COVID-19 mortality. The closure of non-essential services and the recommendation that the population remains at home, with circulation being allowed only to essential services (supermarkets, pharmacies, and health services) were vital to fight the disease's progress.

Researchers predicted that, with the measure of social isolation, 1.7 million lives and the US $ 8 trillion will be saved until October 1st.[12] Additionally, there will be time to ease the burden on health systems in large cities and to better test treatments and even the much publicized vaccine.

The scientific literature is firm in referring to strict social isolation as a necessary tool to control the spread of COVID-19 and, consequently, deaths from the disease. This research confirms this hypothesis and highlights rigid social isolation as a positive strategy for fewer deaths in Ceará. Mortality due to COVID-19 has varied between countries, influenced by the non-standard definition of cases, underreporting, and the date of the epidemiological peak.[13] In Brazil, deaths from coronavirus are significant,[14] which demonstrates the importance of monitoring the disease in assessing severity and as a tool for decision making.[7]

Mortality data from the disease among the regions of Brazil reveal that the Northeast region is the second in the country in the number of cases, surpassed only by the Southeast region. Most cases in the region occur in the states of Ceará and Bahia,[15] with emphasis on the cities of Fortaleza and Salvador, respectively. Thus, mortality due to COVID-19 in Ceará is similar to other countries with many cases of the disease.[7]

It is worth noting that the mortality rate can be affected by underreported or incorrectly reported cases; this will allow the authorities to take necessary and effective measures. In Brazil, underreporting is due to the low rate of testing per million inhabitants. In addition, there is a significant delay in reporting test results during the first weeks of the COVID-19 outbreak. It has tested all suspected cases, as well as those that have been in contact with a confirmed case. However, the low availability of RT-PCR (reverse transcription polymerase chain reaction) tests has forced the Ministry of Health to recommend the test only for severe cases. This approach has also been extended to those in the high-risk groups (for example, health professionals).[16]

With no intention of reducing mortality rate, control and prevention measures to contain the spread of the epidemic were taken by local health

authorities in different spheres (federal, state and municipal governments),[17] such as personal hygiene practices, diagnostic tests, and social isolation, as COVID-19 is not symptomatic in all infected individuals.[18]

Without isolation measures, the transmission of the disease happens rapidly, causing a sharp-looking epidemic curve, characterizing a high number of cases in a short period. This situation causes an "overload of the health system", a situation of high demand for assistance, with no possibility of an adequate response due to the current contribution of installed capacity.

Despite the institution of measures of social isolation and strict social isolation, these practices have caused many controversies in the country, as some authorities are skeptical about their effect.[17] These data reflect the findings of this study, which revealed a rate of social isolation around 50% and decreasing over the days. In the same period evaluated, there was a decrease in the occupancy rate of wards and an increase in the occupancy rate of the ICU. This data may be related to the severe clinical evolution of patients with the disease, in addition to the time factor. The patient who stays in the hospital for a long time progresses seriously and is transferred to the ICU. This increases the ICU occupation and decreases the ward occupation depending on the epidemiological peak.

Even in the face of the social vulnerability that the pandemic has generated, a key point for facing it is the decrease in the circulation of people on the streets and public collective spaces.[14] This avoids exhausting the capacity of health systems to treat the population with more severe forms of the disease, which requires admission to the ICU and the use of a mechanical ventilator for respiratory support.[19]

The concern with the availability of ICU beds and mechanical ventilators for severe hospitalized cases is visible.[15] It is worth mentioning that, in this study, the ICU occupancy rate did not constitute an intervening factor for reducing the mortality rate due to COVID-19 in the final model of the analysis, this data corroborates with the available evidence,[20] which shows that increasing the availability of ICU beds and other supplies for the management of critical patients evidenced greater effectiveness to public health.

Being elderly or having cardiovascular, neurological, and pulmonary diseases have a significant association with death from the disease,[7] common conditions in the states of northeast Brazil.[21] Thus, it appears that the ICU occupancy rate is an indirect indicator of the worsening of cases by COVID-19, probably due to the lack of adherence to social isolation measures by people who live with those who have risk factors. It is also possible that the elderly or people with cardiovascular, neurological, or pulmonary diseases are not taking the necessary measures.

Despite the daily data on the progress of the pandemic in the world and the literature has shown an upward curve for these two variables. Given this scenario, several health institutions have sought to adapt their ICUs to the care of patients with COVID-19. In Brussels, Belgium, a tertiary health institution made its ICUs able to establish a flow of care based on operational management, communication, and psychological support, in addition to training employees involved in the care process.[22]

Changes in the form of care and measures to control the disease are necessary and, when instituted early, have a positive impact on the clinical outcome. However, it is important to recognize social inequities within the state. Authors warn that only a small portion of the population has access to health services, which reaffirms the relevance of rigid social isolation.[7]

The main limitations of this study stem from the use of secondary data, as underreporting and / or insufficient testing influence the mortality and incidence rate, limiting the view on the real context of the pandemic.

Conclusion

Rigid social isolation has shown an effect in reducing mortality during the COVID-19 pandemic. The early implementation of such action, together with other collective health measures, has been important in ensuring the continuity of its benefits. To maintain the best possible balance in measures, government officials must constantly monitor the outbreak situ-

ation and the effect of the measures implemented. Analyzing the rate of transmission, daily increase in cases and deaths, and testing representative samples in different contexts can help to assess the true prevalence of the infection. Such information is necessary for decision making by health professionals and managers to reinforce their guidelines.

Collaborations

Almeida ILS, Garces TS, Sousa GJB, Cestari VRF, Florêncio RS, Moreira TMM, Pereira MLD and Carvalho REFL contributed to the writing of the article, relevant revision of the intellectual content and approved the final version submitted for publication.

References

1. World Health Organization (WHO). Coronavirus disease (COVID-19) pandemic: Situation Reports – 10. Geneva: WHO; 2020 [cited 2020 May 2]. Available from: https://www.who.int/docs/default-source/coronaviruse/situation-reports/20200130-sitrep-10-ncov.pdf?sfvrsn=d0b2e480_2

2. World Health Organization (WHO). Coronavirus disease (COVID-19) pandemic: Situation Reports – 11. Geneva: WHO; 2020 [cited 2020 May 2]. Available from: https://www.who.int/docs/default-source/coronaviruse/situation-reports/20200131-sitrep-11-ncov.pdf?sfvrsn=de7c0f7_4

3. World Health Organization (WHO). Coronavirus disease (COVID-19) pandemic: Situation Reports – 40. Geneva: WHO; 2020 [cited 2020 May 2]. Available from: https://www.who.int/docs/default-source/coronaviruse/situation-reports/20200229-sitrep-40-covid-19.pdf?sfvrsn=849d0665_2

4. World Health Organization (WHO). Coronavirus disease (COVID-19) pandemic: Situation Reports – 71. Geneva: WHO; 2020 [cited 2020 May 2]. Available from: https://www.who.int/docs/default-source/coronaviruse/situation-reports/20200331-sitrep-71-covid-19.pdf?sfvrsn=4360e92b_8

5. Brasil. Ministério da Saúde. Painel Corona vírus. Brasília (DF): Ministério da Saúde; 2020 [citado 2020 Mai 6]. Disponível em: https://covid.saude.gov.br/.

6. Ceará (Estado). Decreto n.º 33.574, de 05 de maio de 2020. Governo do Estado do Ceará. [internet]. 2020. [citado 2020 Mai 12]. Disponível em: https://coronavirus.ceara.gov.br/wp-content/uploads/2020/05/Decreto-33.574-de-05-de-maio-de-2020_DOE.pdf.

7. Sousa GJ, Garces TS, Cestari VR, Moreira TM, Florêncio RS, Pereira ML. Estimation and prediction of COVID-19 cases in Brazilian metropolises. Rev Lat Am Enfermagem. 2020;28:e3345

8. Ceará (Estado). Decreto nº 33.595, de 20 de maio de 2020. Governo do Estado do Ceará. [internet]. 2020 [citado 2020 Mai 26]. Disponível em: https://www.ceara.gov.br/wp-content/uploads/2020/05/Decretos-N%C2%BA33.595-de-20-de-maio-de-2020.pdf.

9. Werneck GL, Carvalho MS. The COVID-19 pandemic in Brazil: chronicle of a health crisis foretold. Cad Saúde Pública. 2020; 36(5):e00068820.

10. Ceará (Estado). IntegraSUS: Transparência da saúde do Ceará. Governo do Estado do Ceará. 2020 [cited 2020 Mai 28]. Disponível em: https://integrasus.saude.ce.gov.br/.

11. Tableau public. Índice de Isolamento social Inloco, 2020 [cited 2020 may 28]. Available from: https://public.tableau.com/profile/inloco.tableau#!/vizhome/MKTScoredeisolamentosocial/VisoGeral.

12. Zhao H, Feng Z. Staggered release policies for COVID-19 control: Costs and benefits of relaxing restrictions by age and risk. Math Biosci. 2020;326:108405.

13. Rothan HA, Byrareddy SN. The epidemiology and pathogenesis of coronavirus disease (COVID-2019) outbreak. J Autoimmun. 2020;102433.

14. Ribeiro F, Leist A. Who is going to pay the price of COVID-19? Reflections about na unequal Brazil. Int J Equ Health. 2020; 19:91-3.

15. Marinelli NP, Albuquerquer LP, Sousa IDB, Batista FM, Mascarenhas MD, Rodrigues MT. Evolution of indicators and servisse capacity at the beginning of the COVID-19 epidemic in Northeast Brazil, 2020. Epidemiol Serv Saúde. 2020; 29(3):e20200226.

16. Veiga e Silva L, de Andrade Abi Harb MD, Teixeira Barbosa dos Santos AM, de Mattos Teixeira CA, Macedo Gomes VH, Silva Cardoso EH, et al. COVID-19 Mortality Underreporting in Brazil: Analysis of Data From Government Internet Portals. J Med Internet Res. 2020;22(8):e21413.

17. Bezerra AC, Silva CE, Soares FR, Silva JA. Factor associated with people's behavior in social isolation during the COVID-19 pandemic. Cien Saúde Colet. 2020; 25(Supl.1):2411-21

18. Rothe C, Schunk M, Sothmann P, Bretzel G, Froeschl G, Wallraich C, et al. Transmission of 2019-nCoV infection from an asymptomatic contact in Germany. N Eng J Med 2020; 382:970-1.

19. Moreira RS. COVID-19: intensive care units, mechanical ventilators, and latent mortality profiles associated with case-fatality in Brazil. Cad Saúde Pública 2020; 36(5):e00080020.

20. Becher T, Frerichs I. Mortality in COVID-19 is not merely a question of resource availability. Lancet Respir Med. 2020 Sep;8(9):832-3.

21. Melo SP, Cesse EÂ, Lira PI, Rissin A, Cruz RS, Batista Filho M. [Chronic noncommunicable diseases and associated factors among adults in an impoverished urban area of the Brazilian northeast]. Cien Saude Colet. 2019;24(8):3159-3168. Portuguese.

22. Waele E, Demol J, Blockeel C, Vloeberghs V, DeVos CB, Rosseel P, Ruts L, et al. Adaptive strategies for intensive vare during the spread of COVID-19: the Brussels experience. ICU Manag Practice. 2020; 20(1):20-7.