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ORIGINAL ARTICLE

Hospital admission and mortality rates for non-COVID-19 respiratory diseases in Brazil's public health system during the covid-19 pandemic: a nationwide observational study

Diogo de Azevedo Resende de Albuquerque[1], Marcelo Dantas Tavares de Melo[1], Thiago Lins Fagundes de Sousa[2], Paulo Garcia Normando[1], Juliana Góes Martins Fagundes[2], Jose de Arimateia Batista Araujo-Filho[3]

1. Faculdade de Medicina, Universidade Federal da Paraíba, João Pessoa (PB) Brasil.
2. Faculdade de Medicina da Universidade de São Paulo, São Paulo (SP), Brasil.
3. Hospital Sírio-libanês, São Paulo (SP), Brasil.

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ABSTRACT

Objective: To assess the influence of the COVID-19 pandemic on hospital admissions (HA), intra-hospital deaths (HD), and intra-hospital lethality rates (HL) related to respiratory diseases (RD) other than COVID-19 in Brazil. **Methods:** This observational time-series study was conducted through comparative analyses of the HA, HD, and HL related to non-COVID-19 RD registered between March and December 2020 by the Brazilian Unified Public Health System on the DataSUS Tabnet platform, using as reference the values recorded in the same period of 2019 and those projected by linear regression methods for 2020, considering the period from 2015 to 2019. The adopted statistical significance level was 5% ($p < 0.05$). **Results:** Compared to 2019, in 2020, there was a 42% decrease in HA and a 7.4% decrease in total HD related to non-COVID-19 RD, followed by a 60% increase in HL associated with this group of diseases. The HA and HL registered in 2020 differed significantly from the projected trend for that year by linear regression ($p < 0.05$). Of note, a significant reduction in hospitalizations due to asthma (-46%), chronic obstructive pulmonary disease (-45%), bronchiectasis (-54%), pneumonia (-46%), and acute bronchitis (-73%) was observed. **Conclusions:** During the first 8 months of the pandemic, there was a decline in HA and an increase in HL related to non-COVID-19 RD in Brazil, which can hypothetically reflect logistical challenges and delays in the management of this group of diseases.

Keywords: Pulmonary disease, COVID-19, non-COVID-19, Hospitalization, Mortality.

INTRODUCTION

Brazil is considered one of the most affected countries in the world by COVID-19. The record of the first case of the disease was February 26, 2020, and the first death was registered on March 17 of the same year, both in the state of São Paulo. Within 24 days, the virus had already spread across the country. Since then, the number of cases in Brazil has fluctuated according to the natural history of the disease, based on waves of infection.[1] In July 2020, Brazil faced the first peak of the disease, with more than 1,000 deaths per day, and ranked as the second country in the world in the number of cases and deaths by COVID-19, currently reaching more than 22 million confirmed cases and more than 650,000 deaths due to the virus.[2]

Some of the restrictions adopted during the first year of the COVID-19 pandemic in Brazil included quarantines, restrictions regarding public and private gatherings, and the closure of schools, public workplaces, and private businesses. Moreover, it was necessary to expand hospital beds in intensive care units and wards and suspend appointments, complementary exams, and elective procedures, as well as direct most of the resources to care for patients infected with the disease.[3-5] In this context, populational studies have registered changes in the hospitalization patterns of other conditions, such as cancer[6,7] and cardiovascular diseases (CVD),[8] but also respiratory diseases, with reduced hospital admissions for chronic obstructive pulmonary disease (COPD) and asthma. The authors of a Korean study hypothesized that the decline in hospitalizations was due to the decrease in the transmissibility of other viruses, such as influenza, as a result of the measures to contain the advance of COVID-19, reducing the incidence of such diseases.[11] For instance, the pattern of CVD showed a relative decrease in hospital admissions; however, it was associated with an increase in the mortality rate of CVD patients in that period.[8-10] This paradigm shift was also extended to other non-COVID-19-related diseases.[12]

In light of the above, the aim of the present study was to investigate the changes in hospital admission and mortality rates related to non-COVID-19 respiratory diseases during the first 10 months of the COVID-19

Correspondence to:
Marcelo Dantas Tavares de Melo. Centro de Ciências Médicas, Universidade Federal da Paraíba - Jardim Universitário, S/N. CEP 58051-900, Campus I, Castelo Branco, João Pessoa, PB – Brasil.
Tel.: +55 (83) 99846-4272. E-mail: marcelot@alumni.usp.br

pandemic in Brazil using nationwide and population-based healthcare registries.

METHODS

This observational time-series study included hospital admissions (HA), intra-hospital deaths (HD), intra-hospital lethality rates (percentage of deaths among admissions) (HL), and the in-hospital and outpatient procedures performed through the Brazilian public health system (SUS) between March and December of 2015 to 2020. Data were extracted in March 2021 by accessing the SUS Hospital Information System (SIH/SUS) and the SUS Outpatient System (SIA/SUS), both available on the DataSUS Tabnet platform. It is noteworthy that these are public and anonymous data, in compliance with Article I of Resolution 510/2016 of the National Research Ethics Commission.[13]

The selection of the outpatient and in-hospital procedures was based on the codes of the Management System of the SUS Table of Procedures, Medicines, and Orthotics, Prostheses, and Materials (SIGTAP). The in-hospital and outpatient performance of each selected procedure were recorded, considering all related procedure codes, and grouped according to similarity as laboratory tests, imaging exams, respiratory function tests, and blood gases, as shown in Table S1.

Data on the records of secondary diagnoses related to respiratory pathologies were selected based on the Morbidity List of the 10th Revision of the International Statistical Classification of Diseases and Related Health Problems (ICD-10) and included the number of admissions and intra-hospital deaths and the intra-hospital lethality rates. The listed diseases on the DataSUS Tabnet platform are categorized according to their pathophysiological similarity as acute, chronic, other, and restrictive. Acute respiratory diseases: acute pharyngitis and tonsillitis; acute laryngitis and tracheitis; acute bronchitis and bronchiolitis; Influenza [flu]; pneumonia; other acute upper airway infections. Chronic respiratory diseases: chronic sinusitis; chronic diseases of the tonsils and adenoids; emphysema, bronchitis, and other chronic obstructive lung diseases; asthma; bronchiectasis. Other respiratory diseases: pneumoconiosis; other diseases of the nose and sinuses; other diseases of the upper respiratory tract; other diseases of the respiratory system. These data are available in Table S2.

Statistical analysis

A descriptive analysis of the number of outpatient and inpatient consultations was performed in terms of absolute numbers and percentages regarding the total number of consultations. Data were analyzed based on the conducted procedures (type of procedure) and the federative region (Midwest, Northeast, North, Southeast, and South) and state (including the 26 states and the Federal District). The number of non-COVID-19 respiratory hospitalizations and deaths were evaluated quantitatively, and as a percentage of the total, and segmented by pathology (disease category) (Table S2); the nature of the service (elective or urgent), age group (0 to 19 years old, 20 to 59 years old, and 60 years old or above), race, and sex (Table S4), and the federative region and state (Tables S5 and S6).

Statistical analyses were performed both for the groups (e.g., laboratory tests and acute respiratory diseases) and the components of each of the respective categories (e.g., biopsy and bronchoalveolar lavage for laboratory tests). Thus, it was possible to assess each of the procedures/pathologies individually, as well as in general, by category.

The values recorded between 2019 and 2020 and the corresponding percentage variation between them were compared, showing a percentage decrease or increase in that period. However, it is noteworthy that the annual variation cannot be directly attributed to the pandemic; therefore, it is necessary to assess the trend established in previous years to better understand the possible changes related to the pandemic.

In the interval from 2015 to 2019, the number of procedures, hospitalizations, deaths, and the estimated mortality rate for the year 2020 in the period from March to December were calculated using linear regression. Based on these estimated values, it was possible to determine whether the data showed a trend of growth or decrease for the year 2020 and compare them with the actual values found. In this sense, it is possible to assess both the historical trend and the statistical variations that occurred in previous years.

Since linear regression is subject to Gaussian error, Student's t-test was used to compare the projected values with those registered in 2020, rejecting the null hypothesis with a p-value less than 0.05 (95% confidence interval). The programs Microsoft® Excel® and Scilab® 6.1.0 were used to conduct the statistical analyses.

RESULTS

From March to December of 2015 to 2020, the number of hospital admissions totaled 5,764,727, and the number of deaths was 482,193. Considering the previous and the first year of the COVID-19 pandemic (2019 and 2020, respectively), a total of 102,504,443 procedures were identified, 132,593 of which were related to in-hospital procedures and 102,371,850 to outpatient procedures. In the same period, we evaluated the differences in the numbers of hospitalizations for non-COVID-19 acute, chronic, and other respiratory diseases, demonstrating a reduction in the absolute number of hospitalizations for such conditions, with an increase in intra-hospital mortality, as shown in Figure 1.

Regarding the data related to outpatient and in-hospital procedures surveyed between the years 2015 and 2020, from March to December,

and considering the projections for 2020 that were calculated using data from 2015 to 2019 through linear regression, a growing trend was observed in the number of procedures (dotted lines in Figure 2) for the year 2020. However, the data extracted from DataSUS showed a decrease in the number of procedures performed in 2020 compared to the calculated trend and the previous year, as shown in Figure 2A. In the same way, based on the number of hospitalizations and intra-hospital deaths recorded, considering all the surveyed diseases and the projections for 2020 (dotted lines), it can be noted that there was a significant reduction in the number of hospitalizations and deaths; this discrepancy was accentuated when comparing the values expected for 2020 (according to the calculated trend) and those extracted from the DataSUS platform, as shown in Figure 2B.

A significant increase in the intra-hospital lethality rate was also noticed in 2020 when compared with the numbers recorded in previous years, presenting a different behavior from the previously analyzed criteria (procedures, hospitalizations, and deaths), as shown in Figure 2. The projected rate for 2020 was 8.23% ($p < 0.005$) versus 12.89% of the actual intra-hospital mortality rate registered that year.

The number of procedures performed from March to December, considering the years 2019 and 2020, is shown in Table 1. There was a 15% decrease in the total number of procedures, with a 15% reduction in outpatient procedures and a 5% decrease in in-hospital procedures. Furthermore, we observed a 65% reduction in respiratory function tests, a 91% increase in chest CT scans, and a 33% increase in blood gas tests performed. Unfortunately, there is no way to differentiate whether the reason for requesting tests, such as chest tomographies and blood gases, was related to COVID-19.

These obtained data were compared with the trend in the number of procedures estimated for the year 2020 (March to December), showing a significant difference ($p = 0.02$) of 2,974,340 procedures between the total number estimated and performed. There was also a significant difference between the total number of imaging tests performed and estimated for 2020 ($p = 0.001$), of 3,194,339, with chest radiography being the one with the highest absolute disparity, with 3,794,046 tests performed below the estimated number (15,745,559). On the other hand, an increase in the number of performed chest CT scans (1,447,082) was observed compared to the estimated value (819,941), reflecting a difference of 627,141 more expected exams, both with statistical significance ($p < 0.05$).

Comparing the number of hospitalizations due to respiratory tract involvement from March to December 2020 with the same period of the

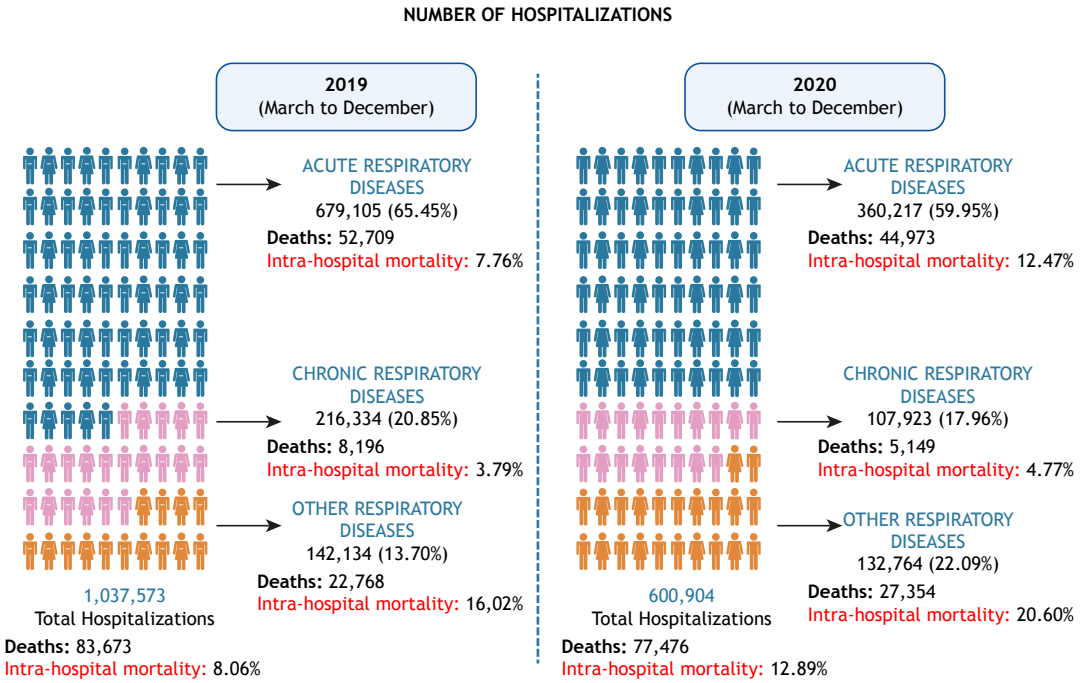
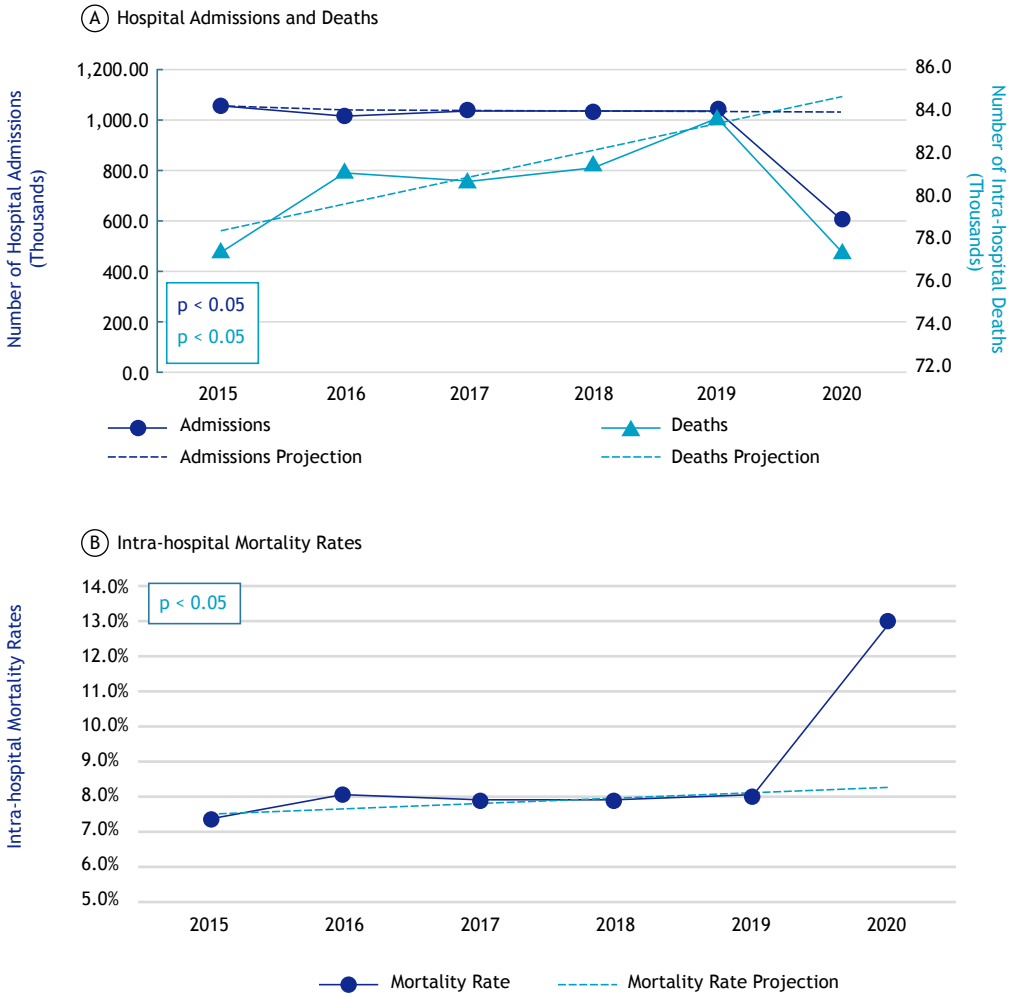


Figure 1. Descriptive analysis of the number of hospitalizations, deaths, and the intra-hospital mortality rates from March to December of 2019 to 2020 to assess the possible impacts of the new coronavirus pandemic on respiratory diseases. Acute respiratory diseases: acute pharyngitis and acute tonsillitis; acute laryngitis and acute tracheitis; acute bronchitis and acute bronchiolitis; Influenza [flu]; pneumonia; other acute upper airway infections. Chronic respiratory diseases: chronic sinusitis; chronic diseases of the tonsils and adenoids; emphysema, bronchitis, and other chronic obstructive lung diseases; asthma; bronchiectasis. Other respiratory diseases: pneumoconiosis; other diseases of the nose and sinuses; other diseases of the upper respiratory tract; other diseases of the respiratory system. Schematic generated using the BioRender web-based software.



[1] Temporal Intervals: March to December of respective years
[2] Projections calculated by linear regression, Student's distribuition

Figure 2. Analysis of the trend in A) number of hospitalizations and deaths and B) intra-hospital mortality rates, from March to December of 2015 to 2020. P-value calculated based on the difference between the projected values and those registered in 2020 using Student's t distribution. Graphs generated using the BioRender web-based software.

previous year, there was a 42% reduction in the total number of hospitalizations, as listed in Table S3. A considerable decrease in hospitalizations for Chronic Respiratory Diseases (-50%) and Acute Respiratory Diseases (-47%) was noted, with emphasis on Acute Inflammatory Diseases, which dropped by 70%, while Airway Infections reduced by only 44%, mainly due to the 37% increase in hospitalizations classified as Influenza [flu], which compensated for the process of retraction in the number of hospitalizations for acute airway infections.

Based on the trend analysis of the estimated number of hospitalizations for the year 2020 (March to December), in general, the values recorded on DataSUS were well below the absolute values calculated statistically for that year, except for influenza (expected value of 14,349 and reported value of 22,341, representing an increase of 7,992 hospitalizations) and other respiratory diseases (expected value of 113,494 and reported value of 120,339, representing an increase of 6,845 hospitalizations). It is noteworthy that all estimated values showed statistical significance ($p < 0.05$).

Considering the absolute number of deaths due to non-COVID-19 RD, a decrease in the total number of deaths between March and December of 2019 and 2020 was observed, from 83,673 deaths in 2019 to 77,476 in 2020, representing a 7% reduction. However, when analyzing deaths due to influenza, other acute infections of the upper airways, and other respiratory diseases individually, there was an increase in the number of deaths from 2019 to 2020, representing a 194% (1,164), 84% (166), and 20% (4,586) increase in mortality, respectively.

Table 1. Statistical analysis of the number of procedures in the months from March to December, comparing the years 2019 and 2020.

	March to December 2019	March to December 2020	% difference	Estimated number of procedures	(CI > 95%)	p-value
Laboratory tests						
Biopsy	2,164	1,874	-13%	2,123	2,292 - 1,954	0.0011
Bronchoalveolar Lavage	4,254	2,810	-34%	4,253	7,972 - 533	0.0405
Total	6,418	4,684	-27%	6,376	10,104 - 2,647	0.0001
Imaging exams						
Bronchography	6	6	0%	5	51 - 0	0.4469
Bronchoscopy	18,882	11,433	-39%	19,051	21,692 - 16,409	0.0002
Scintigraphy	3,949	1,725	-56%	3,854	2,783 - 4,925	0.0005
Thoracic MRI	12,576	13,289	6%	12,363	7,891 - 16,834	0.1302
Thorax X-ray	15,652,349	11,951,513	-24%	15,745,559	14,861,700 - 16,629,416	0.0000
Thorax CT	758,520	1,447,082	91%	819,941	747,732 - 892,148	0.0000
Tracheoscopy	15,385	10,291	-33%	16,284	15,917 - 16,651	0.0000
Chest ultrasound	18,238	9,623	-47%	22,086	14,061 - 30,110	0.0010
Video thoracoscopy	906	817	-10%	974	807 - 1,139	0.0040
Total	16,480,811	13,445,779	-18%	16,640,118	15,688,098 - 17,592,137	0.0001
Respiratory function tests						
Spirography	75,061	20,187	-73%	74,574	70,898 - 78,248	0.0000
Spirometry	10,087	2,514	-75%	6,909	0 - 15,697	0.0222
Respiratory function	307,189	112,967	-63%	325,002	312,167 - 337,836	0.0000
Total	392,337	135,668	-65%	406,485	389,782 - 423,186	0.0000
Blood Gases (Total)	1,658,394	2,206,684	33%	1,714,176	1,362,836 - 2,065,516	0.0013
Grand Total	18,537,960	15,792,815	-15%	18,767,155	17,551,319 - 19,982,990	0.0002

MRI: magnetic resonance imaging; CT: computed tomography.

In the trend analysis, in turn, there was a lower number of deaths than the generalized estimate, with the exception of cases related to influenza (591 cases estimated versus 1,765 registered, difference: +199%), other acute upper airway infections (202 cases estimated versus 363 registered, difference: +80%), and other respiratory diseases (22,416 cases estimated versus 27,354 registered; difference: +22%). It is important to note that the estimated values for acute respiratory diseases (total), influenza, other acute infections of the upper airways, other respiratory diseases, chronic respiratory diseases, and the overall total also differed statistically from the registered values ($p < 0.05$), as shown in Table S3.

DISCUSSION

The impacts of the pandemic can be analyzed in different ways, from the acute results, with the reallocation of material and human resources for treatment, to the change in the entire healthcare system, aiming at a management task force. These factors supposedly justify the higher intra-hospital lethality rate when compared to the predicted value for that year, despite the reduction in the number of hospitalizations for non-COVID-19 respiratory diseases. In other words, the overload of the healthcare system due to coronavirus infection probably reduced the availability of hospital beds for patients with non-COVID-19 RD, a fact that may have implied restricting hospitalizations for more severe cases of this class of diseases, thus influencing intra-hospital mortality. According to Table 1, it can be noted that the impact of such reallocation was considerable on diagnostic methods for respiratory diseases. There was a significant reduction in the number of biopsies and bronchoalveolar lavages, as well as in pulmonary function assessment methods. This fact was due to the hindrance of their performance on account of the closure of pulmonary function laboratories throughout the country. If, on the one hand, there was a reduction in performance in these sectors, with the pandemic, there was a significant increase in chest tomographies and blood gas analyses due to greater availability and the need to classify COVID-19 according to Berlin criteria, which include lung involvement.[14]

Attention is drawn to the significant reduction in the hospitalization of patients for respiratory diseases other than COVID-19. This drop, which in total reached 42%, also occurred in hospitalizations for asthma (-46%), COPD (-45%), bronchiectasis (-54%), pneumonia (-46%), and acute bronchitis (-73%), as can be seen in Table S3. Several hypotheses have been raised, including the fact that greater environmental isolation and the use of masks can contribute to the reduction of chronic disease exacerbations, given that viral infections are associated with the exacerbation of such diseases, including COPD and asthma. In addition, the temporal pattern of chronic disease exacerbations shows a correlation between respiratory viral infections and exacerbations of chronic obstructive pulmonary disease.[15-17] The use of masks, social distancing,

and the increase in hygiene care could contribute to the decrease in viral infections. However, this is not the only valid hypothesis; the reduction in the performance of diagnostic methods also contributed to diagnostic errors and the non-classification of hospital admissions.

When evaluating the total number of deaths due to respiratory diseases, there was an overall reduction, with an increase in the number of deaths by influenza. This fact seems to be due to the lower number of hospitalizations for respiratory diseases. Nevertheless, in terms of lethality, there was a general increase of 60% in 2020 compared to 2019. The rise in mortality and morbidity due to non-COVID-19 diseases was noticed in other countries;[18] however, the root cause remains unclear. The overwhelmed medical systems (as observed in Italy, the United States, Brazil, and India) and the disruption of standards of care have been reported as some of the leading causes of the increase in mortality and morbidity, although with low levels of certainty.[18] We believe this fact is related to the logistical challenges observed worldwide to guarantee the access of patients with chronic RD to specialized centers for treatment during the first year of the pandemic.

Some limitations of this study deserve consideration. The Brazilian national healthcare system has 2 branches, SUS and the supplementary health sector, which includes private healthcare plans, health insurance, and private health professionals. In order to minimize the heterogeneity of the presented data, this study intentionally disregarded patients from the supplementary health sector (approximately 30% of Brazil's population). In this context, it is important to highlight the limitations of DataSUS data (SIA and SIH/SUS). The data referring to the last six months before data collection could have been updated, including the period from October to December 2020. In addition, sporadic updates, fluctuations regarding the seasonality of respiratory diseases, and failure to update by the health department may occur. Therefore, there is no way to certify that all data is consolidated, regardless of the year. Case underreporting and errors in disease classification or diagnosis involving respiratory and viral diseases may also have occurred, especially during the first wave of the pandemic, due to the limited availability of confirmatory tests. It is also noteworthy that, based on the central limit theorem, it was assumed that the data were normal over time, given that the data for each year consists of the totalization of several random variables. Since DataSUS does not provide fully individualized data, it is impossible to thoroughly verify the homoscedasticity of the data. Finally, these results should be interpreted with caution. Additional studies are needed to clarify whether our observations represent a significantly higher mortality rate adjusted for disease severity or merely reflect the increased self or primary care management of less severe conditions.

In conclusion, a decline in HA and an increase in HL related to non-COVID-19 RD were registered during the first 8 months of the COVID-19 pandemic in Brazil. From our point of view, this can hypothetically reflect logistical challenges and delays in the management of this group of diseases. Such measures serve as an alert for the development of public policies, through hospital bed management and medical education, for the correct diagnosis and appropriate indications for hospitalization in each case, ensuring that there is no delay in treatment and worsening of mortality.

AUTHOR CONTRIBUTIONS

DARA and MDTM: study conception and planning; DARA, MDTM, TLFS, PGN, JGMF, and JABA: data collection, processing, and interpretation; PGN: statistical analysis and data tabulation; DARA, MDTM, TLFS, JGMF, and JABA: writing and review of the preliminary and final versions of the manuscript; DARA, MDTM, and TLFS: approval of the final version of the manuscript.

CONFLICTS OF INTEREST

None declared.

REFERENCES

1. Fan G, Yang Z, Lin Q, Zhao S, Yang L, He D. Decreased Case Fatality Rate of COVID-19 in the Second Wave: A study in 53 countries or regions. Transbound Emerg Dis. 2021 Mar;68(2):213–215. https://doi.org/10.1111/tbed.13819.
2. MINISTÉRIO DA SAÚDE. CORONAVÍRUS BRASIL. PAINEL DE CASOS DE DOENÇA PELO CORONAVÍRUS 2021 (COVID-19) NO BRASIL [Internet]. 2021 [cited 2021 Jan 11]. Available from: https://covid.saude.gov.br/https://covid.saude.gov.br/.
3. Cimerman S, Chebabo A, Cunha CAD, Rodríguez-Morales AJ. Deep impact of COVID-19 in the healthcare of Latin America: the case of Brazil. Braz J Infect Dis. 2020 Mar-Apr;24(2):93–95. https://doi.org/10.1016/j.bjid.2020.04.005.
4. Castro MC, Resende De Carvalho L, Chin T, Kahn R, França GVA, Macário EM, et al. Demand for hospitalization services for COVID-19 patients in Brazil. Available from: https://doi.org/10.1101/2020.03.30.20047662.
5. Emanuel EJ, Persad G, Upshur R, Thome B, Parker M, Glickman A, et al. Fair Allocation of Scarce Medical Resources in the Time of Covid-19. N Engl J Med. 2020 May 21;382(21):2049–2055. https://doi.org/10.1056/NEJMsb2005114.
6. Fonseca GA, Normando PG, Loureiro LVM, Rodrigues REF, Oliveira VA, Melo MDT, et al. Reduction in the Number of Procedures and Hospitalizations and Increase in Cancer Mortality During the COVID-19 Pandemic in Brazil. JCO Glob Oncol. 2021 Jan;7:4–9. https://doi.org/10.1200/GO.20.00471.
7. Araujo-Filho JAB, Normando PG, Melo MDT, Costa AN, Terra RM. Lung cancer in the era of COVID-19: what can we expect? J Bras Pneumol. 2020 Oct 23;46(6):e20200398. https://doi.org/10.36416/1806-3756/e20200398.
8. Normando PG, Araujo-Filho JA, Fonseca GA, Rodrigues REF, Oliveira VA, Hajjar LA, et al. Reduction in Hospitalization and Increase in Mortality Due to Cardiovascular Diseases during the COVID-19 Pandemic in Brazil. Arq Bras Cardiol. 2021 Mar; 116(3):371–380.

https://doi.org/10.36660/abc.20200821.

9. Toniolo M, Negri F, Antonutti M, Masè M, Facchin D. Unpredictable Fall of Severe Emergent Cardiovascular Diseases Hospital Admissions During the COVID-19 Pandemic: Experience of a Single Large Center in Northern Italy. J Am Heart Assoc. 2020 Jul 7;9(13):e017122. https://doi.org/10.1161/jaha.120.017122.
10. Shi S, Qin M, Shen B, Cai Y, Liu T, Yang F, et al. Association of Cardiac Injury With Mortality in Hospitalized Patients With COVID-19 in Wuhan, China. JAMA Cardiol. 2020 Jul 1;5(7):802–810. https://doi.org/10.1001/jamacardio.2020.0950.
11. Huh K, Kim YE, Ji W, Kim DW, Lee EJ, Kim JH, et al. Decrease in hospital admissions for respiratory diseases during the COVID-19 pandemic: a nationwide claims study. Thorax. 2021 Sep;76(9):939–941. http://doi.org/10.1136/thoraxjnl-2020-216526.
12. Ojetti V, Covino M, Brigida M, Petruzziello C, Saviano A, Migneco A, et al. Non-COVID Diseases during the Pandemic: Where Have All Other Emergencies Gone? Medicina (Kaunas). 2020 Oct 1;56(10):512. https://doi.org/10.3390/medicina56100512.
13. Conselho Nacional de Saúde. Resolução no 510, de 7 de abril de 2016. DOU no 98. 2016 May 24;44–6. Available from: http://conselho.saude.gov.br/resolucoes/2016/Reso510.pdf.
14. The ARDS Definition Task Force, Ranieri VM, Rubenfeld GD, Thompson BT, Ferguson ND, Caldwell E, et al. Acute Respiratory Distress Syndrome: The Berlin Definition. JAMA. 2012 Jun 20;307(23):2526–2533. https://doi.org/10.1001/jama.2012.5669.
15. Satia I, Cusack R, Greene JM, O'Byrne PM, Killian KJ, Johnston N. Prevalence and contribution of respiratory viruses in the community to rates of emergency department visits and hospitalizations with respiratory tract infections, chronic obstructive pulmonary disease and asthma. PLoS One. 2020 Feb 6;15(2):e0228544. https://doi.org/10.1371/journal.pone.0228544.
16. Zwaans WA, Mallia P, van Winden ME, Rohde GG. The relevance of respiratory viral infections in the exacerbations of chronic obstructive pulmonary disease—a systematic review. J Clin Virol. 2014 Oct;61(2):181–8. https://doi.org/10.1016/j.jcv.2014.06.025.
17. Chan KPF, Ma TF, Kwok WC, Leung JKC, Chiang KY, Ho JCM, et al. Significant reduction in hospital admissions for acute exacerbation of chronic obstructive pulmonary disease in Hong Kong during coronavirus disease 2019 pandemic. Respir Med. 2020 Sep;171:106085. https://doi.org/10.1016/j.rmed.2020.106085.
18. Lau VI, Dhanoa S, Cheema H, Lewis K, Geeraert P, Lu D, et al. Non-COVID outcomes associated with the coronavirus disease-2019 (COVID-19) pandemic effects study (COPES): A systematic review and meta-analysis. PLoS One. 2022 Jun 24;17(6):e0269871. https://doi.org/10.1371/journal.pone.0269871.