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Changing Patterns of Malignant Neoplasm Notifications in Brazil during the COVID-19 Pandemic: a Seasonal Analysis

Mudança nos Padrões de Notificação de Neoplasias Malignas no Brasil Durante a Pandemia de COVID-19: uma Análise Sazonal

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Abstract

The COVID-19 pandemic has caused delays in the diagnosis, treatment and follow-up of patients with malignant neoplasms (MN). To analyze the distribution pattern of MN cases in Brazil, we collected data in August 2022, provided by the Department of Informatics of the Brazilian Ministry of Health, from 2013 to 2021. The data were organized in Microsoft Excel, the analysis and presentation of the data were made using ggplot and Reshape packages, and temporal patterns and forecast models were obtained by ARIMA method together with aTSA. The results show that the COVID-19 pandemic did not directly impact the notifications of MN cases, but changed the profile of notifications, as in 2018 there was an increase in the diversity of notified neoplasms, and a change in the number of cases in 2019 and 2020. In addition, the distribution between the evaluations of neoplasms was not proportional, showing conversion in 12 (32.4%), decrease in 24 (64.9%) and increase in 1 neoplasm (2.7%). The findings help to understand the new behavior of notifications, demonstrating a pattern similar to the seasonal forecast model, with random or linear trending patterns. This distribution, with a seasonal pattern, shows variability in certain periods of the year, providing important information for early diagnosis and better planning. Data from this research reinforce the need for active screening methods and incentives for preliminary screening for better detection and management of this malignancy.

Keywords: Neoplasms. COVID-19. Delayed Diagnosis.

Resumo

A pandemia de COVID-19 causou atrasos no diagnóstico, tratamento e acompanhamento de pacientes com neoplasias malignas (NM). Para analisar o padrão de distribuição dos casos de MN no Brasil, coletamos dados em agosto de 2022 disponibilizados pelo Departamento de Informática do Ministério da Saúde do Brasil de 2013 a 2021. Os dados foram organizados no Microsoft Excel, a análise e apresentação dos dados foram feitas usando os pacotes ggplot e Reshape, e os padrões temporais e modelos de previsão foram obtidos pelo método ARIMA junto com o aTSA. Os resultados mostram que a pandemia de COVID-19 não impactou diretamente nas notificações dos casos de NM, mas mudou o perfil das notificações, pois em 2018 houve aumento na diversidade de neoplasias notificadas, e mudança no número de casos em 2019 e 2020. Além disso, a distribuição entre as avaliações das neoplasias não foi proporcional, mostrando conversão em 12 (32,4%), diminuição em 24 (64,9%) e aumento em 1 neoplasia (2,7%). As descobertas ajudam a entender o novo comportamento das notificações demonstrando um padrão semelhante ao modelo de previsão sazonal, com padrões de tendência aleatórios ou lineares. Essa distribuição com padrão sazonal, apresenta variabilidade em determinados períodos do ano, fornecendo informações importantes para o diagnóstico precoce e melhor planejamento. Os dados desta pesquisa reforçam a necessidade de métodos de triagem ativa e incentivos à triagem preliminar para melhor detecção e manejo dessa malignidade.

Palavras-chave*: Neoplasias. COVID-19. Diagnóstico Tardio.*

1 Introduction

Malignant neoplasms (NM) is a set of cells with disordered, autonomous proliferation, capable of invading other tissues, and represents a worldwide health problem[1]. NM can exhibit aggressive progression from the point of their onset, and early detection offers the best prognosis for cancer patients[2-4].

Screening for neoplasms is a meticulous process and should involve important factors such as the patient's age and the frequency of screening tests, in order to promote early diagnosis and highlight the importance of awareness campaigns (Instituto Nacional do Câncer, INCA, 2021)[5,6].

With the COVID-19 pandemic that started in 2020, the routine of countless people around the world was modified due to control measures to contain its spread[7-9]. When combined with the lack of resources for MN screening programs, these changes have negatively impacted early diagnosis[5,8-11]. Such alterations resulted in significant delays both in the diagnosis and in the treatment and follow-up of patients with MN, with important consequences. Thus, it became clear that COVID-19 was not limited to direct damage, as it showed a harmful impact on this population also in relation to indirect effects[11].

To understand the impact of the COVID-19 pandemic on the new distribution of MN cases registered in the Unified Health System database, we carried out this research with the

objective of analyzing the distribution pattern of MN cases in Brazil after the implementation of restrictive measures. Because the resumption of screening tests may have changed the entire epidemiological profile of notifications, thus prospective studies are needed to assess the new distribution of MN cases in Brazil.

2 Material and Methods

This study was based on the use of secondary data made available by the Department of Informatics of the Brazilian Ministry of Health through the Cancer Information System (http://tabnet.datasus.gov.br/cgi/menu_tabnet_php.htm). The data were collected in August 2022 and were based on detailed cancer diagnoses distributed by month from 2013 to 2021 in Brazil. The NM cases were not studied according to population-specific characteristics; therefore, only the number of NM notifications was analyzed, not the characteristics of the affected population.

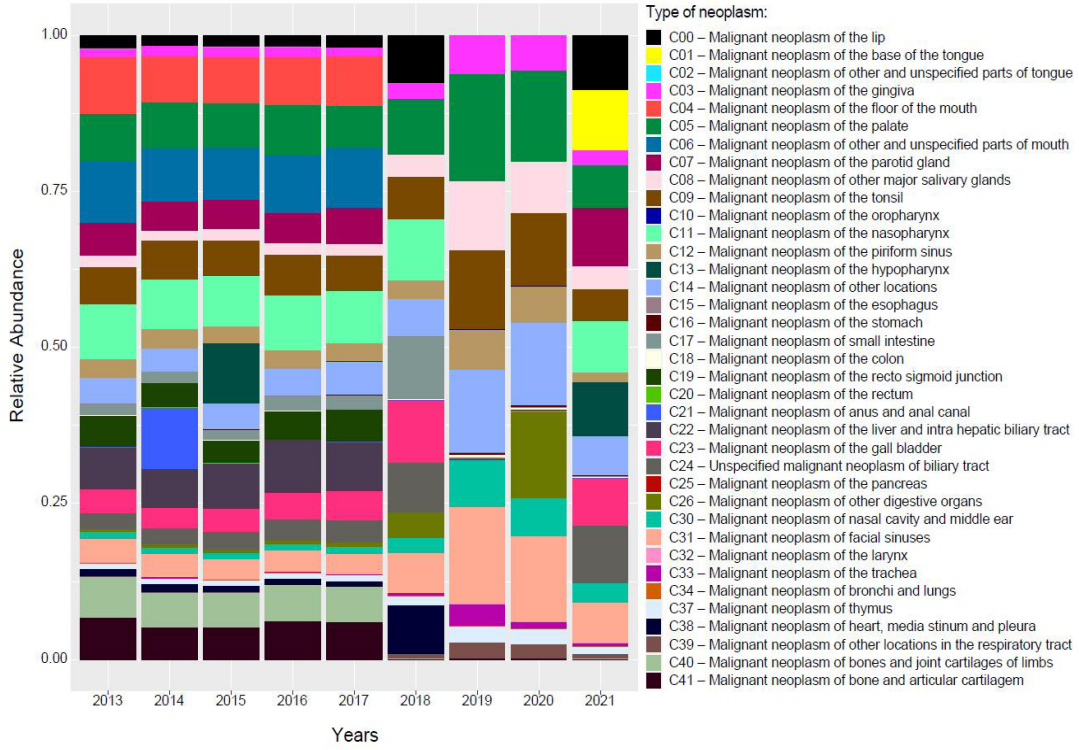
After data collection, the information was organized in Microsoft Excel version 16.67 spreadsheets. For the analysis, NM cases without data throughout the entire study period (2013 to 2021) were excluded. The International Classification of Diseases (ICD-10) was used for NM categorization as it allows for the identification of all diseases in an internationally recognized and validated standard.

The ggplot2 package[12] available in the R repository[13] was used for data presentation. This package was used to create relative abundance plots, transforming the data into percentages to correct for absolute values based on population growth, with the assistance of the Reshape package[14] also distributed by the R platform. The temporal patterns of the last 3 years of notifications in Brazil and the prediction models were obtained using the AutoRegressive Integrated Moving Average (ARIMA) method, in conjunction with the Alternative Time Series Analysis (aTSA) prediction model[15]. As this research involved public and conglomerate data without personal identification of research subjects, it did not require approval from an ethics committee.

3 Results and Discussion

During the initial years studied, the number of NM cases observed was 56,286, 56,978, 58,143, 60,989, 62,662 for the years 2013 to 2017, respectively. The data did not show significant changes in the abundance of reported cases. However, in 2018, there was an increase in notifications, reaching 89,857 cases, indicating an increase in the diversity of reported neoplasms. This change in notifications in 2018 was followed by another alteration in the number of cases in 2019 and 2020, with 122,989 and 120,357 cases reported, respectively. This demonstrates that the COVID-19 pandemic did not directly impact the notifications of NM cases, but it did alter the profile of notifications (Figure 1).

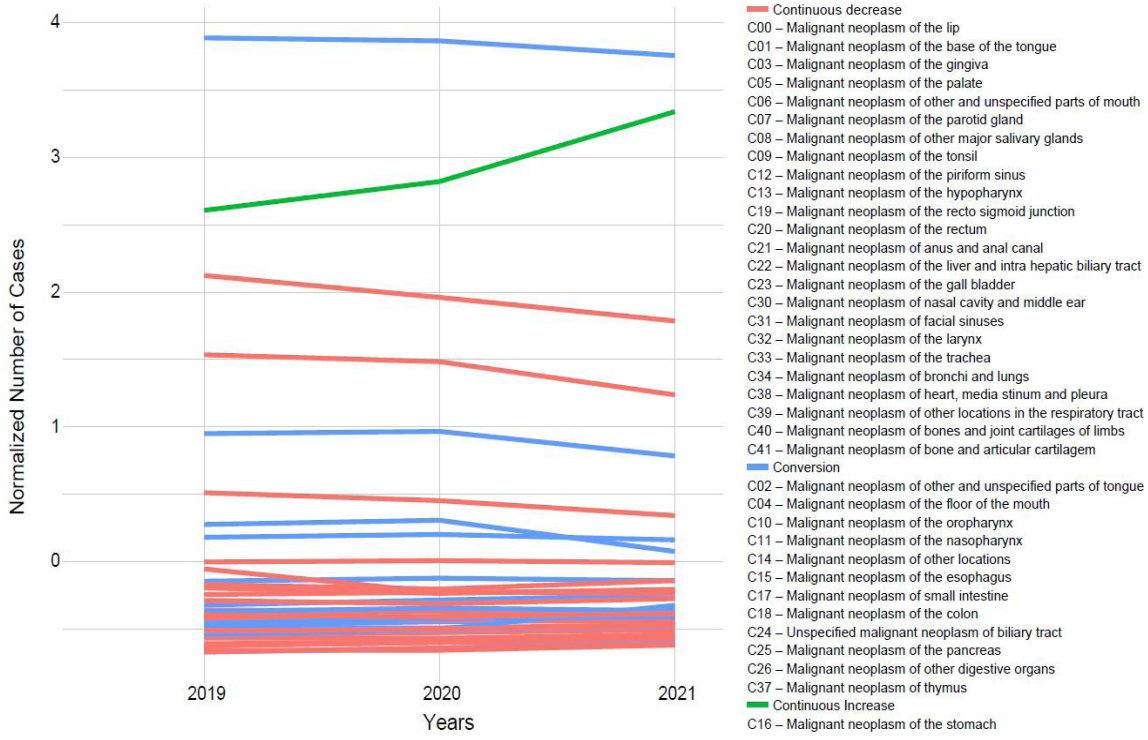
Figure 1 - List of notifications of malignant neoplasms per year in Brazil



The different colors represent the different notifications, expressed as a percentage for each year. Data obtained from the Department of Informatics of the Brazilian Ministry of Health through the Cancer Information System (http://tabnet.datasus.gov.br/cgi/menu_tabnet_php.htm). For analysis, the R program and the ggplot2 and Reshape package were used. As well as the AutoRegressive Integrated Moving Average (ARIMA) method, together with the Alternative Time Series Analysis (aTSA) forecasting model.
Source: research data.

Analyzing the years 2019, 2020, and 2021, which were the years when the first and second waves of COVID-19 occurred, NM notifications in Brazil exhibited three distinct patterns: (i) Continuous Increase, representing notifications that increased throughout these three years; (ii) Conversion cases, consisting of notifications that increased or decreased during 2019 and 2020 but returned to their initial level in 2021; and finally, (iii) Continuous Decrease cases, which were notifications that decreased from 2019 to 2021. The trend of notifications tended to decrease over the past two years (2020 and 2021), as seen in the previous results. However, this distribution was not proportional among the evaluated neoplasms. We detected the conversion of notifications in 12 neoplasms, which accounted for 32.4% of the evaluated neoplasms. Additionally, 24 neoplasms, corresponding to 64.9% of the notifications, showed a decrease during the pandemic, while only one NM presented an increase in notifications, representing 2.7% (Figure 2).

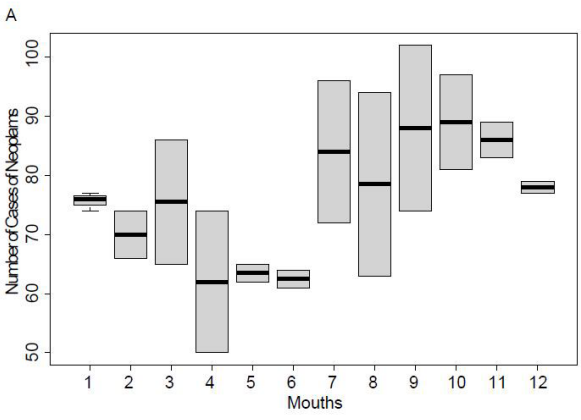
Figure 2 - Normalized Number of Cases distributed from 2019 to 2021 according to their evolution over the years. Consistent Decrease (red), Consistent Increases (green) or Intensification (blue)

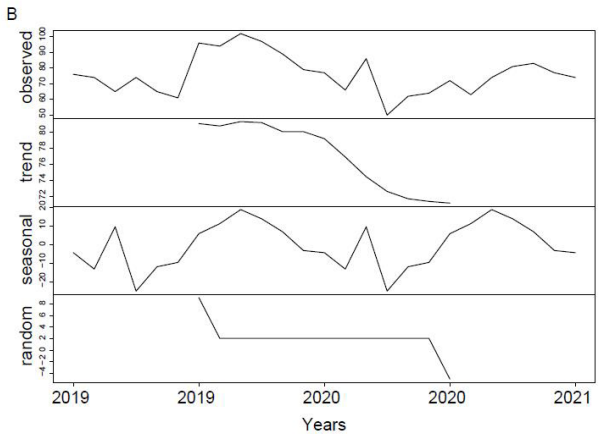


Data obtained from the Department of Informatics of the Brazilian Ministry of Health through the Cancer Information System (http://tabnet.datasus.gov.br/cgi/menu_tabnet_php.htm), analyzed by the R program.
Source: research data.

To understand this new distribution of data, complex forecast models were applied to comprehend the new temporal behavior of notifications. For this purpose, a monthly analysis of notifications was conducted, revealing that January (01), May (05), June (06), and December (12) exhibited more uniform notifications with lower variance during the studied years (2019 to 2021). In contrast, the remaining months of the year showed a wide variation (Figure 3A). The new temporal pattern revealed that the observed distribution of notifications (Observed) follows a similar pattern to the predicted seasonal simulated model, excluding random or linear trend patterns (Figure 3B). This demonstrates that this new distribution of NM notifications from 2019 to 2021 exhibits a concentration of notifications in these months without indicating a decrease or increase.

Figure 3 - (A) Boxplot graph of neoplasm cases distributed monthly. (B) Decomposition of time series into random, trend, and seasonal patterns of cancer diagnoses between 2019 and 2021 in Brazil





Source: Data were obtained from DATASUS and graphics developed by the Auto Regressive integrated moving average (ARIMA) prediction model found in forecast and aTSA.

Screening recommendations for NM underwent constant changes during the isolation period, with recommendations for interruption as a way to avoid overburdening the healthcare system[16]. In general, although there was no reduction in the total number of notifications from 2013 to 2017, a decrease occurred in the years 2019 to 2021, and there was a change in the profile of case notifications due to the inconsistency in the periodicity of screening exams caused by the interruption of services[5,8-10,17,18].

During the pandemic, access to healthcare services and primary care were prioritized[16,19,20]. Countries like Italy[21], South Korea[22], the United Kingdom[23], Chile[24], and Japan[25] experienced setbacks in NM screening programs. As a result of the strain on the healthcare system, several regulations were issued to assist physicians and guide patients in promoting social isolation. These measures delayed the early screening of neoplasms[6,26], resulting in fluctuations in NM case notifications from 2019 to 2021[18].

The new distribution of notifications during the COVID-19 pandemic exhibited a seasonal pattern, providing important insights into Brazilian healthcare, as some neoplasms saw an increase in notifications while others decreased. It is necessary to identify these changes and better plan early detection measures. For example, stomach neoplasms showed a continuous increase in case notifications during the period influenced by the novel coronavirus. The primary method for screening and diagnosing stomach NM is digestive endoscopy, which experienced a decline during the pandemic due to the generation of aerosols[16,25].

However, as medical practices evolved in dealing with COVID-19, this procedure was once again requested, aiding in the detection of this neoplasm[16,27]. The monthly distribution pattern revealed that this new distribution is behaving seasonally, showing variability in certain periods of the year. This allows for anticipation and planning to better serve the population throughout the year. Strategies should be implemented to address the centralization of case detection in specific months and to understand the non-detection of other NM types. This study provided a comprehensive and important analysis of the distribution of neoplasms in Brazil. However, it had limitations such as the use of recent secondary data, making it necessary to monitor this new pattern of seasonal distribution in the long term.

4 Conclusion

This research demonstrates the fluctuations in the pattern of cases of malignant neoplasms since 2018, and thus demonstrates the relevance of raising awareness about the need to monitor this new scenario of distribution of altered notifications in the face of the COVID-19 pandemic. Thus, the seasonal distribution in specific months reinforces the need for active screening methods that have greater reach and effectiveness in other months. And so, we emphasize the need to encourage incentives for early screening for better detection and management of this malignancy.

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