

Treatment Patterns of Invasive Neoplasms in the Brazilian Unified Health System from 2000 to 2019

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Padrões de Tratamento das Neoplasias Invasivas no Sistema Único de Saúde no Período de 2000 a 2019

Patrones de Tratamiento de las Neoplasias Invasivas en el Sistema Único de Salud del Brasil en el Período de 2000 a 2019

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ABSTRACT

Introduction: Different treatment modalities can be used to manage cancer. **Objective:** To analyze the treatment patterns of patients diagnosed with the six most common types of invasive cancer in Brazil and treated in the Brazilian Unified Health System. **Method:** This is a cross-sectional analysis using data extracted from the Integrated Module of Hospital Cancer Registries, including patients diagnosed with female breast, prostate, colorectal, lung, stomach, and cervical cancer from 2000 to 2019. Data were analyzed using the chi-square test and effect size. **Results:** Data from 1,204,222 patients were included. Surgery was the most frequent treatment in cases diagnosed at an early stage, particularly for prostate (87.5%) and colorectal cancer (56.1%). For advanced-stage cancers, chemotherapy predominated, especially for lung (88.2%) and breast cancer (48.3%). Clinical staging at diagnosis was the primary determinant of therapeutic decision-making, particularly regarding surgery and chemotherapy. Variables such as age, education level, skin color, geographic region, and the accreditation level of oncology services significantly influenced treatment patterns. **Conclusion:** The advanced stage of cancer at diagnosis was the primary factor determining the type of treatment received. Sociodemographic inequalities also influenced access to different therapeutic options.

Key words: Neoplasms/diagnosis; Epidemiology; Unified Health System; Antineoplastic Protocols.

RESUMO

Introdução: Diferentes tratamentos podem ser utilizados para o enfrentamento do câncer. **Objetivo:** Analisar os padrões de tratamento de pacientes diagnosticados com os seis tipos mais comuns de câncer invasivo no Brasil e atendidos no Sistema Único de Saúde. **Método:** Análise transversal com dados extraídos do Módulo Integrador dos Registros Hospitalares de Câncer sobre pacientes diagnosticados com os cânceres de mama feminino, próstata, colorretal, pulmão, estômago e colo do útero de 2000 a 2019. Para análise dos dados foi utilizado o teste qui-quadrado e o tamanho do efeito. **Resultados:** Foram incluídos dados de 1.204.222 pacientes. A cirurgia foi o tratamento mais frequente nos casos diagnosticados precocemente, destacando-se os casos de câncer de próstata (87,5%) e colorretal (56,1%). Para cânceres em estágio avançado, predominou a quimioterapia, principalmente em pulmão (88,2%) e mama (48,3%). A importância do estadiamento clínico no diagnóstico para a tomada de decisão terapêutica foi identificada em todos os tipos de câncer, principalmente em relação à cirurgia e quimioterapia. Variáveis como idade, escolaridade, cor da pele, Região de residência e nível de acreditação do serviço impactaram os padrões de tratamento. **Conclusão:** Este estudo mostrou que o estágio avançado do câncer no momento do diagnóstico foi o principal definidor do modo de tratamento recebido. Desigualdades sociodemográficas também influenciaram o acesso às diferentes opções terapêuticas.

Palavras-chave: Neoplasias/diagnóstico; Epidemiologia; Sistema Único de Saúde; Protocolos Antineoplásicos.

RESUMEN

Introducción: Existen diferentes modalidades de tratamiento para el manejo del cáncer. **Objetivo:** Analizar los patrones de tratamiento de pacientes diagnosticados con los seis tipos más comunes de cáncer invasivo en el Brasil y atendidos en el Sistema Único de Salud. **Método:** Estudio transversal con datos extraídos del Módulo Integrador de los Registros Hospitalarios de Cáncer, incluyendo pacientes diagnosticados con cáncer de mama femenino, próstata, colorrectal, pulmón, estómago y cuello uterino entre 2000 y 2019. El análisis de datos se realizó mediante la prueba de ji al cuadrado y tamaño del efecto. **Resultados:** Se incluyeron datos de 1 204 222 pacientes. La cirugía fue el tratamiento más frecuente en los casos diagnosticados en etapa temprana, destacándose los cánceres de próstata (87,5%) y colorrectal (56,1%). En los cánceres en estadio avanzado predominó la quimioterapia, especialmente en pulmón (88,2%) y mama (48,3%). La estadificación clínica al momento del diagnóstico fue determinante en la elección terapéutica, especialmente en relación con la cirugía y la quimioterapia. Variables como edad, nivel educativo, color de piel, región de residencia y nivel de acreditación del servicio oncológico impactaron en los patrones de tratamiento. **Conclusión:** El estadio avanzado del cáncer en el momento del diagnóstico fue el principal factor que determinó el tipo de tratamiento recibido. Las desigualdades sociodemográficas también influyeron en el acceso a las diferentes opciones terapéuticas.

Palabras clave: Neoplasias/diagnóstico; Epidemiología; Sistema Único de Salud; Protocolos Antineoplásicos.

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INTRODUCTION

Cancer incidence has increased worldwide due to population aging and greater exposure to risk factors for its development¹. It is the second major cause of premature death due to chronic non-communicable disease, being responsible for nine million deaths a year worldwide². About 28.4 million cancer cases are estimated for 2040, that is, 47% more than 2020¹.

In Brazil,³ 704 thousand new cancer cases are expected each year of the 2023-2025 triennium. Excluding non-melanoma malign neoplasms, the most common types are those located in the breast, in women (73 thousand cases), and on the prostate, in men (71 thousand cases), followed by colon and rectum (45 thousand), lung (32 thousand), stomach (21 thousand) and cervix (17 thousand). In 2019, the country recorded 120,994 deaths from the disease in individuals aged 30-69 years⁴.

The choice of treatment for solid tumors is based, among other factors, on the primary location, clinical stage, and availability of resources⁵. However, in low and medium-income countries like Brazil, difficulty accessing public health services can impact waiting times for diagnosis and first consultation, and consequently, the start of treatment, directly affecting prognosis⁶.

A care plan for patients with solid tumors may vary from local control, such as surgery and radiotherapy, to systemic treatment with chemotherapy, used in isolation or combination⁷. In addition to these traditional treatment modalities, diverse technologies have been developed and incorporated into clinical practice, such as targeted therapy, immunotherapy, hormone therapy, and radiopharmaceuticals, resulting in high costs to health systems⁸⁻¹².

In public health systems, such as the Brazilian one, the increasing cancer incidence, added to the rising costs of treatment, is an expressive economic challenge¹³. In this scenario, it becomes essential to understand the treatment patterns adopted for the main types of cancer in the country. This knowledge subsidizes the creation of public policies, guides adequate funding of services, and contributes to the quality of oncology care. In this sense, the objective of this study is to analyze the treatment patterns of patients diagnosed with the six most common types of invasive cancer in Brazil and treated by the Brazilian Unified Health System (SUS) from 2000-2019.

METHOD

A cross-sectional analysis was conducted using individual records of patients diagnosed with cancer over two decades (2000-2019). Data was obtained on June

10, 2021, from the Integrated Module of Hospital-based Cancer Registries (RHC), which concentrates hospital-based cancer registries in Brazil (<https://irhc.inca.gov.br/RHCNet/>). Although there are considerable gaps in the records of some variables (notably in date of admission, stage of tumor-nodule-metastasis, and disease stage at the end of the first treatment) in the RHC, the quality of data has improved over the years (2000-2020)¹⁴.

Since this study utilized secondary and publicly available data, approval by a Research Ethics Committee was not required, as per Resolution 510/2016¹⁵.

The study included all analytical cases referring to patients diagnosed with one of the six most frequent types of cancer in Brazil³, namely: (female) breast cancer (C50), prostate (C61), colorectal (C18-21), lung (C33-34), stomach (C16), and cervix (C53)¹⁶. All cases that lacked information regarding age at diagnosis, sex, whether the patients were under 18 years, those with no treatment record, and cases with a history of previous oncology treatment were excluded.

For this study, any treatment for controlling a tumor or its metastases is considered an oncology treatment. Treatments aimed exclusively at symptom relief, management of comorbidities and tumoral complications were not included¹⁷. Moreover, only the first treatment modality performed after diagnosis was considered (that is, considering chronology): surgery (yes or no), chemotherapy (yes or no), and radiotherapy (yes or no). Any subsequent treatment received was not included in this analysis.

Other variables assessed were age at diagnosis; sex (when relevant); race/skin color¹⁸; years of study; marital status; and Region of residence, categorized according to the Human Development Index in 2000 (North [0.527] and Northeast [0.516] or South [0.660], Southeast [0.676] and Middle West [0.639])¹⁹.

Moreover, medical assistance locations were assessed regarding their level of oncological accreditation to SUS: High-Complexity Oncology Center (Cacon), with multidisciplinary resources to treat any cancer type, or High-Complexity Oncology Care Unit (Unacon), with resources to treat the five most common cancer types in the country or others (isolated radiotherapy services, hospital radiotherapy services, hospitals specialized in cancer treatment, general hospitals that offer cancer surgery) or missing data²⁰; and regarding cancer clinical stage at diagnosis: initial – I and II, localized disease, – or advanced – III and IV, with compromise of lymph nodes and/or metastasis – or missing data^{21,22}. Data imputation was conducted to reduce the amount of missing data from the variable clinical stage to reduce selection bias and ensure greater representation of cases in the analysis of

treatment patterns. The imputation followed a previously validated methodology in the context of Hospital-based Cancer Registries, as described by Valerio et al.²³.

The statistical analyses were conducted using Stata 15.0²⁴ (StataCorp LLC). To assess concordance between imputed and actual clinical staging data, the adjusted Kappa²⁵ coefficient was used. To achieve this, cases for which clinical stage data were available were selected, and a new variable was created based on the input stage (Chart 1). Values under 0.40 indicated low concordance; values ranging from 0.40-0.75 indicated moderate concordance, and values over 0.75 indicated high concordance.

Next, the absolute numbers and relative frequencies of the first mode of treatment after diagnosis (surgery, chemotherapy, or radiotherapy) were analyzed by cancer type and following the other variables. The chi-squared test was used for proportions, considering the value of *p* and effect size. To obtain effect size we used Cohen's *W* (for variables with two categories) and Cramér's *V* (for the three-category variable [treatment location]) associated with the chi-square test. For Cohen's *W*, the effect size 0.10-0.29 was classified as weak, 0.30-0.49 as moderate, and ≥ 0.50 as strong. For Cramér's *V*, the effect size 0.07-0.20 was classified as weak, 0.21-0.34 as moderate, and ≥ 0.35 as strong²⁶.

RESULTS

Data from 1,204,222 patients were included (Figure 1). However, the distribution of cases was not homogeneous over the studied period, since the RHC Integrated Module coverage increased over the years, from 45 hospitals in 2000 to 176 in 2005, 268 in 2012, and 320 in 2019.

As a result of the clinical staging data imputation, the number of missing data was reduced from 324,992 (27.0%) to 70,631 (5.9%), corresponding to 21.1% recovery (Supplementary Figure 1). There was moderate concordance (Kappa = 0.64) between input and actual data.

In general, surgery was the most frequent treatment modality for a first intervention after diagnosis, mainly for breast (62.5%), stomach (62.1%), and colorectal (60.3%) cancers (Table 1).

In women with breast cancer, surgery was less frequent among those who lived in the North and Northeast regions (54.4%, weak effect), treated at an Unacon (56.9%, weak effect), and, especially, those diagnosed in an advanced stage (36.8%, strong effect). In contrast, chemotherapy was less used in elderly patients (30.5%, weak effect), and more frequent among the residents in the North and Northeast regions (35.8%, weak effect), treated at an Unacon (30.9%, weak effect) and with an advanced stage disease (52.9%, strong effect) (Figure 2 and Supplementary Table 1).

Among men with prostate cancer, the probability of undergoing surgery was lower in elders (39.3%, weak effect), in patients treated at an Unacon (32.5%, moderate effect), and in those diagnosed with an advanced stage disease (33.0%, weak effect). Chemotherapy was more frequently used in cases of advanced disease (15.2%, weak effect), while radiotherapy was less frequent in non-white men (18.4%, weak effect) (Figure 2 and Supplementary Table 2).

In colorectal cancer, there was a lower frequency of surgery among patients living in the North and Northeast regions (47.3%, weak effect), assisted at an Unacon (55.0%, weak effect), and diagnosed in an advanced stage (49.0%, moderate effect). Chemotherapy was also less

Chart 1. Methodology used for clinical staging data imputation

Step	Variables considered	Classification criteria
1	Missing data were corrected following the Classification of Malign Tumors	T1 and T2 = initial stage
		T3 and T4 = advanced stage
2	The remaining missing data after step 1 were corrected according to the main reason for not getting treatment	Advanced disease, inability to treat, or other associated diseases = advanced stage
3	The remaining missing data after step 2 were corrected according to the main treatment received at the hospital	Surgery = initial stage
		Chemotherapy = advanced stage
4	The remaining missing data after step 3 were corrected according to the disease staging at the end of the first treatment ^a	Death = advanced stage
5	The remaining missing data after step 4 were corrected according to the main reason for not getting treatment	Death = advanced stage

Note: ^a For the State of São Paulo, step 4 was not conducted as there were no records of this variable in the consulted database.



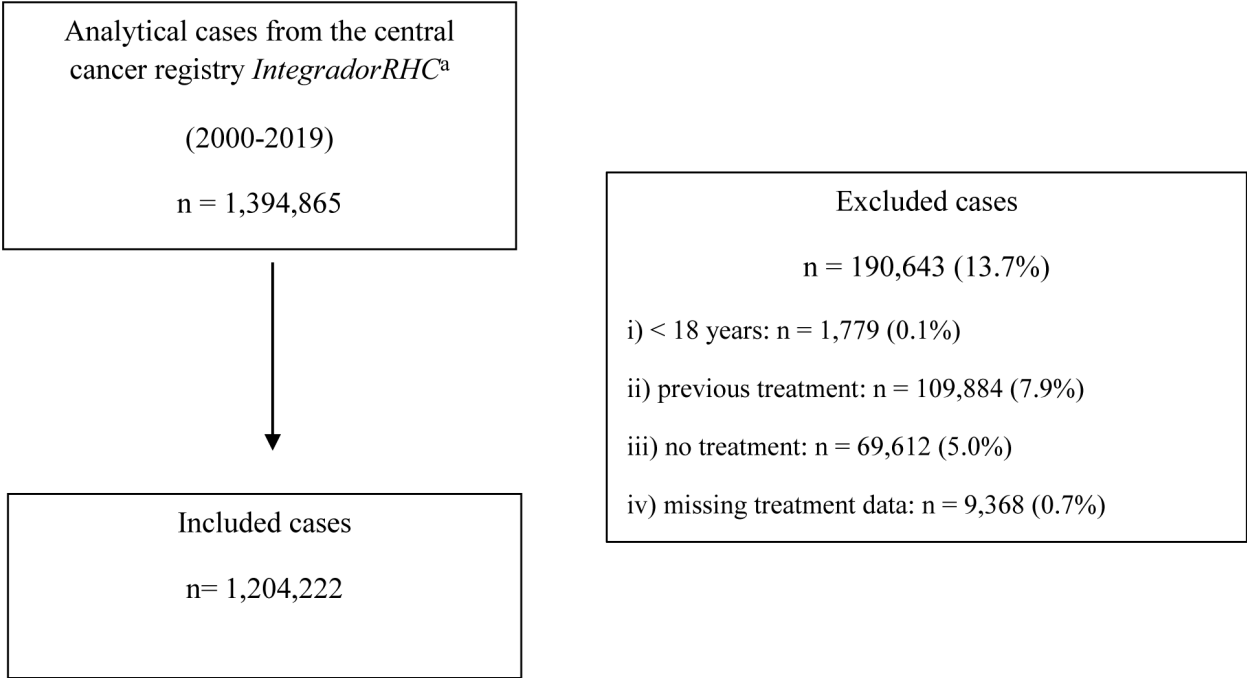


Figure 1. Flowchart showing the analytical case selection from the Hospital-Based Cancer Registries Integrator Module

Note: * Analytical cases of patients diagnosed with female breast cancer, prostate, colorectal, lung, stomach, and cervical cancer, with invasive characteristics, that is, excluding tumors *in situ*.

Table 1. Absolute and percentage values of the first treatment modality received by patients diagnosed with the six most common types of invasive cancer in Brazil over 2000-2019

Treatment	Types of invasive cancer						Total
	Breast	Prostate	Colorectal	Lung	Stomach	Cervix	
Surgery							
Yes	230,228	130,992	108,308	23,969	55,954	62,346	549,451
	(62.5%)	(43.4%)	(60.3%)	(22.7%)	(62.1%)	(39.1%)	
No	137,932	170,640	71,156	81,493	34,222	96,982	592,425
	(37.5%)	(56.6%)	(39.7%)	(77.3%)	(37.9%)	(60.9%)	
Chemotherapy							
Yes	99,315	17,051	42,682	47,814	26,123	21,931	254,916
	(27.0%)	(5.6%)	(23.8%)	(45.3%)	(29.0%)	(13.8%)	
No	268,845	284,581	136,782	57,648	64,053	137,397	949,306
	(73.0%)	(94.4%)	(76.2%)	(45.3%)	(71.0%)	(86.2%)	
Radiotherapy							
Yes	23,464	23,464	25,583	29,893	5,348	72,460	150,319
	(6.4%)	(6.4%)	(14.3%)	(28.3%)	(5.9%)	(45.5%)	
No	344,696	344,696	153,881	75,569	84,828	86,868	1,090,538
	(93.6%)	(93.6%)	(85.7%)	(71.7%)	(94.1%)	(54.5%)	

frequently used in patients treated at an Unacon (30.4%, weak effect) and with advanced disease (37.6%, moderate effect) (Figure 2 and Supplementary Table 3).

For lung cancer, patients in the advanced stage presented a lower probability of undergoing surgery (11.6%, strong effect) and a higher probability of receiving chemotherapy (56.3%, strong effect) and radiotherapy (29.1%, weak effect). However, both chemotherapy (53.7%, weak effect) and radiotherapy (20.5%, weak effect) were less frequently indicated for patients treated at an Unacon (Figure 2 and Supplementary Table 4).

Among patients with gastric cancer, surgical treatment was less frequent in those treated at an Unacon (57.0%, weak effect), as well as chemotherapy (34.1%, weak effect). Additionally, those with cancer in an advanced stage presented a lower probability of undergoing surgery (45.2%, strong effect) and a higher probability of receiving chemotherapy (46.4%, strong effect) (Figure 2 and Supplementary Table 5).

For women with cervical cancer, surgeries were less frequent among elders (25.7%, weak effect), with fewer years of education (36.5%, weak effect), and living in the North and Northeast Regions (32.6%, weak effect). These same groups presented a greater frequency of radiotherapy (57.8%, 48.2%, and 51.7%, respectively; all with weak effects). Patients in an advanced stage had a lower probability of undergoing surgery (11.3%, strong effect) and a higher probability of receiving chemotherapy

(25.9%, moderate effect) and radiotherapy (61.6%, strong effect). The frequency of chemotherapy was also greater for patients treated at an Unacon (17.5%, weak effect) (Figure 2 and Supplementary Table 6).

DISCUSSION

This study has demonstrated, in an unprecedented manner in the Brazilian context, the treatment patterns adopted for the six most common types of invasive cancer, taking into account both clinical and sociodemographic variables. Consistently for all cancer types assessed, patients diagnosed in advanced stages received chemotherapy treatment more frequently and were less prone to undergo surgery. Moreover, characteristics like age, years of education, skin color, geographical Region of residence, and oncology accreditation level of the treatment location impacted treatment patterns, presenting effect sizes that ranged from weak to strong, depending on the cancer type and therapeutic modality considered.

The results from this study reinforce the importance of primary health care in the prevention and screening of at least four of the six most common cancer types in the Brazilian population. The effectiveness of these strategies could potentially reduce both the demand for high-complexity oncological care and mortality, especially in Regions with more restricted access to specialized services²⁷.

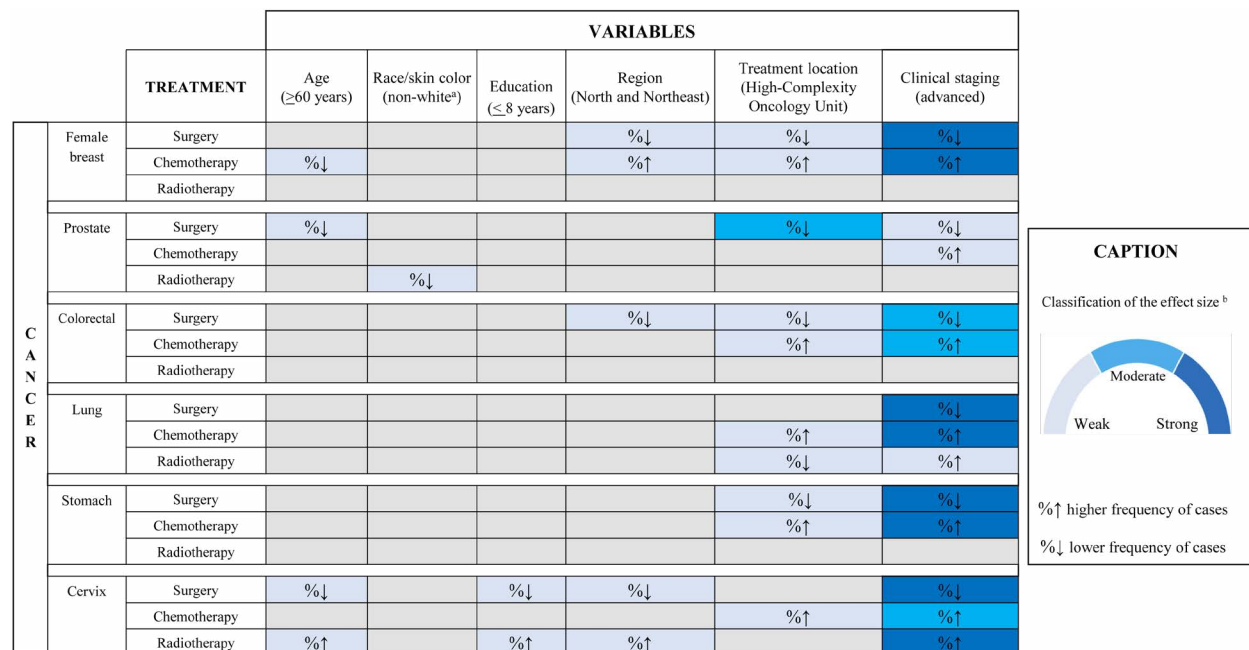


Figure 2. Classification of the effect size of characteristics related to the first treatment modality received by patients diagnosed with the six most common types of invasive cancer in Brazil, according to effect size

Note: ^a black, Asian, brown, and indigenous. ^b For Cohen's *W* (for variables with two categories), a 0.10-0.29 size was classified as weak, 0.30-0.49 as moderate, and ≥ 0.50 as strong. For Cramér's *V* (for variable [treatment location] with three categories), the 0.07-0.20 size was classified as weak, 0.21-0.34 as moderate, and ≥ 0.35 as strong²⁵.

Moreover, these results also indicate inequality in access to cancer treatment in Brazil. Identifying these elements can help guide strategic investments, formulation of public policies, and define priorities in terms of healthcare programs in the country, given the need to increase efficiency in the health system, improve early diagnosis rates, and ensure adequate care. Access to adequate treatment, besides being an ethical imperative, is essential to ensuring the economic sustainability of SUS, promoting equity, and prioritizing historically vulnerable groups^{4,13}.

Cancer staging at the time of diagnosis must be understood as the main treatment determinant. As provided for in the clinical guidelines, disease extension is one of the key factors considered in the elaboration of therapeutic plans, surgery being the first modality of choice in early diagnosed cases²⁰. A diagnosis in advanced staging (III or IV) implies more aggressive, costly, and worse prognoses treatments²⁸. In general, the cost of treating a patient with cancer in an advanced stage is substantially higher than that of treating an initial stage cancer²⁹. Although it is pretty well established that healing potential is greater when cancer is diagnosed at an initial stage, in Brazil, there is an increasing number of diagnoses in advanced stages³⁰, making the healing approach less viable.³¹

Moreover, consistent findings of undertreatment were verified in patients aged 60 years and over, characterized by a lower frequency of chemotherapy in breast cancer, a lower frequency in surgery for prostate cancer, and a lower rate of surgery associated with radiotherapy in cervical cancer. Although advanced age alone is not a contraindication for certain treatments, there is a general tendency for older cancer patients not to be exposed to more aggressive therapies. This phenomenon often results from a chronological age-centered assessment, disregarding more robust clinical parameters, such as biological age, functionality, cognition, nutritional state, and social support. Such an approach perpetuates the risk of mistaken decisions, automatically associating old age with frailty³².

Overcoming these obstacles requires adopting more precise criteria, based on multidimensional assessments, to ensure that therapeutic decisions consider risks, benefits, toxicity, and potential impact on quality of life³³. It is worth highlighting that, although elderly patients present, on average, about five comorbidities at the time of diagnosis, not all are relevant in increasing the susceptibility to treatment toxicity³⁴.

Another important result of the study was racial disparity in access to therapies, particularly in prostate cancer, where non-white patients were less likely to receive radiotherapy. Although the scientific literature

has already documented that reducing social inequalities and amplifying coverage of health services is key for effective cancer control, racial and ethnic disparities persist, reflecting the structural racism that permeates health systems³⁵. Previous studies corroborate these results, demonstrating that Black men are less likely to receive proper treatment when compared to white men³⁶.

Women with cervical cancer and fewer years of education were also observed to present a lower probability of undergoing surgery and radiotherapy, indicating a clear social gradient in access to treatment. Strengthening education policies is a structural strategy that not only improves health indicators but also promotes better adherence to screening programs and early diagnosis, especially for cervical cancer^{37,38}.

The results also showed that treatment patterns vary according to the geographical Region of the country, reflecting historical inequalities in the country's social and economic development. Brazil, with its continental dimensions, faces structural challenges that directly impact access to health services, particularly in the North and Northeast Regions. In these Regions, surgeries were less frequent and chemotherapy more frequent in breast cancer, there were fewer surgeries performed for colorectal cancer, and fewer surgeries, in addition to more radiotherapy, in cervical cancer. These results reflect limitations in infrastructure, specialized human resources, and funding³⁰.

The unequal distribution of oncological services in the country impairs access to them. North and Northeast are the Regions with a more limited offer of health services, including oncology, which are more concentrated in the South and Southeast of the country. Of the 449 establishments with credentials to provide some type of specialized cancer service in the country, 102 (23%) are located in the South and 220 (49%) in the Southeast³⁹. In this scenario, it is possible to infer that amplifying the network of specialized services, combined with strategies for reducing social and economic inequalities, could help reduce undertreatment and cancer mortality in more vulnerable populations.

Another relevant factor identified was the impact of the accreditation level of oncological services on the treatment patterns. Patients treated at services with a lower level of accreditation had less access to surgery and a higher probability of receiving chemotherapy, regardless of the cancer type. This result reinforces that Cacon services, by relying on multiprofessional teams, high-end technology, and adequate infrastructure, offer better chances of healing treatments. This scenario proves the need for more equitable planning in distributing these centers across the national territory, particularly given the projected increase in cancer incidence³ and the growing

demand for specialized oncological care. Moreover, it becomes essential to strengthen articulation between Health Care Networks at federal, state, and city levels, ensuring efficient referral flows so patients can access treatments compatible with their disease stage and the best clinical practices available³⁹.

One limitation of this study is the difficulty in estimating how thorough the case investigations are and the quality of registries in the RHC Integrator Module. Specifically, some key variables to optimize the potential use of databases are often absent, such as disease clinical staging²⁴, immunohistochemical results, and other prognostic markers, in addition to the presence of comorbidities. In this study, gaps in clinical staging data were imputed following a previously validated methodology in the context of RHC²⁴, reaching a recovery rate similar to that found by Valerio et al.²³ and moderate concordance between imputed and actual data. This procedure aimed at restoring the completeness of a variable so that treatment patterns of cases that occurred in different Regions of the country could be thoroughly, faithfully, representatively, and methodologically assessed.

It is also worth mentioning the use of a long historical period (2000-2019), which encompassed significant changes in the organization of oncological services in the country and the increase in the number of hospitals included in the national RHC. In early 2000, for instance, most oncological surgeries were performed in general hospitals instead of specialized oncological centers, and therefore, data on those were not included in the RHC Integrator Module. Moreover, regulations on private medical assistance also changed throughout the period, including different rules of coverage for oncological treatment and the inclusion of chemotherapy medication, which were previously available only through the public health system.

The consulted database is a systematic source of information on cancer cases diagnosed and treated in hospitals across the country. To minimize the inclusion of duplicated records, only analytical cases were considered¹⁷. It is also worth mentioning the high number of cases included which, along with the selection of analytical cases and exclusion of tumors *in situ*, contributed to obtaining important results, analyzed from the perspective of effect size. Considering the size of the studied population (1,204,222 patients), multiple regression models can produce statistically significant results that have little practical relevance, however. The effect size is a standardized indicator, specific to each statistical test, and, unlike the value of *p*, does not depend on the sample size²⁶. For this reason, this study prioritized the use of effect size, which offers a more robust interpretation of the magnitude of associations, regardless of the sample size.

Further studies on the subject are needed, involving regional and multidimensional analyses and investigations of longitudinal changes in treatment patterns, to better elucidate other issues and advance scientific knowledge. Understanding the treatment patterns for the thousands of patients with the six most common types of invasive cancer in Brazil is important to inform the planning and development of strategic solutions for proper and timely cancer treatment in the country. Moreover, this information can be useful for debates on social inclusion and programmatic vulnerability at individual, social, and political levels.

Considering the projected increase in the number of new cancer cases in the country³, these results are expected to stimulate academic institutions and researchers to seek more evidence and encourage other actors, like governments, health service providers, and medical organizations to take actions towards improving the standard of cancer treatment in the whole country. Such actions are essential to improve the prognosis of patients with cancer in Brazil.

CONCLUSION

Cancer staging at the time of diagnosis was the primary factor determining the type of treatment received. Demographic variables are also associated with limited access to different therapeutic options.

CONTRIBUTIONS

Livia Costa de Oliveira and Luiz Claudio Santos Thuler designed the study, analyzed, and interpreted the data. All the authors drafted, critically reviewed the manuscript, and approved the final version to be published.

DECLARATION OF CONFLICT OF INTERESTS

As the scientific-editor of INCA's "Revista Brasileira de Cancerologia" the author Anke Bergmann declares potential conflict of interests. The other authors have no conflict of interests

DATA AVAILABILITY STATEMENT

The data used in the present study are available at INCA's page at <https://irhc.inca.gov.br/RHCNet/>.

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