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Original Article

Hospitalizations and deaths due to alcohol-associated liver disease in Brazil and its regions, 2000–2022

Internações e óbitos por doença hepática associada ao álcool no Brasil e regiões, 2000–2022

Hospitalizaciones y muertes por enfermedad hepática asociada al alcohol en Brasil y sus regiones, 2000–2022

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ABSTRACT

Background and Objectives: Alcohol-associated liver disease (ALD) is the leading cause of alcohol-attributable mortality and the sixth leading cause of related hospital admissions. Hepatic steatosis occurs in approximately 90% of alcohol consumers, with 10% to 20% of chronic heavy drinkers progressing to severe forms such as alcoholic hepatitis and cirrhosis. Given the prevalence and severity of ALD, coupled with the scarcity of studies on the subject, it is essential for the scientific community to explore this topic further. The objective of the present study was to analyze the temporal evolution and epidemiological profile of hospital admissions and deaths due to ALD across the five regions of Brazil, from 2000 to 2022. **Methods:** This is an ecological study utilizing secondary data from the Mortality Information System (SIM) and the Hospital Information System (SIH), covering the period from 2000 to 2022, based on the occurrence of Alcoholic Liver Disease. **Results:** A total of 344,039 hospital admissions and 214,642 deaths were registered in Brazil. A higher frequency of hospitalizations and deaths was observed among males, individuals aged 40 to 59 years, those self-identified as Black or mixed-race (pardos), unmarried individuals, and those with a low level of education. The annual percentage changes for admissions and deaths trended upward across all regions, peaking in the North region at 2.57% and 4.95%, respectively. While the South region presented relatively low absolute values, its hospitalization and mortality rates were well above the national average. **Conclusion:** This ecological analysis demonstrated the upward impact of the condition on hospitalizations and deaths across different regions of the country. These findings highlight the importance of promoting public health initiatives to curb alcohol abuse. Future research should analyze the integration of databases to support control and prevention strategies for the disease, as well as assess healthcare access and post-discharge survival rates.

Keywords: *Alcoholic Liver Diseases. Alcohol Abuse. Information Systems. Epidemiological Studies.*

RESUMO

Justificativa e Objetivos: A doença hepática associada ao álcool (DHA) é a principal causa de morte atribuível ao álcool e a sexta em internações relacionadas. A esteatose hepática ocorre em cerca de 90% dos etilistas, sendo que 10% a 20% dos bebedores pesados crônicos evoluem para formas graves, como hepatite alcoólica e cirrose. Devido à prevalência e gravidade da DHA e à existência de poucos estudos sobre o tema, torna-se essencial que o assunto seja explorado pela comunidade científica. O objetivo do presente trabalho foi analisar a evolução temporal e o perfil epidemiológico das internações hospitalares e óbitos por DHA nas cinco regiões do Brasil, no período entre 2000 e 2022. **Métodos**: Trata-se de estudo ecológico com dados secundários do Sistema de Informações de Mortalidade e do Sistema de Informações Hospitalares, para período de 2000 a 2022, conforme ocorrência de Doença Alcoólica do Fígado. **Resultados**: Foram registradas 344.039 internações e 214.642 óbitos no Brasil. Observou-se maior frequência de internações e mortes em indivíduos do sexo masculino, faixa etária de 40 a 59 anos, entre indivíduos autodeclarados pretos ou pardos, solteiros e com baixa escolaridade. As variações percentuais anuais para as internações e óbitos foram ascendentes em todas as regiões e maiores na região Norte, 2,57% e 4,95%, respectivamente. A região Sul apresenta valores relativamente baixos, no entanto, possui taxas de internação e mortalidade muito acima da média nacional. **Conclusão**: esta análise ecológica permitiu demonstrar como o agravo tem impactado de forma ascendente em internações e óbitos nas diferentes regiões do país. Ressaltando a importância na promoção de ações em saúde para a contenção do uso abusivo de álcool. Pesquisas futuras poderão analisar a integração entre os bancos de dados para subsidiar estratégias de controle e prevenção do agravo, assim como verificar a oportunidade de acesso e a sobrevida após a internação.

Descritores: *Hepatopatias Alcoólicas. Abuso de Álcool. Sistemas de Informação. Estudos Epidemiológicos.*

RESUMEN

Justificación y Objetivos: La enfermedad hepática asociada al alcohol (EHA) es la principal causa de mortalidad atribuible al alcohol y la sexta en hospitalizaciones relacionadas. La esteatosis hepática ocurre en aproximadamente el 90% de los consumidores de alcohol, y e ntre el 10% y el 20% de los bebedores crónicos empedernidos progresan a formas graves, como hepatitis alcohólica y cirrosis. Debido a la prevalencia y gravedad de la EHA, y a la escasez de estudios sobre el tema, resulta fundamental que la comunidad científica explore esta temática. El objetivo del presente trabajo fue analizar la evolución temporal y el perfil epidemiológico de las hospitalizaciones y muertes por EHA en las cinco regiones de Brasil, en el período comprendido entre 2000 y 2022. **Métodos**: Se trata de un estudio ecológico que utiliza datos secundarios del Sistema de Información de Mortalidad (SIM) y del Sistema de Información Hospitalaria (SIH), para el período de 2000 a 2022, según la ocurrencia de la Enfermedad Hepática Alcohólica. **Resultados**: Se registraron 344.039 hospitalizaciones y 214.642 muertes en Brasil. Se observó una mayor frecuencia de ingresos y defunciones en individuos del sexo masculino, en el grupo de edad de 40 a 59 años, entre individuos autodeclarados negros o mestizos (pardos), solteros y con bajo nivel de escolaridad. Las variaciones porcentuales anuales para las hospitalizaciones y muertes fueron ascendentes en todas las regiones, siendo mayores en la región Norte, con 2,57% y 4,95%, respectivamente. La región Sur presenta valores absolutos relativamente bajos; sin embargo, posee tasas de hospitalización y mortalidad muy por encima del promedio nacional. **Conclusión**: Este análisis ecológico permitió demostrar el impacto ascendente de la afección en las hospitalizaciones y muertes en las diferentes regiones del país. Se resalta la importancia de promover acciones de salud pública para contener el abuso de alcohol. Investigaciones futuras podrían analizar la integración entre las bases de datos para fundamentar estrategias de control y prevención de la enfermedad, así como evaluar la oportunidad de acceso a la atención médica y la supervivencia posterior al alta hospitalaria.

Palabras Clave: *Enfermedades Hepáticas Alcohólicas. Abuso de Alcohol. Sistemas de Información. Estudios Epidemiológicos.*

INTRODUCTION

Alcoholic beverages constitute, in many societies, a part of the social routine; however, alcohol is among the leading causes of preventable death worldwide, responsible for 3 million deaths annually.[1] In Brazil, 336,407 hospitalizations and 69,054 deaths were identified as partially or totally attributable to alcohol. Among these, liver health conditions were the 6th leading cause of hospitalization and the 1st leading cause of death in 2021.[2] In this way, it is evident that there is a significant need to develop research that seeks to better understand the behavior of liver diseases in relation to alcohol use.

The biochemical injury to the liver resulting from excessive alcohol intake is called Alcohol-Associated Liver Disease (ALD) and encompasses various sequelae in the organ, such as alcoholic liver cirrhosis, alcoholic hepatitis, alcoholic fibrosis and sclerosis, and alcoholic fatty liver.[3]

Among individuals with alcoholism, an approximate 90% prevalence of hepatic steatosis is observed.[4] Among these individuals, it is estimated that about 10% to 20% of chronic heavy drinkers progress to more severe forms of liver disease, such as alcoholic hepatitis and cirrhosis.[5] The acute manifestation of these diseases presents high mortality, which can reach 50% in cases of acute alcoholic hepatitis, and may result in a life expectancy of around 1 to 2 years in patients with advanced liver cirrhosis.[6]

The amount and duration of alcohol consumption constitute the most important risk factors for the development of alcoholic liver disease. Women are more susceptible than men, despite the higher incidence of the disease in males. Obesity, high-fat diets, and concomitant infection with the hepatitis C virus are other factors that deserve attention.[7]

Patients with ALD present fatigue, hepatomegaly, and anorexia in mild cases. In severe cases, jaundice, ascites, fever, abdominal pain, hepatic encephalopathy, and bleeding from varices are evident clinical signs. Elevation of liver enzymes with an AST/ALT ratio greater than 1.5, hyperbilirubinemia, neutrophilia, as well as prolonged prothrombin time, hypoalbuminemia, and thrombocytopenia, are findings observed in laboratory tests.[8]

Due to the prevalence and severity of ALD and the scarcity of studies on the topic in Brazil, it becomes essential for the subject to be explored by the scientific and healthcare communities.[9] Therefore, one way to address this gap is through ecological studies, which allow for a better analysis of the understanding of the territory and the behavior of the disease in different regions of the country, taking into account the peculiarities of each location, such as access to the healthcare system and demographic and socioeconomic characteristics.

In this context, the objective of the present study was to analyze the temporal trends and epidemiological profile of hospitalizations and deaths due to Alcohol-Associated Liver Disease in the five regions of Brazil, during the period from 2000 to 2022.

METHODS

A mixed ecological study (temporal and multiple-group) was conducted using data from the Mortality Information System (SIM) and the Hospital Information System (SIH), both belonging to the Department of Information and Informatics of the Unified Health System (DATASUS). The units of analysis for data extraction were Brazil and its regions, according to the 23-year time series (period from 2000 to 2022). The study population consisted of cases of Alcoholic Liver Disease, with the sample related to the manifestation of these cases according to each information system: number of hospitalizations and number of deaths. Thus, this is a non-random sample based on the totality of data available within the system itself.

Information from the SIM was included for the Cause – ICD-10 Brazil code “K70.1 Alcoholic liver disease”. In the SIH, the item “Alcoholic liver disease” was selected in the “Lista Morb CID-10 field”. In May 2024, the data extraction was conducted by a research group member with expertise in system management, guided according to the variables of interest available within the system. For the SIM, the variables were number of deaths by region of the country, age group, sex, race, education level, and marital status. For the SIH, the variables were number of hospitalizations by region of the country, age group, sex, and race of the patients. These variables were presented descriptively to illustrate the sociodemographic profile and the impact of the condition at the national level.

Furthermore, with the aim of calculating hospitalization rates and mortality coefficients, the population data of the Brazilian regions from 2000 to 2022, obtained from the Brazilian Institute of Geography and Statistics (IBGE) for the same extraction period, were used as the population base. The data were extracted, organized, and analyzed in a Microsoft Excel® spreadsheet. Descriptive statistics were performed, such as absolute and relative frequency for the categorical variables: sex, age, education level, self-reported race/ethnicity/skin color, and marital status. Furthermore, the following indicators were calculated: the hospitalization rate for the selected cause (Number of hospitalizations of residents paid by SUS for selected causes × 10,000 / Total resident population during the considered period) and the cause-specific mortality rate (Number of deaths from the specific cause

in a given location and period × 100,000 / Total population of the same location and period).

The study of time series, both for the hospitalization rate and the mortality rate, was conducted in accordance with the Prais-Winsten model (R^2 = 70%), and data autocorrelation was analyzed using the Durbin-Watson statistical test (range 0 to 4, with values up to 2 indicating no autocorrelation). The accepted statistical significance was $p \leq 0.05$, and the increasing or decreasing trend was determined according to the visual distribution of the curve. These are statistical measures commonly used for time series analysis in Health Surveillance, as they allow the evaluation of the dependence of a serial measure on its own values at previous time points.[10]

Regarding ethical aspects, in accordance with CNS Resolution No. 510/2016, since the study was conducted using publicly available secondary data, review by the Research Ethics Committee was not required.

RESULTS

A total of 344,039 hospitalizations due to ALD in Brazil were recorded during the period from 2000 to 2022, representing an average annual rate of 7.8 hospitalizations per 100,000 population (R^2 = 0.065). The region with the highest hospitalization rate for ALD was the Southern Region (10.5; R^2 = 0.068), followed by the Southeast (9.0; R^2 = 0.001), Central-West (7.4; R^2 = 0.280), Northeast (6.1; R^2 = 0.345), and Northern Region (3.6; R^2 = 0.170). Regarding the evolution of the hospitalization rate in the country and in the Brazilian regions during the studied period, the highest annual percent changes (APC) were recorded in the Northern Region (APC = 2.57) and the Central-West Region (APC = 2.33) (Figure 1).

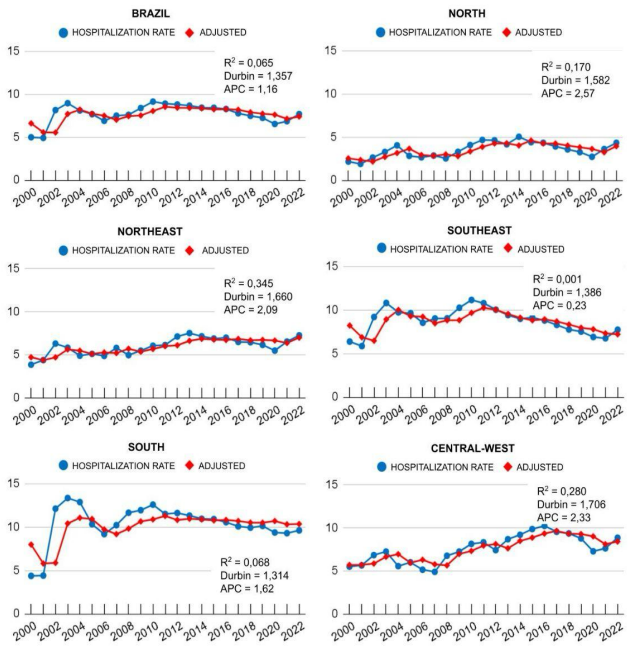

Figure 1. Evolution of the hospitalization rate for Alcohol-Associated Liver Disease (hospitalizations per 100,000 population) in Brazil and in the five Brazilian regions from 2000 to 2022.

Regarding deaths, 214,642 deaths from ALD were recorded in the country during the same period, corresponding to an average annual mortality rate of 4.9 deaths per 100,000 population (R^2 = 0.386). The region with the highest mortality rate was the Southern Region (5.6; R^2 = 0.015), followed by the Northeast (5.5; R^2 = 0.552), Central-West (5.2; R^2 = 0.668), Southeast (4.8; R^2 = 0.035), and Northern Region (2.2; R^2 = 0.706). When observing the evolution of the mortality rate in the country and in the Brazilian regions over the two decades of analysis, the highest annual percent changes (APC) were identified in the Northern Region (APC = 4.95) and the Northeast Region (APC = 4.47) (Figure 2).

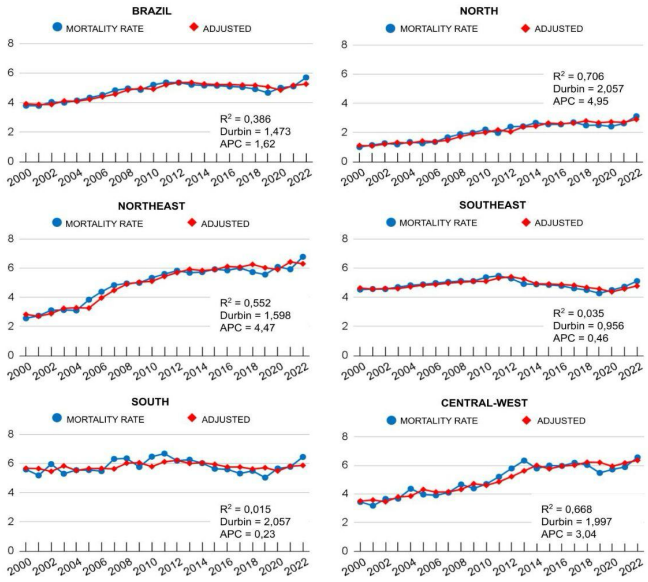

Figure 2. Evolution of the mortality rate for Alcohol-Associated Liver Disease (deaths per 100,000 population) in Brazil and in the five Brazilian regions from 2000 to 2022.

The epidemiological profile of hospitalizations for ALD in Brazil was composed mainly of male patients (82.0%) and those in the 40 to 59-year age group (55.6%). In the racial characterization, there was an equal predominance of white individuals (35.8%) and black or brown individuals (35.8%) (Table 1).

Table 1. Number of hospital admissions for alcoholic liver disease from 2000 to 2022 by Brazilian region according to sex, age group, and race.

Variable	North N (%)	Northeast N (%)	Southeast N (%)	South N (%)	Central-West N (%)
Sex					
Male	10,378 (78.5)	59,853 (80.5)	135,874 (82.4)	56,404 (84.1)	20,288 (79.7)
Female	2,845 (21.5)	14,508 (19.5)	29,095 (17.6)	10,624 (15.9)	5,182 (20.3)
Age group					
0 - 19 years	250 (1.9)	702 (0.9)	712 (0.4)	269 (0.4)	189 (0.7)
20 - 29 years	625 (4.7)	3,461 (4.6)	4,824 (2.9)	1,529 (2.3)	875 (3.4)
30 - 39 years	1,710 (12.9)	12,204 (16.4)	21,751 (13.2)	7,354 (11.0)	3,825 (15.0)
40 - 49 years	3,035 (22.9)	19,600 (26.4)	44,675 (27.1)	17,782 (26.5)	7,346 (28.8)
50 - 59 years	3,448 (26.1)	18,612 (25.0)	49,149 (29.8)	21,015 (31.3)	7,104 (27.9)
60 - 69 years	2,417 (18.3)	12,065 (16.2)	30.,97 (18.3)	13,104 (19.5)	4,180 (16.4)
70 - 79 years	1,267 (9.6)	5,667 (7.6)	10,898 (6.6)	4,845 (7.2)	1,547 (6.1)
80+ years	471 (3.6)	2,050 (2.8)	2,764 (1.7)	1,130 (1.7)	404 (1.6)
Race/skin color					
White	247 (2.5)	3,138 (5.8)	46,414 (41.3)	34,132 (73.0)	2,809 (14.3)
Black	150 (1.5)	1,639 (3.0)	6,248 (5.6)	1,484 (3.2)	392 (2.0)
Mixed (Pardo)	5,742 (57.0)	27,101 (50.3)	33,249 (29.6)	3,671 (7.8)	7,202 (36.7)
Asian (Yellow)	134 (1.3)	983 (1.8)	1,283 (1.1)	291 (0.6)	399 (2.0)
Indigenous	65 (0.7)	27 (0.1)	75 (0.1)	71 (0.1)	121 (0.6)
Unknown	3,738 (37.1)	21,011 (39.0)	24,965 (22.2)	7,136 (15.2)	8,697 (44.3)

In the records of deaths due to ALD, male individuals predominated (88.1%), individuals aged 40 to 59 years (56.3%), those of Black or Mixed race (49.8%), single (39.8%) or married (33.0%) marital status, and individuals with 7 years of schooling or less (58.1%) (Table 2).

Table 2. Deaths from alcoholic liver disease from 2000 to 2022 by Brazilian region according to sex, age group, and race.

Variable	North N (%)	Northeast N (%)	Southeast N (%)	South N (%)	Central-West N (%)
Sex					
Male	6,895 (89.0)	54,488 (88.4)	79,695 (87.5)	33,488 (89.6)	14,566 (86.6)
Female	8,489 (11.0)	7,125 (11.6)	11,360 (12.5)	3,895 (10.4)	2,245 (13.4)
Unknown	3 (0.0)	17 (0.0)	10 (0.0)	2 (0.0)	5 (0.0)
Age group					
0 - 19 years	17 (0.2)	59 (0.1)	34 (0.0)	12 (0.0)	9 (0.1)
20 - 29 years	222 (2.9)	1,932 (3.1)	1,610 (1.8)	477 (1.3)	402 (2.4)
30 - 39 years	1,005 (13.0)	9,316 (15.1)	10,613 (11.6)	3,654 (9.8)	2,355 (14.0)
40 - 49 years	1,899 (24.5)	16,886 (27.4)	24,761 (27.2)	9,738 (26.1)	4,801 (28.5)
50 - 59 years	2,060 (26.6)	16,217 (26.3)	27,986 (30.7)	11,743 (31.4)	4,816 (28.6)
60 - 69 years	1,468 (19.0)	10,387 (16.9)	17,528 (19.2)	7,827 (20.9)	2,892 (17.2)
70 - 79 years	703 (9.1)	4,931 (8.0)	6,664 (7.3)	3,185 (8.5)	1,138 (6.8)
80+ years	331 (4.3)	1,785 (2.9)	1,646 (1.8)	709 (1.9)	324 (1.9)
Unknown	41 (0.5)	117 (0.2)	223 (0.2)	40 (0.1)	79 (0.5)
Race/skin color					
White	1,080 (13.9)	9,683 (15.7)	49,084 (53.9)	29,302 (78.4)	5,081 (30.2)
Black	713 (9.2)	6,607 (10.7)	8,966 (9.8)	2,270 (6.1)	1,555 (9.3)
Mixed (Pardo)	5,581 (72.1)	39,751 (64.5)	27,589 (30.3)	4,480 (12.0)	9,403 (55.9)
Asian (Yellow)	26 (0.3)	207 (0.3)	388 (0.4)	86 (0.2)	63 (0.4)
Indigenous	118 (1.5)	127 (0.2)	72 (0.1)	79 (0.2)	195 (1.2)
Unknown	228 (2.9)	5,255 (8.5)	4,966 (5.4)	1,168 (3.1)	519 (3.1)
Marital status					
Single	3,748 (48.4)	28,739 (46.6)	33,176 (36.4)	12,096 (32.4)	7,597 (45.2)
Married	1,956 (25.3)	18,204 (29.5)	32,094 (35.2)	14,298 (38.3)	4,344 (25.8)
Widowed	447 (5.8)	3,059 (5.0)	5,797 (6.4)	2,828 (7.6)	968 (5.8)
Legally separated	368 (4.8)	2,770 (4.5)	11,330 (12.4)	4,951 (13.2)	1,723 (10.2)
Other	532 (6.9)	2,138 (3.5)	1,993 (2.2)	1,001 (2.7)	620 (3.7)

continue

Variable	North N (%)	Northeast N (%)	Southeast N (%)	South N (%)	Central-West N (%)
Unknown	695 (9.0)	6,720 (10.9)	6,675 (7.3)	2,211 (5.9)	1,564 (9.3)
Schooling					
None	1,542 (19.9)	13,883 (22.5)	5,417 (5.9)	2,747 (7.3)	2,094 (12.5)
1 - 3 years	1,952 (25.2)	14,501 (23.5)	20,123 (22.1)	9,487 (25.4)	3,968 (23.6)
4 - 7 years	1,738 (22.4)	10,232 (16.6)	21,842 (24.0)	10,766 (28.8)	4,487 (26.7)
8 - 11 years	1,028 (13.3)	5,316 (8.6)	12,662 (13.9)	5,528 (14.8)	2,476 (14.7)
12+ years	223 (2.9)	1,098 (1.8)	3,237 (3.6)	1,260 (3.4)	580 (3.4)
Unknown	1,263 (16.3)	16,599 (26.9)	27,784 (30.5)	7,596 (20.3)	3,211 (19.1)

DISCUSSION

Unlike previous investigations, which evaluated shorter periods or specific regions, the present study conducts an extensive temporal analysis—spanning 22 years—of alcohol-associated liver disease in Brazil. This temporal breadth enables a more robust understanding of changes in the epidemiological and regional patterns of the disease, representing an unprecedented advancement in the national literature on the subject.

The analysis of the time series from 2000 to 2022 showed an increasing trend in hospitalizations and deaths due to ALD, as also indicated by other national studies regarding this pattern of the condition.[3,11,12]

Brazil, as well as Latin America, showed mortality rates from ALD above the global average. Globally, mortality from ALD has also shown an increasing trend, with a 22% rise in the death rate between 2000 and 2020.[13] Countries with higher per capita alcohol consumption have been associated with higher rates of cases and deaths from ALD, once again reinforcing the impact of the amount of alcohol consumed on the occurrence of the disease.[14]

Despite the geographic consistency in the increase in hospitalization and mortality due to ALD across all regions, this increase occurred with different intensities: while the Southeast and South regions tend toward stability, the North, Central-West, and Northeast showed high APCs in hospitalizations and deaths. It should be considered that this difference may be related to improvements in healthcare services in the Brazilian regions, improved care, timeliness, and diagnostic accuracy. Or even, whether the information systems are being better operationalized regarding the reporting of ALD, and better qualified in terms of data recording and processing.[9] It is worth noting that, according to the findings of the present study, although the South region shows low APC values for hospitalizations and mortality, it has hospitalization and mortality rates well above the national average. Moreover, alcohol consumption in this region is the highest in Brazil.[15]

In Brazil, the risk of hospitalization for ALD is 7.9 times higher in males compared to females, with hospitalizations and deaths among men accounting for 83.1% and 83.5%, respectively, from 2013 to 2018. Although abusive alcohol consumption and the incidence of ALD are more prevalent in men, the proportion of women engaging in chronic alcohol use, as well as developing alcohol-related liver disorders, is concerning.[16]

According to the literature, women have greater physiological susceptibility to liver injury from excessive alcohol consumption compared to men,[17] and therefore have lower safe intake thresholds. However, the present study identified a significant predominance of the male population in both the number of hospitalizations and deaths from ALD across all regions of the country, with values ranging from 78.5–84.1% and 86.6–89%, respectively, for this population group. These findings were similar to those reported by another study, which showed a higher proportion of hospitalizations and deaths in men from ALD in Brazil between 2006 and 2015, accounting for 81.68% and 87.82%, respectively.[9]

A study conducted in the state of Paraná between 2015 and 2023 showed that hospital morbidity and mortality from alcoholic hepatitis were much higher in men compared to women.[18] Internationally, a higher prevalence and mortality of ALD in males is also observed in Asia, Europe, and North America[19] In this context, it is likely that the higher prevalence of the disease in men, both in Brazil and in other regions of the world, is due to a greater proportion of men consuming alcoholic beverages, whether for historical and/or cultural reasons, with this consumption often being abusive.

National deaths from ALD occurred predominantly in adults aged 50 to 59 years (28.8%), followed by those aged 40 to 49 years (26.7%). This age profile was consistent with a study that, when analyzing deaths caused by alcoholic liver disease in Brazil from 2010 to 2016, found that more than half of the patients died between the ages of 40 and 59.[20] A study conducted in the United States reported the highest number of deaths in patients aged 55 to 64 in 2017, showing that the middle-aged population is the most affected, likely due to the cumulative effect of alcohol on the liver over the years of the patient's alcohol consumption.[21]

With regard to race, the majority of hospitalizations and deaths from ALD were among Black or Mixed (Pardo) individuals in the North, Northeast, and Central-

West regions, whereas self-declared White individuals predominated in the South and Southeast regions. These differences may be related to the ethnic composition of the population in each region. However, it should be noted that there is a high rate of unspecified race in the data from the SIH, ranging from 15.2% (South) to 44.4% (Central-West). The same issue was observed in a study that analyzed the temporal trend of incomplete race/ skin color registration in the country's health information systems and identified an average incompleteness of 33%, suggesting institutional racism and inequity in care for ethnic-racial groups.[22]

Regarding marital status, being single prevailed among deaths, likely highlighting the impact of the lack of family support on the worse progression of ALD. When studying the relationship between a patient's marital status and alcohol abuse, researchers found that marriage is a protective factor against alcohol abuse and, consequently, against diseases for which alcohol is the primary etiology.[23]

The low educational level of patients who died from ALD aligns with a study that associates fewer years of schooling with a higher likelihood of abusive alcohol consumption,[24] however, like race, this variable showed high rates of incompleteness, ranging from 16.3% to 30.5%, preventing further conclusions about the values found.

With regard to the system from which the data were obtained, the SIH was created in 1982, and in that year, it was the first DATASUS system to implement data collection through the submission of Hospital Admission Authorization records. The system was centralized until 2006, the year it became decentralized to the managers of healthcare facilities. The decentralization of data improved information quality, and the change in data entry may have been the reason for the high variations in hospitalization data for ALD between 2002 and 2006 in the present study. As for the SIM (Mortality Information System), since the 1990s, the system has been operated in a decentralized manner. Furthermore, the Death Certificate is the base document that contains the data recorded in the SIM and, as it is a form with legal, social, and health implications, it requires greater rigor and accuracy in its completion, which justifies the uniformity of the data related to deaths collected in the present study.[25]

The limitations of the study are related to the use of secondary data. The use of this type of data offers several advantages, such as saving time, reducing costs, and enabling the analysis of large volumes of data. However, one of the main limitations is related to the quality and completeness of the data. Secondary data that is typically collected may present measurement errors, incomplete information, or inconsistencies. The lack of control over the data collection process may compromise the accuracy of the results. Another limitation of ecological studies is the inability to establish causal relationships, since they do not work with individualized information for each case. The present study did not aim to perform linkage between the analyzed systems. The main interest was to examine the behavior of the condition, regarding mortality and hospitalizations, at the national and regional levels. Future research may undertake this analytical technique, even to better identify access opportunities, the time between hospitalization and death, survival, and case outcomes.

The analysis of the temporal evolution revealed an increasing trend in hospitalizations and deaths from Alcohol-Associated Liver Disease (ALD) in Brazil between 2000 and 2022, with significant regional differences. The North, Northeast, and Central-West regions showed significant increases in hospitalization and mortality rates, which may reflect either a worsening of the condition or improvements in the quality of health records.

According to the epidemiological profile of ALD for hospitalizations and deaths identified (male sex, 40–59 years old, single, and with low educational level) and the racial disparities observed by region, the study has the potential to contribute to the development of public policies targeting these population groups, with the aim of proposing strategic actions to contain the condition and improve the organization of health service responses at the national level. The panel resulting from the ecological analysis indicates how ALD has impacted different regions and how its progression unfolds, which also enables the development of prevention and harm-reduction programs, according to the results found for each locality. In any case, the promotion of health actions to curb abusive alcohol use should be the primary measure in addressing this reality."

One cannot overlook the need to improve data collection and analysis to reduce the incompleteness of variables such as education and race, in order to better define the profile of individuals affected by ALD. Future studies, especially those that integrate data from different sources and focus on the disease's progression over time, will be essential to support more appropriate and targeted control and prevention strategies.

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AUTHORS' CONTRIBUTIONS

Apollo Nobre Torres contributed to the literature review, writing of the abstract, introduction, methodology, discussion, interpretation and description of results, and conclusions. **Mirian Akiko Kawamura** contributed to the literature review, writing of the abstract, introduction, methodology, discussion, interpretation and description of results, and preparation of tables. **Laís Vasques Bertoncini** contributed to the literature review, writing of the introduction, discussion, interpretation and description of results. **Gustavo Tadeu Freitas Uchôa Matheus** contributed to the literature review, writing of the introduction, discussion, interpretation, description of results, and preparation of tables. **Sérgio Antonio Zullo** contributed to the preparation of statistics. **Fernanda Carolina Camargo** contributed to the writing of the abstract, introduction, methodology, discussion, interpretation and description of results, conclusions, and review. **Geisa Perez Medina Gomide** contributed to the planning of the work and the review of all sections of the article.

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