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Epidemiological Profile and Healthcare Costs of Gallstone-Related Hospitalizations in Niterói, Brazil: A Retrospective Cohort Study (2020-2022)

Perfil Epidemiológico e Custos Hospitalares das Internações por Colelitíase em Niterói, Brasil: Um Estudo de Coorte Retrospectivo (2020-2022)

Perfil Epidemiológico y Costos Hospitalarios de las Internaciones por Colelitiasis en Niterói, Brasil: Un Estudio de Cohorte Retrospectivo (2020-2022)

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Abstract:
This study aims to analyze the epidemiological profile, institutional concentration, and hospitalization costs associated with gallstone disease and cholecystitis in public hospitals in Niterói, Rio de Janeiro, from 2020 to 2022. This is a retrospective, descriptive, and analytical epidemiological study using DATASUS data on admissions under ICD-10 category K80 across six public municipal hospitals. A total of 2,033 admissions were recorded, with a strong predominance of female patients (76.64%) and those aged 40 to 59 years (41.31%). Hospital Orêncio de Freitas concentrated most admissions (50.81%) and total hospitalization costs (49.17%), which reached a global sum of USD 384,090. Hospitalization costs were strongly correlated with admission volume ($R^2 = 0.99$), whereas age explained only a small proportion of the variability ($R^2 = 0.0131$) and sex and race/color showed negligible association ($R^2 < 0.01$). Through this study, it was possible to observe that admissions are highly concentrated in a single hospital and predominantly affect women, with expenditures driven by procedural volume rather than demographic factors. This highlights the need to optimize elective surgical flows and decentralize healthcare resources.

Keywords:
Gallstones; Cholecystitis; Hospitalization Costs; Public Health; Health Planning.

Resumo:
O presente estudo tem como objetivo analisar o perfil epidemiológico, a concentração institucional e os custos de internação associados à colelitíase e colecistite em hospitais públicos de Niterói, Rio de Janeiro, de 2020 a 2022. Trata-se de um estudo epidemiológico retrospectivo, descritivo e analítico, utilizando dados do DATASUS referentes a internações com CID-10 categoria K80 em seis hospitais públicos municipais. Registraram-se 2.033 internações, com marcado predomínio do sexo feminino (76,64%) e da faixa etária de 40 a 59 anos (41,31%). O Hospital Orêncio de Freitas concentrou a maior parte das admissões (50,81%) e dos custos

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totais de internação (49,17%), os quais atingiram o montante global de USD 384.090. Os custos hospitalares correlacionaram-se fortemente com o volume de internações ($R^2 = 0,99$), enquanto a idade explicou apenas uma pequena proporção da variabilidade ($R^2 = 0,0131$) e o sexo e raça/cor apresentaram associação desprezível ($R^2 < 0,01$). Com este estudo, foi possível observar que as internações concentram-se fortemente em um único hospital e acometem principalmente mulheres, sendo os gastos determinados pelo volume de procedimentos e não por fatores demográficos. Isso indica a necessidade de otimização do fluxo cirúrgico eletivo e de descentralização de recursos assistenciais.

Palavras-chave:
Colelitíase; Colecistite; Custos Hospitalares; Saúde Pública; Planejamento em Saúde.

Resumen:
El presente estudio tiene como objetivo analizar el perfil epidemiológico, la concentración institucional y los costos de hospitalización asociados con la colelitiasis y la colecistitis en hospitales públicos de Niterói, Río de Janeiro, entre 2020 y 2022. Se trata de un estudio epidemiológico retrospectivo, descriptivo y analítico, utilizando datos de DATASUS referentes a hospitalizaciones con diagnóstico ICD-10 categoría K80 en seis hospitales públicos municipales. Se registraron 2.033 hospitalizaciones, con un marcado predominio del sexo femenino (76,64%) y del grupo etario de 40 a 59 años (41,31%). El Hospital Orêncio de Freitas concentró la mayor parte de las admisiones (50,81%) y de los costos totales de hospitalización (49,17%), que alcanzaron un monto global de USD 384.090. Los costos hospitalarios se correlacionaron fuertemente con el volumen de hospitalizaciones ($R^2 = 0,99$), mientras que la edad explicó solo una pequeña proporción de la variabilidad ($R^2 = 0,0131$) y el sexo y la raza/color mostraron una asociación despreciable ($R^2 < 0,01$). Este estudio permitió observar que las hospitalizaciones se concentran fuertemente en un único hospital y afectan principalmente a las mujeres, siendo los gastos determinados por el volumen de procedimientos y no por factores demográficos. Esto indica la necesidad de optimizar el flujo quirúrgico electivo y descentralizar los recursos asistenciales.

Palabras clave:
Colelitiasis; Colecistitis; Costos Hospitalarios; Salud Pública; Planificación Sanitaria.

INTRODUCTION

Despite their high prevalence and substantial surgical burden, gallstone-related diseases remain insufficiently characterized from a healthcare systems perspective in Brazil[1]. Cholelithiasis and cholecystitis are among the leading causes of gastrointestinal surgical admissions worldwide, contributing significantly to morbidity, healthcare expenditure, and hospital resource utilization[2]. Their incidence has increased over recent decades, driven by well-established risk factors including female sex, aging, obesity, genetic predisposition, and rapid weight loss[2]. Although prevalence rates vary geographically, gallstone disease affects approximately 10% of the Brazilian population and up to 20% of individuals in North America and Europe[3].

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In Brazil, gallstone disease represents a major burden to the Unified Health System (SUS). Between 2020 and 2024, more than 1.3 million hospitalizations for cholelithiasis and cholecystitis were recorded nationwide, generating healthcare costs exceeding 500 million reais[4]. Marked regional disparities were observed, with the Southeast concentrating the highest number of admissions, while the Central-West region accounted for the lowest hospitalization volume[5]. Notably, hospitalization rates increased substantially after 2020, potentially reflecting the cumulative effects of delayed elective surgical care and healthcare disruption during the COVID-19 pandemic[6].

Despite this substantial epidemiological and economic impact, population-based studies evaluating the institutional distribution of biliary admissions, hospitalization costs, and healthcare burden within the Brazilian public health network remain scarce. In a country characterized by major regional and structural inequalities in healthcare delivery, understanding the demographic and institutional determinants of gallstone-related hospitalizations is essential for improving surgical planning, optimizing resource allocation, and strengthening healthcare system efficiency. Therefore, this study aimed to analyze the epidemiological profile, institutional concentration, and hospitalization costs associated with gallstone disease in public hospitals in Niterói between 2020 and 2022 using DATASUS data.

METHODS

DESIGN

This retrospective, descriptive, and analytical epidemiological study was conducted using publicly available hospital admission data extracted from the Department of Informatics of the Brazilian Unified Health System (DATASUS)[7]. The study analyzed hospitalizations recorded between Jan 1, 2020, and Dec 31, 2022, in public hospitals within the municipality of Niterói, Rio de Janeiro, Brazil. The evaluated institutions included Hospital Orêncio de Freitas, Hospital Municipal Carlos Tortelly, Hospital Universitário Antônio Pedro, Hospital Municipal Oceânico Dr. Gilson Cantarino, Hospital Estadual Azevedo Lima, and Hospital Municipal Getúlio Vargas.

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INCLUSION AND EXCLUSION CRITERIA

All hospital admissions with a primary or secondary diagnosis related to gallstone disease and its complications were included, according to the International Classification of Diseases, 10th Revision (ICD-10), category K80[8]. Records with incomplete or inconsistent information regarding diagnosis, hospital identification, age, sex, or other essential demographic variables were excluded. Admissions occurring in private institutions or outside the municipality of Niterói were also excluded. Cases unrelated to gallstone disease or its complications were not considered for analysis.

VARIABLES AND DATA PROCESSING

The analyzed variables included age, sex, race/color, hospital unit, number of hospitalizations, and total hospitalization costs. Data were extracted, organized, and processed using spreadsheet software before statistical analysis. Descriptive analyses were performed to characterize the epidemiological profile of gallstone-related hospitalizations in the municipal public healthcare network. Absolute and relative frequencies were calculated for categorical variables, while continuous variables were summarized using means and standard deviations when appropriate. The results were presented through tables and graphical representations to facilitate visualization of epidemiological and institutional trends.

STATISTICAL ANALYSIS

To evaluate factors associated with total hospitalization costs, multiple linear regression models were constructed using hospitalization cost as the dependent variable and age, sex, race/color, and hospital unit as independent variables. The coefficient of determination (R^2) was calculated to estimate the proportion of variance in hospitalization costs explained by the regression model. Independent-samples t-tests were additionally performed for comparisons between demographic groups when appropriate. Statistical significance was defined as a two-tailed p value of less than 0.05. All statistical analyses were conducted using R software (R Foundation for Statistical Computing, Vienna, Austria)[9].

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ETHICAL CONSIDERATIONS

As this study was based exclusively on publicly accessible and anonymized secondary data obtained from DATASUS, approval by a research ethics committee and informed consent were not required according to Brazilian regulations for public-domain databases.

RESULTS

A total of 2,033 hospitalizations related to gallstone disease were identified in public hospitals in the municipality of Niterói between 2020 and 2022. The admissions were distributed across six institutions within the Brazilian Unified Health System (SUS): Hospital Municipal Carlos Tortelly, Hospital Municipal Oceânico Dr. Gilson Cantarino, Hospital Orêncio de Freitas, Hospital Universitário Antônio Pedro, Hospital Estadual Azevedo Lima, and Hospital Municipal Getúlio Vargas.

SOCIODEMOGRAPHIC ANALYSIS

Women accounted for most hospitalizations (76.64%), whereas men represented 23.36% of cases. The highest proportion of admissions occurred among individuals aged 40–59 years (41.31%), followed by those aged 60–79 years (28.82%) and 20–39 years (24.64%). Patients at the extremes of age (0–19 years and ≥80 years) collectively represented only 5.2% of admissions.

Regarding race/color, 33.39% of patients were classified as mixed-race, 33.25% as White, and 11.60% as Black, while 21.44% of records lacked race/color information. Individuals identified as Asian accounted for 0.29% of cases.

Hospital Orêncio de Freitas concentrated most hospitalizations (50.81%), followed by Hospital Estadual Azevedo Lima (19.13%) and Hospital Municipal Oceânico Dr. Gilson Cantarino (16.72%). Hospital Universitário Antônio Pedro accounted for 9.73% of admissions, whereas Hospital Municipal Carlos Tortelly and Hospital Municipal Getúlio Vargas represented a substantially smaller proportion of cases (3.54% and 0.04%, respectively).

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Table 1. Baseline Sociodemographic Characteristics of Patients Hospitalized for Gallbladder Diseases in Public Hospitals in Niterói (2020–2022).

Variable	**No. of hospitalizations**	**(%)**
Gender		
Male	475	23,36
Female	1558	76,64
Age		
0-19	40	1,96
20-39	501	24,64
40-59	840	41,31
60-79	586	28,82
80+	66	3,24
Race/Ethnicity		
White	676	33,25
Black	236	11,60
Mixed race	679	33,39
Asian	6	0,29
Unknow	436	21,44
Hospital		
Hospital Municipal Carlos Tortelly	72	3,54
Hospital Municipal Oceânico Dr. Gilson Cantarino	340	16,72
Hospital Orêncio de Freitas	1033	50,81

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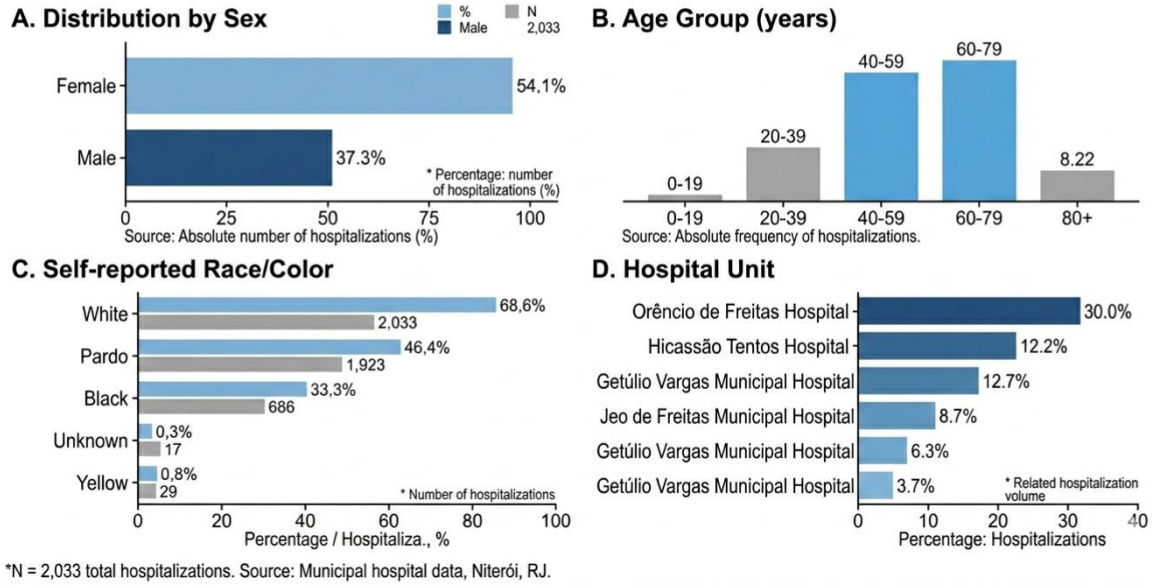
Hospital Universitário Antônio Pedro	198	9,73
Hospital Estadual Azevedo Lima	389	19,13
Hospital Municipal Getúlio Vargas	1	0,04

Figure 1. Sociodemographic Overview of Hospitalizations for Gallbladder Diseases in Niterói Between 2020 and 2022.



Sociodemographic distribution of gallbladder disease-related hospitalizations in public hospitals in Niterói, Brazil (2020–2022). Panels show distributions according to sex (A), age group (B), self-reported race/color (C), and hospital unit (D). Total hospitalizations: N = 2,033.

HOSPITAL COST OF GALLBLADDER-RELATED HOSPITALIZATIONS

Total expenditures related to gallstone-related hospitalizations reached USD 384,090 during the study period. Hospital Orêncio de Freitas accounted for the largest proportion of costs, representing 49.17% of total expenditures (USD 188,882). Hospital Estadual Azevedo Lima and Hospital Municipal Oceânico Dr. Gilson Cantarino contributed 21.22% (USD 81,499) and 17.39% (USD 66,785), respectively. Together, these three institutions accounted for more than 87% of all hospitalization-related costs.

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Hospital Universitário Antônio Pedro represented 10.69% of expenditures (USD 41,078), whereas Hospital Municipal Carlos Tortelly contributed 1.51% (USD 5,792). Hospital Municipal Getúlio Vargas showed minimal financial impact, accounting for only 0.01% of total costs (USD 54).

Table 2. Total Cost of Gallbladder Disease-Related Hospitalizations in Public Hospitals in Niterói Between 2020 and 2022.

Hospital	Total Cost (USD)
Hospital Municipal Carlos Tortelly	5792
Hospital Municipal Oceânico Dr. Gilson Cantarino	66785
Hospital Orêncio de Freitas	188882
Hospital Universitário Antônio Pedro	41078
Hospital Estadual Azevedo Lima	81499
Hospital Municipal Getúlio Vargas	54

SOCIODEMOGRAPHIC VARIABLES AND THEIR IMPACT ON COST

Hospitalization costs increased modestly with age, with an estimated mean increase of USD 1.12 per additional year of life. However, age explained only a small proportion of the variation in costs ($R^2 = 0.0131$). In contrast, hospitalization volume demonstrated an extremely strong correlation with total institutional expenditure ($R^2 = 0.99$), indicating that hospitals with higher admission volumes incurred proportionally greater costs.

Sex and race/color showed negligible associations with hospitalization costs ($R^2 < 0.01$ for both variables), suggesting minimal influence of demographic characteristics on overall healthcare expenditure related to gallstone disease.

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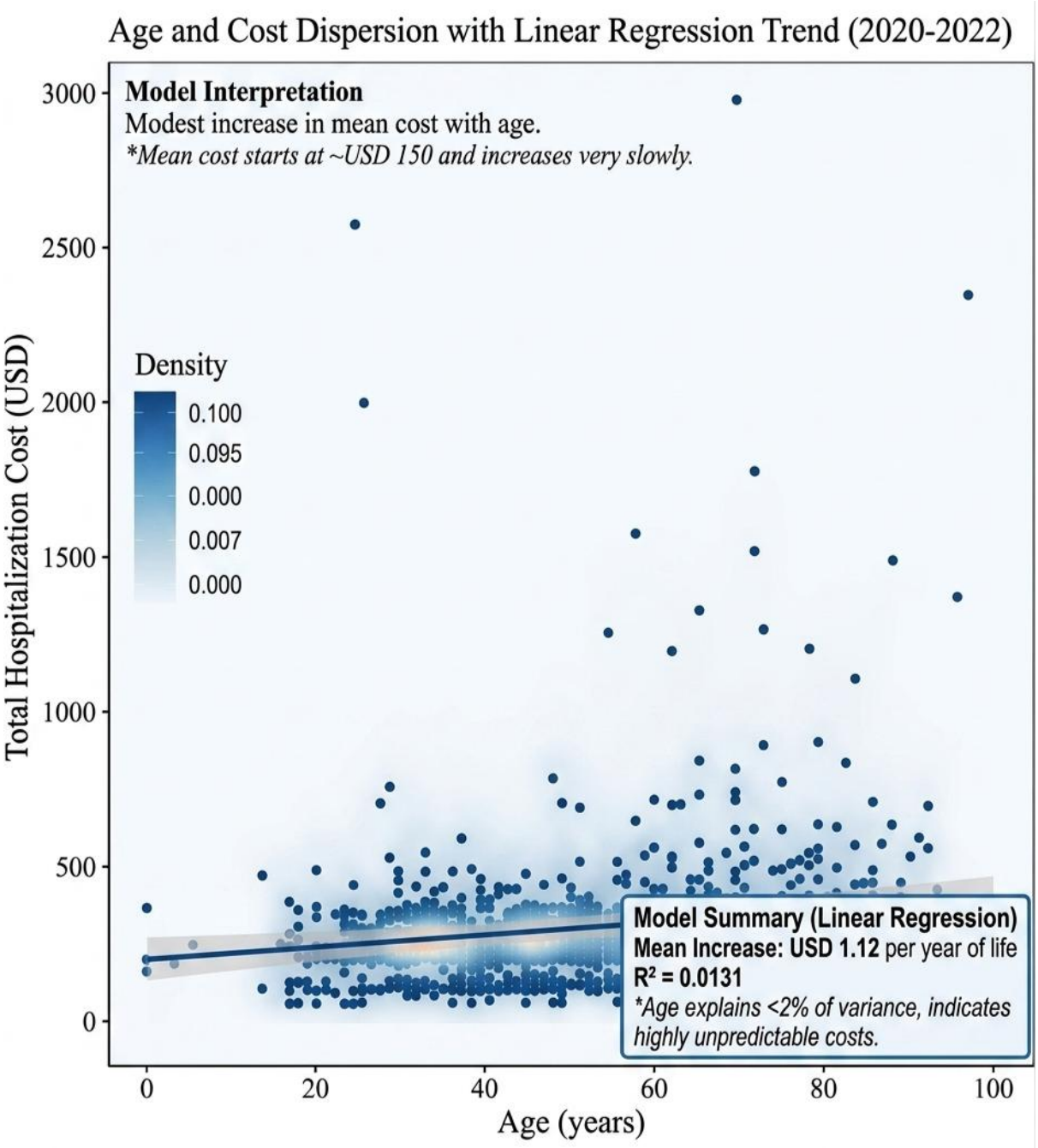
Figure 2. Association Between Age and Hospitalization Costs for Gallbladder Diseases: Linear Regression Analysis (2020–2022).



Linear regression analysis of age and hospitalization costs among patients admitted for gallbladder diseases in public hospitals in Niterói, Brazil (2020–2022). Increasing age was associated with a slight increase in mean hospitalization costs, although age explained only a small proportion of cost variability ($R^2 = 0.0131$).

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DISCUSSION

This study provides a comprehensive overview of gallstone-related hospitalizations within the public healthcare network of Niterói between 2020 and 2022, revealing a marked concentration of admissions among women, substantial institutional asymmetry in healthcare burden, and a strong relationship between hospitalization volume and total healthcare expenditure.

The predominance of female patients observed in this cohort is consistent with the established epidemiology of gallstone disease, which disproportionately affects women, particularly during middle adulthood due to hormonal influences on bile composition and cholesterol metabolism[5,10]. The concentration of hospitalizations in individuals aged 40–59 years further reinforces the classical demographic profile associated with symptomatic biliary disease[11]. However, beyond confirming known epidemiological trends, the present findings highlight how these patterns translate into a measurable burden on municipal hospital infrastructure and healthcare financing.

A particularly relevant finding was the central role of Hospital Orêncio de Freitas, which alone accounted for more than half of all admissions and nearly half of the total hospitalization costs related to gallbladder disease. This disproportionate concentration suggests the existence of institutional centralization within the local biliary care network, potentially reflecting differences in surgical capacity, referral pathways, emergency care availability, or specialized hepatobiliary expertise. From a health systems perspective, this finding is highly relevant because excessive concentration of surgical demand in a single institution may increase susceptibility to overload during periods of healthcare disruption, such as those experienced during the COVID-19 pandemic.

Indeed, the marked increase in admissions observed after 2020 may partially reflect the accumulation of delayed elective procedures and diagnostic investigations during the pandemic years[12]. Similar trends have been described internationally, where postponement of elective cholecystectomies resulted in increased rates of acute biliary complications, emergency admissions, and higher hospital resource utilization[13]. In this context, gallstone disease emerges not merely as a common surgical condition, but also as a sensitive indicator of surgical backlog and healthcare system resilience.

Although men represented a minority of hospitalizations, the literature consistently demonstrates that male sex is associated with greater technical difficulty during cholecystectomy, including higher rates of inflammation, fibrosis, adhesions, and complicated

gallbladder disease at presentation[14]. These factors may contribute to longer operative times, increased conversion to open surgery, and prolonged hospitalization. While sex demonstrated minimal direct influence on total hospitalization costs in the present regression analysis, the clinical implications remain important from an operational standpoint, particularly in surgical planning, operating room allocation, and postoperative resource management. Therefore, the lower prevalence of male admissions should not lead to underestimation of their potential complexity within surgical services.

The analysis of acute biliary disease (ICD-10 K80.0 and K80.1) further reinforces the substantial burden among women, who accounted for nearly three-quarters of acute admissions[15]. This finding has important implications for preventive strategies and early elective surgical management, particularly in populations at increased risk for progression from asymptomatic cholelithiasis to acute inflammatory complications[16].

Another relevant observation was the extremely strong correlation between hospitalization volume and total costs ($R^2 = 0.99$), indicating that institutional expenditure is driven predominantly by procedural demand rather than demographic characteristics such as sex or race/color. In contrast, age showed only a modest association with increasing costs, while sex and race/color demonstrated negligible explanatory power[17]. These findings suggest that healthcare resource allocation for gallstone disease should prioritize optimization of patient flow, surgical throughput, and institutional capacity rather than demographic stratification alone[17].

From a public health and healthcare administration perspective, these results support the need for strengthening decentralized elective surgical pathways and improving access to timely cholecystectomy within the SUS network[18]. Expanding surgical capacity across multiple institutions may reduce overload in high-demand hospitals, minimize emergency admissions related to delayed treatment, and potentially lower cumulative hospitalization costs[14]. Additionally, monitoring gallstone-related admissions may provide a useful proxy for evaluating the efficiency of municipal surgical services and the long-term impact of healthcare disruptions on elective care delivery.

This study has limitations inherent to retrospective analyses based on administrative databases, including the absence of granular clinical information such as operative time, conversion rates, postoperative complications, disease severity, and length of stay stratified by surgical complexity. Furthermore, reliance on DATASUS records may introduce inaccuracies related to coding quality and incomplete demographic data, particularly regarding race/color classification. Nevertheless, the use of a population-level public database provides important

epidemiological and economic insights into the organization of biliary surgical care within a large Brazilian municipality.

CONCLUSION

Gallstone-related hospitalizations in Niterói predominantly affected women and were highly concentrated in a small number of public hospitals, particularly Hospital Orêncio de Freitas. Hospitalization costs were driven mainly by admission volume, emphasizing the impact of surgical demand and institutional capacity on healthcare expenditure. These findings highlight the importance of optimizing elective surgical pathways and strengthening resource allocation within the SUS network.

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