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## Social Context and Geographic Space: An Ecological Study about Hospitalizations of Older Persons

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### ABSTRACT

**Objectives:** To identify the diseases that lead older persons to hospitalizations in the public health system in the state of Rio de Janeiro and, through a study of spatial distribution among hospitalization rates of the municipal districts, discuss the social contexts involved in the hospitalization of the elderly. **Methods:** An ecological cross-sectional study using secondary data from the Brazilian hospital information system from the period 2009 to 2015 was performed. The hospitalization rates of people 60 years and older, residing in 92 municipalities in the state of Rio de Janeiro, were calculated. The municipal districts were grouped according to the similarity of such rates using K-means nonhierarchical clustering analysis. **Results:** Diseases of the circulatory and respiratory systems, endocrine disorders, illnesses of the genitourinary system or the digestive tract, and certain infectious and parasitic diseases were the most discriminatory diseases for cluster composition. The first cluster, the municipal districts with the lowest hospitalization rates, which were more

urbanized and had greater access to social and health services, was named *Access and Inclusion*. The second group, which had the highest hospitalization rates, was named *Isolation and Vulnerability*. **Conclusions:** The primary care-sensitive conditions are the main causes of hospitalization of the elderly in the state, with greater intensity in the municipalities that are geographically rugged and remote. These outcomes reinforce the importance of valuing geographical knowledge, the guidelines of the unified health system concerning equity and regionalization, and the determinants and social determinations involved in the process of health and disease.

**Keywords:** epidemiology, health of the elderly, hospitalization, medical geography, social health determinants.

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### Introduction

Since the 19th century there have been important economic, social, and demographic changes in the world, particularly in the rich countries of Europe and North America and in Japan. These changes have affected living and working conditions, which have also altered the health status of the population [1].

The population aging encompasses improvements in the living and working conditions, the effects of the public policy, and the health technological revolution (medicine and equipment) [1]. These changes and improvements were achieved later in low- and medium-income countries, of which Brazil is an example [1–3].

In Brazil, just as social and economic transformations have occurred unevenly across the regions of the country, so has the process of aging and health outcomes varied because of differing contexts [4,5].

According to the 2010 census [4], the state of Rio de Janeiro had just over 2 million elderly people, accounting for 13% of its total population. Nevertheless, because of social and economic

factors, access to health services, and the effectiveness of local primary care services, the rate of aging has varied between municipalities [6].

Knowledge of the profiles of hospitalization and their spatial distribution provides a view of the effects of local contexts on the health of the population of these spaces [7]. The aim of this study was to determine which diseases lead to the hospitalization of elderly persons of the state of Rio de Janeiro in the public health system and, from the spatial distribution among municipalities, discuss the social contexts involved in the illness and hospitalization of the elderly.

### Methods

#### Study Location

The state of Rio de Janeiro has the fourth smallest territory among the federal units of Brazil and the third largest population in the country, resulting in a land occupation of 365.23

Conflicts of interest: The authors have indicated that they have no conflicts of interest with regard to the content of this article.

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2212-1099/\$36.00 – see front matter © 2018 Published by Elsevier Inc. on behalf of International Society for Pharmacoeconomics and Outcomes Research (ISPOR).

<https://doi.org/10.1016/j.vhri.2017.12.002>

inhabitants/km<sup>2</sup>. The 2010 census identified nearly 16 million residents, of which 2 million were 60 years and older, representing 13% of the population of the state. Rio de Janeiro also features the country's highest aging rate, justifying the choice of the region for this study.

### Data Collection and Analysis

The variable used in the study was hospitalization rate according to main diagnosis, on the basis of the chapters of the *International Statistical Classification of Diseases and Related Health Problems, Tenth Revision*. The calculation involved dividing the number of hospitalizations according to the municipalities of residence communicated to the hospital (on the basis of the chapter selected) by the total number of residents 60 years and older (in the study period) multiplied by 1000. Hospitalizations involving people 60 years and older during 2009 to 2015, which were financed by the public health system, were considered. Data on the number of hospitalizations were collected at municipal level in consultation with the database of the *Departamento de Informática do Sistema Único de Saúde* (the Statistics Department of the Unified Health System, the Brazilian national public health system). To obtain the denominator, the population of elderly residents in 2012 was used to estimate the population of the period. These data were collected from the database of the *Instituto Brasileiro de Geografia e Estatística* (the Brazilian Institute of Geography and Statistics). Samples were collected in April 2015.

The analysis excluded hospitalization due to “pregnancy, childbirth and the puerperium” (chapter XV) and “certain conditions originating in the perinatal period” (chapter XVI) because these are not relevant conditions of hospitalization among the elderly. After analysis of the calculated rates, variables referring to “diseases of the ear and mastoid process” (chapter IIIV), “congenital malformations, deformations and chromosomal abnormalities” (chapter XVII), and “external causes of morbidity and mortality” (chapter XX) were excluded because they presented zero values in more than 20% of cases and displayed no discrimination between municipal districts. Multivariate outliers were not identified on the basis of standard Mahalanobis distance score ( $D^2$ ).

To identify and group municipalities with similar hospitalization rate characteristics, a hierarchical cluster analysis was performed, using the Ward selection method as a clustering algorithm and considering the square of the Euclidean distance as a measure of similarity. The validation process consisted of three methods. First, the hierarchical cluster analysis was repeated with the Ward selection method, but using only 60% of the municipal districts. Then, the analysis was carried out using the average distance method (between-groups linkage) with all the municipal districts. Finally, the spatial variable

“health region” was used to verify whether the clustering had a neighborly relationship [8].

After the validation process, the number of groups was chosen in a semi-automatic fashion, using the method of distance of the greatest jump between the clusters as displayed by a dendrogram. On the basis of the distance between the groups formed, a total of two clusters were selected for the K-means process. When clustering municipalities that were similar on the basis of hospitalization data, cluster analysis was used instead of the K-means hierarchy, adopting a convergence criterion of 0.5. To interpret the clusters formed, the average hospitalization rate according to main diagnosis was used as a criterion. The magnitude of this measure for each variable was analyzed comparatively between the clusters and between all the variables of the same cluster. Furthermore, the significant values of the *F* statistic were used to identify the most important variables for the discrimination of clusters.

In terms of the significant means of hospitalization for the classification of each group, a statistically significant difference between groups was verified using the Mann-Whitney test at a significance level of 5%. The IBM SPSS Statistics for Windows software package version 20.0 [9] was used to perform the statistical analysis of the data collected in the study.

To facilitate the understanding of the distribution of hospitalization profiles in the state of Rio de Janeiro, spatial analysis of areas was performed using the TerraView software package version 4.2.2 (<http://www.dpi.inpe.br/terralib5/wiki/doku.php>) and the data were presented in a cartographic representation.

This study involved unidentified public domain data to which the Access to Information Act established by Decree No. 7.724, dated May 16, 2012 [10], does not apply.

### Results

In the period 2009 to 2015, there were 4,504,233 hospital admissions in the state of Rio de Janeiro, of which 1,099,368 (24.40%) involved persons 60 years and older. Almost half of these hospitalizations (50.38%) involved women. In terms of Brazilian racial classification, 371,498 (33.79%) were registered as white and 353,927 (32.19%) as black (7.03% were black and 25.15% were brown). One-third (33.57%) of the records did not register ethnic background and the others were classified as yellow or indigenous.

Diseases of the circulatory and respiratory systems, endocrine disorders, illnesses of the genitourinary system or the digestive tract, and certain infectious and parasitic diseases were the variables that displayed the greatest discrimination in terms of cluster composition. The averages of the rates of these diseases are presented in Table 1.

**Table 1 – Average hospitalization rates among people 60 y and older in the period 2009–2015 in the state of Rio de Janeiro, Brazil, 2016.**

ICD-10 chapter	Cluster		Mann-Whitney test
	1	2	
I: Infectious and parasitic diseases	2.514	9.428	<0.001
IV: Endocrine, nutritional and metabolic diseases	3.933	10.711	<0.001
IX: Circulation system diseases	8.890	14.638	<0.001
X: Respiratory diseases	6.220	11.853	<0.001
XI: Digestive system diseases	3.129	3.962	<0.001
XIV: Genitourinary diseases	3.263	5.598	<0.001

ICD-10, International Classification of Diseases, Tenth Revision.

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